CITY OF SAN ANTONIO
OFFICE OF THE CITY MANAGER

TO: Sheryl Sculley, City Manager

FROM: Peter Zanoni, Deputy City Manager

COPY: Mayor & City Council

SUBJECT: **WATER POLICY STUDY UPDATE**

DATE: September 22, 2015

The City's Water Policy Study currently is in draft form. The Water Policy Study was initiated through a City Council Consideration Request memo from Councilman Nirenberg filed on February 10, 2014. A subsequent memo reflecting the work of Mayor Castro and Councilman Nirenberg was issued to the Mayor and City Manager on April 10, 2014 by Councilman Nirenberg. Councilman Nirenberg's April 10 correspondence provided additional guidance on the scope of work for the Water Policy Study.

City staff had contemplated developing a Request for Proposal to solicit an entity to develop the Water Policy Study. Through our inquiry stages, it was brought to our attention from a water policy expert at the University of California that the Texas A&M Institute of Renewable Natural Resources (IRNR) was the preeminent water policy organization in the State of Texas. Since the IRNR is affiliated with the Texas A&M University System, the City had the option to negotiate an Interlocal Agreement as authorized by the Texas Government Code. City staff's approach to recommend an Interlocal Agreement with the IRNR for the City's Water Policy Study was presented to the City Council's Infrastructure & Growth Committee on May 21, 2014. The Council Committee concurred with this approach.

On October 9, 2014, City Council approved the Interlocal Agreement with the IRNR for the development of the Water Policy Study in the amount of $98,096. The study was funded entirely with one-time revenue received in FY 2015 from the City of Fair Oaks Ranch in exchange for the City of San Antonio's release of a portion of our Extraterritorial Jurisdiction to Fair Oaks Ranch. The Study was to have been completed by February 28, 2015; however, a contract extension was requested by the IRNR. The City received the first draft Study on May 1, 2015.

On May 4, 2015 the City shared the draft Study with SAWS. During the months of May and June 2015, City and SAWS staff conducted a peer review of the draft Study and provided a series of recommended edits to the IRNR on June 4, 2015. City and SAWS staff met with the IRNR staff to discuss both City and SAWS recommended edits on June 9 and June 12, 2015.

Subsequently, a second draft of the Study was submitted to the City on July 14, 2015. Planning & Community Development staff has been working with the IRNR since July 2015 to correct continued inaccuracies, outdated information, and opinionated statements within the draft Study prior to its release and presentation to the full City Council.

Examples of inaccuracies and omission of current facts within the draft Study include:

- Inaccurate statements suggesting SAWS would reduce its conservation goals due to the Visa Ridge Project.
- Omitted facts regarding the agreement between SAWS and Vista Ridge that allows SAWS to continue to receive water for an additional 30 years beyond the current contract term.
- Omitted facts that SAWS has contractual protections in place to ensure financial security of the Vista Ridge project.
- Inaccurate statements that suggests SAWS Recycled Water System lacks transparency.
- Omitted facts on work to date by SAWS in their addressing of lost water/non-revenue water including the fact that SAWS has had a consultant since 2013 to assist in this area.
- Failed to acknowledge ongoing efforts by SAWS to use the City's and the MPO's population projections for the region within its 2015 Water Management Plan.
- Unsubstantiated statements suggesting that surface water from treatment plants and water from pipelines are more susceptible to contamination than groundwater sources.
- Inaccurate statements suggesting SAWS has not made any advancement in water diversification lessoning its dependence on the Edwards Aquifer.
- Omitted facts that SAWS will have the largest inland-water desalination plant in the United States and how the desalination plant and other water supply diversification efforts would reduce reliance on the Edwards Aquifer.
- Inaccurate statements pertaining to the Twin Oaks Aquifer Storage and Recovery Project indicating the project's water capacity was not defined.

As of today, with the input from SAWS, City staff has provided a second version of correction edits to the IRNR covering the first 75 pages of the 174 page Water Policy Study that pertains to the City San Antonio. The total 235 page Water Policy Study also includes analysis for the City of Fair Oaks Ranch.

City staff in consultation with the IRNR is anticipating that the final Water Policy Study will be completed in time to be presented to the City Council's Transportation, Technology, and Utilities Committee during their October 7, 2015 meeting. In addition, attached to this memo is the July 2015 draft copy of the IRNR's Water Policy Study for the City of San Antonio and Fair Oaks Ranch. The July 2015 Study as attached includes the inaccuracies, outdated information, and opinionated statements that currently are being corrected by the IRNR.

ATTACHMENTS:
February 10, 2014 City Council Consideration Request from Councilman Nirenberg
April 10, 2014 Councilman Nirenberg and Mayor Castro additional guidance Memo
July 2015 Draft Texas A&M IRNR Water Policy Analyses (Study)

CITY OF SAN ANTONIO
OFFICE OF THE CITY COUNCIL
COUNCIL CONSIDERATION REQUEST

TO:	Mayor and City Council
FROM:	Councilman Ron Nirenberg, District 8
COPIES TO:	Sheryl Sculley, City Manager; Leticia Vacek, City Clerk; Edward Benavides, Chief of Staff; Chris Callanen, Assistant to the City Council; Robbie Greenblum, City Attorney; John Peterek, Senior Management Analyst
SUBJECT:	Edwards Aquifer and Water Supply Planning
DATE:	February 6, 2014

Issue Proposed for Consideration

I ask for your support for inclusion of the following item on the earliest available meeting of the Governance Committee:

Directing staff to research and publish a comprehensive report on all City policies, procedures, standards, regulations, and initiatives involving the cost, quantity and quality of the water drawn from the Edwards Aquifer. Water security – ensuring affordable, abundant, and clean sources of water for future generations of San Antonians – is the most basic and important element of economic quality and vitality of life for our citizens. Therefore, the goal of this study and report is a long term planning initiative to provide for affordable and adequate supplies of water to support the needs of San Antonians and the economic development of the San Antonio region through the year 2050. This report should include as a minimum, a plan to provide affordable rates and abundant clean water to San Antonians; to determine how the City protects the Edwards Aquifer as its main source of drinking water; and how City growth policies impact the management and operation of the San Antonio Water System (SAWS) and vice versa; and any recommendations for changes or improvements.

As part of this analysis of current city policy, staff should consider and report on the costs and benefits of particular policies as they relate to the cost of our water, the impact of water policies and water supplies on both economic growth and the protection of our water supply, how policies align with the goals of the State and South Central Texas Regional Water Plans (Texas Water Development Board), how policies conflict or complement the City's growth/annexation plans and projected growth of water demand, and how policies impact financial risk and rate inflation borne on City residents and ratepayers.

Over the last several years, the rate structure for SAWS in San Antonio attempts to strike a balance between residential and business rates, and to strengthen conservation pricing for all water users. Despite this policy, San Antonians have seen increases in their costs for water and have seen various restrictions imposed on their usage of water during times of drought and decreased rainfall. The cost and supply for San Antonio's water will become even more critical in the future if we continue to experience drought conditions that are even worse than those on record in the 1950s and if we continue to face new lows for rainfall throughout the year. We must comprehensively address the issues concerning our most valuable resource.

Brief Background

The Edwards Aquifer sits below thousands of acres across several counties in Central and South Texas, and it serves as the primary water source for the City of San Antonio and neighboring communities. It is composed of three zones: Contributing, Recharge, and Artesian. The Contributing Zone collects rainfall in the Edwards Plateau of the Texas Hill Country, and water flows down through the porous, permeable limestone of the Recharge Zone. Prolific springs and natural wells, caves, sinkholes, and other karst features are characteristic of the Recharge Zone that spans across northern Bexar County. The southern Artesian Zone comprises the largest surface area of the aquifer, and water passes through slowly due to the thick layer of clay and rock in the ground.

The City of San Antonio has experienced, and will continue to experience, rapid growth over the Recharge Zone, leading to local, regional, and statewide efforts to manage development in these sensitive areas and encourage water supply diversification. Nevertheless, the Edwards Aquifer is – and will continue to be – the preeminent source of water for San Antonio and surrounding communities: 90 percent of the water supply for the San Antonio Water System comes from the Edwards Aquifer. And as such, the Edwards Aquifer is a top concern for households in San Antonio because it is the primary source of water for household needs, it is critical for the economic well-being of the San Antonio community; and because businesses depend on it for their operations, keeping Edwards water plentiful grows more critical and more challenging each year. In December of 2013, the Dallas Federal Bank cited water scarcity as "one of the most pressing economic issues facing the state." Improper planning would have dire consequences for our City as a whole and will cost taxpayers unnecessarily.
For decades, there has been a consensus that the City must engage in a delicate balancing act between economic development in sensitive regions and the protection of Aquifer water quality and flow. The San Antonio City Council first adopted the concept of Recharge Zone protection in 1975, instituting by ordinance a zoning overlay for that portion of the aquifer. In 1987, the city council produced a document entitled "The Edwards Aquifer: Perspectives for Local and Regional Action," endorsing a plan for non-degradation of the aquifer to protect ground water supplies within the city's jurisdiction. In 1994, the council adopted a more comprehensive approach, "The Edwards Aquifer: San Antonio Mandates for Water Quality Protection (33 Mandates)," which called for various actions in a regional watershed plan that considered federal, state, and local rules.

City residents have recognized the challenge of managing our primary water source and, since 2000, have overwhelmingly approved the Edwards Aquifer Protection Program three times, designating sales tax revenue to purchase conservation easements in the Recharge Zone. This program, which has been held as a model regionally and nationally, has led to the protection of over 100,000 acres of the Recharge Zone, equivalent to over 10 percent of the zone.

These efforts notwithstanding, the City's policies related to water security and Edwards protection remain scattershot and, at times, inconsistent with our vision for guaranteeing affordable and abundant water for San Antonians and for the growth of San Antonio.

The City designated SAWS as its agent for enforcing environmental regulations. SAWS is committed to a growth policy in order to sustain an expanding population in the City and accompanying revenue requirements.

In 2002, the City Council established an ad hoc Committee on Water Quality to review the

existing aquifer protection ordinance, recognizing the need to not only review regulations periodically, but also that the foundation of our region's economy – and the growth of San Antonio – will ignore increasing threats to the Edwards Aquifer at its own peril. The committee was composed of various stakeholders from neighborhoods, businesses, the development community, and environmental organizations, and it considered impervious cover limits, floodplain buffers, extension of protections within the Contributing Zone, use of water quality basins, sensitive land acquisition, underground storage tanks, research, and public education about aquifer protection. Despite the importance of its charge and the fact that improvements were identified, the committee was unable to reach consensus on recommendations to be adopted in a final report. The city council adopted various intermediary measures in 2006, and the committee dissolved.

The conflict presented by the need for abundant and affordable water, aquifer protection and growth of water utility services in the region underscores the importance of various City policies that affect water security, one of the world's primary long-term natural resource challenges. The Federal Reserve Bank of Dallas has confirmed that water scarcity is a threat to long-term economic viability, and while economic growth is a contributing factor to this challenge, it can also be its victim. This threatens every family and every business in our region.

Local governments in Texas have understood this problem and responded through conservation efforts, acquiring water rights, diversifying supplies, and expanding service as a business imperative. SAWS has responded through similar initiatives as well, including a Brackish Groundwater Desalinization Program, acquisition of Edwards Aquifer pumping rights, the Regional Carrizo Water Supply Program, and Aquifer Storage and Recovery. In January, the Texas Comptroller of Public Accounts heralded SAWS' efforts as models for other municipalities statewide. Yet, while water source diversification is a worthy pursuit, it will not supplant the preeminence of the Edwards Aquifer to the City's water security. Acquisition of water rights and the expansion of service area by providers across the region reaffirm the importance of insuring our water sources. This pursuit is fundamental to our ability to encourage economic growth.

A comprehensive study examining City policy that impacts water costs, quantity, quality, and planning is needed at this critical time in our City's history. Through this analysis, we can better understand the opportunities to secure our water quality and quantity, complement our vision for the growth of the City, and make policy decisions accordingly for the benefit of every citizen and business in San Antonio.

Submitted for Council consideration by:

Councilman Ron Nirenberg, District 8

Supporting Councilmember's Signatures (4 only)	District No.
1.	6
2.	4
3.	1

4. _____ 7

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CITY OF SAN ANTONIO
OFFICE OF CITY COUNCIL DISTRICT 8

TO: Mayor and City Manager

FROM: Councilman Ron Nirenberg

SUBJECT: Comprehensive Water Policy Report

DATE: April 10, 2014

Dear Mayor Castro and City Manager Sculley:

The purpose of this memorandum is to provide additional guidance on the report requested in my CCR filed February 10. As stated in the April 2 San Antonio Water System briefing to Council on water management, citywide policy questions need to be addressed to aid planning at SAWS and the city. This report should provide the information necessary for current and future Councilmembers to make informed decisions about our city's future as it relates to the availability and affordability of water.

Specifically, the report on San Antonio policies impacting water supply planning should address the following:

1) Historic and projected population growth and water demand;
2) Historic and projected costs for supplying and delivering water in the service area;
3) Summary of the governing bodies involved in San Antonio's water supply and the authority delegated by each of those bodies;
4) City Code provisions and city planning strategies that impact projections for water demand, availability, and costs;
5) Summary risk assessment of existing and proposed water sources, including natural, developmental, and potential conflicting interest factors in the region, along with current mitigating activities;
6) Overview of next step policy questions that City Council must consider in order articulate a Comprehensive Growth Plan that includes available and affordable water through 2050.

This report will help Council as we consider our long-term growth strategy and strive to maintain an exemplary financial position, provide basic services for residents, strengthen economic development, coordinate planning initiatives, and encourage conservation.

DRAFT

Cities of San Antonio and Fair Oaks Ranch

Water Policy Analyses

July 2015

Prepared for:

The City of San Antonio and the City of Fair Oaks Ranch

Authors:

Calvin Finch, PhD, Texas A&M, Institute of Renewable Natural Resources

James Mjelde, PhD, Texas A&M, Department of Agricultural Economics

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Uyen (Amy) Truong, Texas A&M Institute of Renewable Natural Resources

Water Policy Analyses for San Antonio and Fair Oaks Ranch

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Appendix B: City of Fair Oaks Ranch

Executive Summary

Part A: City of San Antonio

The Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses are efforts designed to review and assess the many factors important in implementing effective water policies for the two cities. The timing of the analysis for the City of San Antonio (COSA) allows it to be considered as part of the discussion to complete a new comprehensive plan.

The City of San Antonio portion of this report briefly describes and assigns risk ratings to 12 water-supply sources. It also discusses 24 water issues important to San Antonio water security and assigns grades to the water-management and planning performance in terms of water security when addressing the issues.

The water-issue descriptions include identification of significant issues and recommendations concerning them.

There are a number of the significant issues and recommendations that merit special attention.

Water Planning

- **Population Estimates** – The San Antonio Water System (SAWS) uses population estimates that reflect 21 percent fewer residents in 2060 than the Alamo Area Metropolitan Planning Organization (MPO) estimates recommended by the City of San Antonio Planning and Community Development Department. The SAWS 2012 Water Management Plan recognizes the potential for water shortages in the decade of 2060-2070 if conditions approximate the drought of record. If the more conservative projections for population are used for planning, the shortage could occur as soon as 2040-2050.

  The population estimates need to be reconciled and if the MPO numbers are used, additional water resources need to be identified earlier in the planning period.

- **Public Input and Communication –** The City of San Antonio and the San Antonio Water System are recognized for their superior performance in seeking and using public input in water-policy discussions.

Water Management

- **Drought Management –** By using stakeholder input to develop reductions that bring water use to necessary levels with minimal impact on economic activity, San Antonio is recognized as a leader in drought management. This drought-management capability is a major asset of the City of San Antonio water-security situation because it means the city always has a backup, the ability to reduce water use in an orderly, efficient manner and cope with emergencies as they occur whether the emergencies result from infrastructure failure, acts of terrorism, severe droughts or planning errors.

- **Bexar Metropolitan Water District Integration –** This is another water-management effort that merits a top grade. In the midst of other issues, a water system the size of Corpus Christi was merged into SAWS with no bad publicity or negative impact on staff and customers of either entity. The resultant consolidated water system is working smoothly.

- **Lost/Non-revenue Water –** Not all water-management performance rates a high grade. The lost/non-revenue water rates have been increasing over several years without enough action to correct the losses or even to identify where the lost 15.4 percent of water is going. SAWS must mobilize to make this water-management problem a higher priority and gain access to available lost water.

- **San Antonio as a Water Neighbor –** The SAWS Water Management Plan for 2012 makes it clear it is time for San Antonio to be recognized for the water-related activities that benefit the city's regional neighbors while providing water supplies and security to San Antonio. Among those activities are the Schertz-Seguin Local Government Corporation (SSLGC) shared pipeline and use of the SAWS Aquifer Storage and Recovery (ASR) as the centerpiece of the Edwards Aquifer Habitat for Conservation Plan (EAHCP).

Water Quality

- **Water Quality Protection over Edwards Aquifer Recharge Zone (EARZ)** – This effort includes effective development rules, but immediate questions of development rules for annexed areas and the issue of coal-tar sealants need to be addressed. The area of greatest opportunity, however, is for San Antonio to work with its regional neighbors on developing a long-term plan for protecting runoff from the contributing zone.

- **Edwards Aquifer Habitat Conservation Plan (EAHCP) –** The City of San Antonio and its water purveyor, the San Antonio Water System, merit a very high grade for the leadership they provided in achieving the EAHCP. After 50 years of deadlock and wrangling, the stakeholders of the Edwards Aquifer area have reached consensus on a habitat-conservation plan that has resulted in an Incidental Take Permit from the U.S. Fish and Wildlife Service. This agreement protects the endangered species at the Comal and San Marcos Springs north of San Antonio and stabilizes the availability of the Edwards Aquifer as a water source. It is clear, however, that the challenge is not ended. SAWS needs to keep its Edwards Aquifer Recovery Implementation Program (EARIP) team in place and continue to provide creative, active leadership for this effort.

- **Conservation Easements –** Another high grade in water-quality activities goes to the City of San Antonio for its work to protect Edwards Aquifer recharge through land purchases and conservation easements. In three elections, the citizens of San Antonio have supported expenditure of a portion of their sales taxes for land purchases and conservation easements over the aquifer recharge zone to the level that 18 percent of the sensitive zone has been protected. A plan must be established to continue the effort until 35 percent of the sensitive land is protected.

Regulatory Agencies

- **Local Regulatory Agencies** – Many of the City of San Antonio water-supply projects involve one or more groundwater conservation districts (GCD). The ability of a GCD to change rules and review permits on a frequent basis after a water supply project commences, makes it difficult to develop, finance and maintain a long-term water plan for a large city like San Antonio. Legislation to incorporate more consistency and long-term commitment has been, and needs to continue to be, a major San Antonio legislative goal. Some progress was made during the most recent 2015 legislative session toward this goal; however, more legislative efforts should be pursued in the future. The special requirements for development of brackish-water-desalination projects also make it important that San Antonio seek legislation to develop a more favorable regulatory structure for this underutilized water supply, particularly in productive and isolated zones or aquifers.

Water Supply Projects

- **The Edwards Aquifer, Recycled Water, Aquifer Storage and Recovery (ASR), Brackish Groundwater Desalination and Water Conservation –** The listed water-supply projects are all low-risk projects essential to San Antonio's long-term water security. These projects also represent leadership by San Antonio in using innovative technology and/or water resources targeted by the State of Texas Water Plan for 2010. They need to continue to be the keystone to the San Antonio overall water-management plan.

- **Vista Ridge Water Supply Project –** The Vista Ridge project is not a low-risk water-supply project, but it is innovative in the public/private partnership it represents. The Abengoa and Blue Water corporations have assumed the risk to deliver 50,000 acre feet of Carrizo water from the Burleson County area to San Antonio for a set fee for water delivered. The costs to the San Antonio ratepayer are high and the risk is also high. SAWS and the City of San Antonio need to remain alert to issues that arise, and transparent in their communication on the project's progress.

- **Water Conservation –** The SAWS 2012 Water Management Plan represents a retreat from the long-time successful level of water-conservation activity. The 2012 Water Management Plan offers a final gallons-per-capita-per-day (GPCD) goal of 135 GPCD for 2020 when trend lines indicate there is no reason to be content with such a conservative goal. The issue becomes even more questionable because the 135 GPCD goal is projected for 2020, when the Vista Ridge water-supply project becomes available.

  Ending the water-conservation effort in 2020 is contrary to the commitment by Vista Ridge advocates who state the project would not reduce water-conservation activities. The decision to end the water-conservation initiative at 135 GPCD needs to be reconsidered.

Analysis of City of San Antonio water policy and water security reveals areas of accomplishment that bode well for the future of San Antonio's water supplies. The water supply is being strengthened with innovative water-resource projects, and drought-management capabilities are strong. San Antonio is taking action to protect its Edwards Aquifer resources with an exemplary conservation easement and affordable habitat conservation plan. Its success in public communication is complemented by its growing recognition as a good water neighbor.

There are, however, areas where action must be taken to improve water security. The demands of higher population estimates, climate-change challenges and the potential for a drought of record require that additional water supplies be identified and secured.

The stated goal is to diversify the water-supply inventory to reduce dependence on the Edwards Aquifer but, as Figures A (i) (ii) (iii) on pages 53-54 illustrate, diversification is not obvious when the 2015 and 2060 water-supply-source percentages are reviewed.

San Antonio also needs to take action to protect existing supplies. The lost-water situation must be corrected by internal action and the ambitious water-conservation goals that have characterized San Antonio's efficient use of water in the last three decades need to be reinstated in the next water plan.

The advances made by San Antonio as a good water neighbor need to be projected to work with regional neighbors to develop legislation that makes it easier to share and protect regional water supplies. Specifically, these include development rules for the Edwards Aquifer collection zone, lengthening of permit durations for water resources, and placing brackish-groundwater resources under jurisdiction of a state agency.

Special Note to the Executive Summary

As a primary player in the effort to achieve water security for San Antonio, the San Antonio Water System was given access to a late draft for its consideration.

SAWS had numerous comments and questions. Representatives also provided recently developed sources of information that were not available to or obtained by the authors of the Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses.

In the interest of improving the final report without delaying its completion, the input from SAWS was incorporated into the document as a series of "Special Notes." These Special Notes are attached to the related topic in the Significant Issues and Action Steps portions of this paper.

Special Notes

Part B: Executive Summary for City of Fair Oaks Ranch

(See page 177 in the Fair Oaks section of this report.)

Introduction

This effort will produce a comprehensive long-range report that assesses the water security of the City of San Antonio and the City of Fair Oaks Ranch and their extraterritorial jurisdiction (ETJ). The report will review existing data on city policies, regulations and initiatives involving the cost, quantity and quality of the water from the Edwards Aquifer, Trinity Aquifer and other sources for the period 2015-2060.

The analyses are organized in several parts. The City of San Antonio Analysis is Part A and the City of Fair Oaks Ranch is Part B. The main sections are an Executive Summary, Introduction and Summary Report, and an assignment of Water Planning and Management Grades for each project and situation.

The Summary Report organizes and consolidates the significant issues identified in the sections on water-supply projects and water-supply issues into the major conclusions targeted by these analyses. Conclusions include identification of the most significant assets of the area and the issues that detract most from meeting future water needs. Each topic in the Summary Report includes a list of action Items to address the issues.

The report also includes recommendations for legislation the authors believe will contribute to better meeting the San Antonio and Fair Oaks Ranch water-supply needs.

More in-depth descriptions and discussion of the water situation are given in sections entitled Water Supply Projects, Water Policy Issues in two appendices, one each for the City of San Antonio and the City of Fair Oaks.

Within the Water Supply section, each project is discussed, a risk score assigned, and significant issues identified.

Water Policy Issues include a diverse set of topics within the broader areas of water planning, water management, water quality, regulatory agencies, and water cost. Each topic is briefly described and significant issues noted. The section includes a water-management grade for topics covered.

The Nature of the Report and the Authors

The City of San Antonio and Fair Oaks Ranch Water Policy Analyses are not studies producing original-research results. The effort relies on the use of available information, including research results, and the expertise of the authors of the paper.

> The lead writer, **Dr. Calvin Finch**, is a well-known expert in the fields of water resources and water conservation. He is the former Director of the SAWS Water Conservation Department, and the Director of the SAWS Water Resources Department. He represented SAWS in the five years of negotiation with other Edwards Aquifer stakeholders that resulted in the Edwards Aquifer Habitat Conservation Plan (EAHCP) to protect the Endangered Species at Comal and San Marcos Springs. Since his SAWS experience, Dr. Finch has served as the Director of the Water Conservation and Technology Center for Texas A&M

University. He is currently the lead scientist of the Urban Water Section of the Texas A&M Institute of Natural Renewable Resources.

Dr. James W. Mjelde earned a PhD in Agricultural Economics, specializing in natural resource economics. Currently, he is a Professor in the Department of Agricultural Economics at Texas A&M University. He is also a member of the Texas A&M Energy Institute, a member of the Intercollegiate Faculty of Agribusiness, and a Professor in the Texas A&M Water Resources Program. The most important component of Dr. Mjelde's research is blending interdisciplinary cooperation with economic analysis to address complex societal problems. He has collaborated with 18 disciplines, bringing in the economic analysis components.

Dr. Kelly Brumbelow earned his PhD in Engineering at the Georgia Institute of Technology in 2001. At Texas A&M, he is an Associate Professor, Water Resources Engineering and Assistant Department Head for Undergraduate Programs. His areas of expertise include water resources; planning and management; security of water-distribution systems; decision-support systems; climate-variability and climate-change effects; and assessment of water-resource policy.

Amy Truong has a degree in Environmental Studies with a concentration in Engineering Science from Trinity University. She was an intern in the SAWS Water Conservation Department and was part of Trinity University's engineering science research team for condensate water. She serves as an Extension Assistant for the Urban Water section of the Texas A&M Institute of Natural and Renewable Resources.

List of Acronyms

ACRE FOOT	325,581 gallons
AMR	Automatic Meter Reading
AECOM	An International Professional Technical Services Firm
ASR	Aquifer Storage and Recovery
Bexar Met	Bexar Metropolitan Water District
BMA	Bexar-Medina-Atascosa Counties Water Improvement District #1
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CAB	Conservation Advisory Board
CAP	Citizens Advisory Panel
CCC	Community Conservation Committee
CCGCD	Cow Creek Groundwater Conservation District
CCN	Certificate of Convenience and Necessity
CECs	Contaminants of Emerging Concern
COSA	City of San Antonio
CPS	CPS Energy
CRWA	Canyon Regional Water Authority
CWA	Clean Water Act
CZP	Contributing Zone Plan
Desal	Desalination
DFC	Desired Future Condition
DSP	District Special Project
EAA	Edwards Aquifer Authority
EAHCP	Edwards Aquifer Habitat Conservation Plan
EARIP	Edwards Aquifer Recovery Implementation Program
EARWCP	Edwards Aquifer Regional Water Conservation Program
EARZ	Edwards Aquifer Recharge Zone
EDSP	Endocrine Disrupter Screening Program
EPA	Environmental Protection Agency, see US EPA below
ETJ	Extraterritorial Jurisdiction
EUWCD	Evergreen Underground Water Conservation District
FOR	Fair Oaks Ranch
GBRA	Guadalupe-Blanco River Authority
GCD	Groundwater Conservation District
GCGCD	Guadalupe County Groundwater Conservation District
GCUWCD	Gonzales County Underground Water Conservation District

GPCD	Gallons Per Capita per Day
GPD	Gallons Per Day
GMA	Groundwater Management Area
HCP	Habitat Conservation Plan
LID	Low-Impact Development
LULAC	League of Latin American Citizens
MAG	Modeled Available Groundwater
MPO	Metropolitan Planning Organization
MSL	Mean Sea Level
PAH	Polycyclic Aromatic Hydrocarbons
POSGCD	Post Oak Savannah Groundwater Conservation District
RAC	Rate Advisory Committee
SARA	San Antonio River Authority
SAWS	San Antonio Water System
SB 3	Senate Bill 3
SCTRWP	South Central Texas Regional Water Planning
SDWA	Safe Drinking Water Act
SSLGC	Schertz-Seguin Local Government Corporation
SUD	Special Utility District
SWIFT	State Water Implementation Fund for Texas
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TGRGCD	Trinity Glen Rose Groundwater Conservation District
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
UDC	Unified Development Code
US EPA	United States Environmental Protection Agency
VISPO	Voluntary Irrigation Suspension Program Option
WCD	Water Conservation District
WECo	Water Exploration Co.
WSC	Water Supply Corporation

Water Supply Projects

The San Antonio Water Policy Analysis covers 12 water-supply projects (from larger to smaller) identified in the SAWS 2012 Water Management Plan, and the three water-supply projects that supply the City of Fair Oaks Ranch.

In order of their 2015 or projected volume of yearly water-supply in a normal year, they include:

City of San Antonio

1. Edwards Aquifer Groundwater
2. SAWS Recycled Water
3. Vista Ridge Water Project
4. Brackish Water Desalination
5. Twin Oaks Aquifer Storage and Recovery (ASR)
6. Local (Bexar County) Carrizo Groundwater
7. Medina Lake (BMA) Surface Water
8. Carrizo Water (Schertz/Seguin and Gonzales County)
9. Water Conservation
10. Western Canyon Project
11. Trinity Aquifer Supplies
12. Lake Dunlap/Wells Ranch (CRWA)

City of Fair Oaks Ranch

1. Trinity Aquifer Water
2. Canyon Lake Water
3. Fair Oaks Ranch Recycled Water

Risk Analysis

Each of the water-supply project descriptions is preceded by a risk analysis list and scorecard. The basic risk factors include variability and/or unpredictability. The more of either of those characteristics, the higher the risk score. A risk score may be multiples of (-) as an indicator of little risk, (0) as a middle category of risk and multiples of (+) to indicate more risk. Risk ratings involve identified conditions and opinion of the authors.

Risk Factors

Total Water – Total water is not a risk factor but is an important characteristic of the water project. The amount of water provided by the project (sometimes under various conditions) is included on the risk-factor sheet for every project.

Cost of Water – Cost in itself, even a high cost, is not deemed a risk factor as long as it is a stable cost. Water costs that are uncertain or subject to change due to inflation or other factors will rate a (+) risk point.

Ownership of Water – Some of the water-supply projects include both owned and leased water. The authors assign more risk to leased water. Owned water is rated as a (-) risk factor. Leased water adds risk to the project's reliability so merits a (+) risk point. Projects that include a nearly equal mix of owned or leased water may receive a (0) risk score.

Length of the Contract – Water supplies that are contracted for periods shorter than the 45 years through 2060 merit a risk point (+) because they will have to be renegotiated or replaced.

Distance from San Antonio or Fair Oaks Ranch – A long pipeline to transport water from its source to San Antonio or Fair Oaks Ranch is deemed a risk. A water source that originates under the boundaries of the subject city reduces risk by a point (-). A water source that involves a pipeline less than 30 miles does not receive a risk point (0). Pipelines between 30 miles and 100 miles are determined to be at risk for one point (+) and over 100 miles are assigned two risk points (++).

Endangered Species – Water projects or a project's pipelines in the vicinity of endangered or threatened species are considered at risk and receive a point (+). If there are no endangered species or the issue has been addressed with the completion of an Incidental Take Permit, the project may merit a negative risk point (-) rather than the addition of a point.

Treatment Required – Supply projects requiring significant treatment are deemed more vulnerable to accidents and/or purposeful actions and are rated as more risky (+). Water sources that do not need treatment face less risk (0).

Contamination Threat – Water sources are subject to more or less risk of contamination based on their nature. Surface water sources are deemed more vulnerable and receive a (+). Groundwater sources that recharge quickly are deemed more threatened and receive a

(+). Groundwater sources slow to recharge are deemed to be less vulnerable and receive a (-). A water supply project that includes several sources of varying vulnerability may receive a risk rating of (0).

Sensitivity to Drought – Some water resources projects are not affected by the drought situation in the region. They receive a minus risk credit (-). Projects that move into drought restriction situations in times of drought are assigned a risk point (+). Projects that provide no or very little water in a severe drought situation may be assigned 2 risk points (++).

Regulatory Agencies – The number and characteristics of the regulatory agencies involved with a particular water supply are an important risk factor. If there are no local regulatory entities involved or a local agency with San Antonio representation, the project merits a minus risk point (-). If the regulatory agency is a state agency, the situation is assigned no risk points (0). A local regulatory agency without any representation from San Antonio is deemed a risk and receives a point (+).

Other Issues – Among the issues that may result in a risk point being added include the precarious financial state of a water supplier.

Overall Risk Rating – Risk analysis is subjective. The authors of this paper have related an overall risk rating to the number of negative and positive risk points assigned. A supply project with more minus risk (-) points than a (+) risk points is rated as a “low-risk” water supply project. Projects with an equal number of pluses and minuses, or one more plus, are designated as “medium-risk” projects. Projects with two or more plusses (+) than minuses (-) are rated “high-risk” projects.

Special Note: Risk Ratings and Management Grades are Subjective

Reviewers representing the San Antonio Water System were especially concerned that the risk ratings and management grades were subjective. They questioned some of the specific factors used by the authors and disagreed with some risk ratings and grades assigned.

We emphasized the subjective nature of risk ratings and management grades several places in the Analysis, along with justification for the rating and grading factors we used. We also cited sources of data or analyses that helped us complete the rating and grading decisions. Admittedly, many were based on the opinion of the authors based on their experience in the field. A project rated as a high risk can still be an essential part of the overall water plan. The risk rating identifies the issues that should be addressed to ensure the water resources expected are available.

It is also important to note that this paper recommends that SAWS and the City of San Antonio establish their own risk rating system to assist in evaluating water projects for renewal and development of management strategies.

Of special concern to SAWS was the assignment of risk points for length of a pipeline from San Antonio and the fact that water treatment was involved.

Concerning the assignment of risk points for pipeline length, the scientific literature, represented by the article, “Using the Linear Risk Integral (LRI) Approach in Pipeline QRA for a Better Application of Risk Mitigation Measures, Urban Neunart (2014)” evaluates risk based on units of pipeline length. In the study cited in the paper by Rasekh and Brumbelow (2013), they note that 56 percent of the time human error is at least a partial factor in water project contamination events and that 89 percent of the time intrusions are at treatment plants or well sites.

Risk Table

Name of Project: Total Water:		
Cost of Water:	Unstable	(+)
Ownership State of Water:	Owned	(-)
	Combination	(0)
	Leased or Contract	(+)
Length of Contract:	Shorter than 45 Years	(+)
Distance of Source from San Antonio or Fair Oaks Ranch:	On Site	(-)
	Less than 30 Miles	(0)
	30-100 Miles	(+)
	Over 100 Miles	(++)
Endangered or Threatened Species Issue:	No	(-)
	Yes	(+)
	HCP	(0)
Treatment Required:	No	(-)
	Yes	(+)
Contamination Threat:	Difficult Recharge	(-)
	Easy Recharge	(+)
	Surface Source	(+)
Drought Restrictions: (Drought Sensitivity)	No	(-)
	Yes	(+)
	No, or Very Little Water in Drought	(++)
Regulatory Agencies Involved:	None or One Local with Representation	(-)
	One or More, No Representative	(+)
	State Agency	(0)
Other Issues:	No	(-)

	Consider	(0)
	Yes	(+)
Total Score:	Minus Risk Plus Risk	
Rating:	Low Risk (More minuses than pluses)	
	Medium Risk (Same number or one more plus)	
	High Risk (Two or more pluses than minuses)	

Risk Ratings

Water Projects Listed in Order of Water Production

Part A. City of San Antonio

	Low risk (-)	High Risk (+)	Risk Rating
Edwards Aquifer Groundwater	4	3	Low
SAWS Recycled Water	5	1	Low
Vista Ridge Water Project	3	8	High
Brackish Water Desalination	4	3	Low
SAWS Twin Oaks ASR	4	2	Low
Local Carrizo	4	1	Low
Medina Lake	2	7	High
Gonzales Carrizo	3	5	High
Water Conservation	6	2	Low
Western Canyon	2	5	High
Trinity Water	3	4	Medium
CRWA Lake Dunlap, Wells Ranch	2	5	High

Part B. City of Fair Oaks Ranch

	Low Risk (-)	High Risk (+)	Risk Rating
Trinity Aquifer Water	6	3	Low
Canyon Lake Water	1	5	High
Fair Oaks Ranch Recycled Water	4	1	Low

Water Grade Descriptions

The Cities of San Antonio and Fair Oaks Ranch funded these Water Policy Analyses. One of the products they required was an assignment of grades for water-management activities by water entities in their communities.

Consistent with the rest of this analysis, the “grades” from a neutral team of experts will forward the discussion of whether the communities are prepared in terms of water supply and where issues may exist to improve that preparation.

The grades are admittedly opinions of the team completing this analysis and based on the relatively limited exploration completed.

Water Grade Descriptions

A	Exemplary, recognized as a leading example, and accomplishing the goals for the effort
B	Effective, generally accomplishes goal for effort, but not be exemplary, lacking in one area
C	Seems to be accepted by local ratepayers without any special recognition outside. Meets goals but not exemplary
D	Does not meet goals and effort to correct not adequate
F	Failure to meet goals without much effort to address or correct

Part A: City of San Antonio

Summary Report

Introduction

The City of San Antonio portion of the Cities of San Antonio and Fair Oaks Ranch Water Policies Analyses is made up of 12 water-project and 24 water-policy-issue sections. Each of the projects has been assigned a risk rating and each water-policy issue has been assigned a grade by the authors. The authors are experts in various pertinent water areas and objective assessors of the city's water supplies and policies. The risk rating, grades and brief (but numerous) write-ups are designed to be a catalyst and fuel for the city's efforts to develop the water-planning and policies sections of the comprehensive development plans.

The report is presented as 36 sections, each composed of several paragraphs and intentionally, including a general statement, recommendation and action steps for each of the topics covered. Water-policy issues are covered first, and water projects second.

NOTE: For more details on all the topics, go to the full text in Appendix A on page 61.

Significant Issues and Recommendations

Water Issues

Water Planning

Population Estimates

The San Antonio Water System used a significantly more conservative population estimate for 2060 than the estimate that results when the 92 percent of MPO estimate is projected to 2060 (see Figure 1A. on page 99). The difference is approximately 20.6 percent fewer people are used in the SAWS estimate. That difference in population would require ≈ 110,383 acre feet more water in 2060 than described in the SAWS 2012 Water Plan.

Recommendation – To use a population estimate consistent with the estimate used by other area planning groups and is likely to result in water supply targets that more confidently result in adequate water supply to meet demand.

Action Steps

1. Review the alternate population estimates available (Alamo Area Metropolitan Planning Organization, Region L Water Planning Region, and SAWS 2012 Water Management Plan Estimates)

2. Discuss the alternatives and reasoning provided for the specific development of the various estimates with the City of San Antonio Planning and Community Development Department

3. Make a decision as to the estimate selected and justify it to pertinent policy boards such as the SAWS Board and City of San Antonio City Council.

4. Use the population data in combination with projected GPCD to develop water demand estimates.

GPCD (Demand Management)

The demand-management goals presented in the SAWS 2012 Water Management Plan are less ambitious than the 2009 Water Plan. SAWS provides a justification for reducing the goals from a GPCD of 126 to 135, but examination of the GPCD levels achieved for 2012, 2013 and 2014, plus the trend line offered in Figure 2A on77102, make an argument for consideration of a more aggressive goal.

Recommendation – Re-establish the 126 GPCD goal from the 2009 SAWS Water Management Plan as the goal for the next SAWS Demand Management Plan, and implement programming to achieve that goal.

Action Steps

1. State the dry-year GPCD goal as 126. Justify the revision of the goal to 126 from 135 by citing the trend line provided on Figure 2A on page 102 in this study.

2. Continue the approximately $6 million/year funding for demand management that has been budgeted over recent years.

3. Duplicate the program mix used to utilize the $6 million budget and achieve the results represented in the trend line in Figure 2A on page 102.

4. Adjust programming to reflect new ideas and public stakeholder input as long as the cost of water demand savings approximate the cost achieved by the programming that achieved the two GPCD/year reductions reflected in the Figure 2A trend line on page 102.

Public Input and Communication

San Antonio's exemplary water-conservation success is related to the outstanding public-input process conducted by city leaders and SAWS concerning water policy.

Recommendation – The City of San Antonio maintain its public input process on water-policy issues by continuing to seek and use that input. SAWS make a special point to keep the landscape industry on the water-conservation team, and that the discussion related to Vista Ridge stay front and center in the public's attention.

Action Steps

1. Characterize the issue of irrigation systems' role in water use to include identifying the parties (stakeholders) advocating or defending irrigation and those criticizing the role.

2. Introduce the topic to the Community Conservation Committee (CCC) to include inviting spokespersons for the sides of the issue to present their arguments to the CCC.

3. Define a process to follow that will result in a compromise to engage a super-majority of the advocates on both sides as advocates for the compromise. The process will likely include the media.

4. Translate the compromise into programming that uses the agreement to reduce water use while increasing the number of stakeholders embracing the compromise.

5. Characterize the issues that define the debate about the Vista Ridge Water Project.

6. Introduce the topic and the debate points to the water resources committee, known as the Citizens Advisory Panel (CAP), so they can define a process to monitor the development around the issues of concern and promise of action. The process will likely include the media.

7. Translate the actual characteristics of the Vista Ridge project as it develops into action to change the results or justify the difference from the promised results so the program direction can be changed to maintain public support.

Climate Change

The impact of climate change has been debated. Until recently even the existence of climate change has been questioned. Whatever the policy maker's beliefs, however, it seems that the issue must be addressed in terms of water supplies and water demand.

A paper from 2000 cited in this analysis discusses demand increases of 1.5 percent and 3.5 percent in 2030 and 2090 respectively. The paper also estimated that pumping from the Edwards Aquifer will have to be reduced by nine percent in 2030 and 20 percent in 2090 to account for a reduction in Edwards Aquifer recharge in order to protect the endangered species.

Recommendation – Climate change needs to be addressed in the next SAWS Water Management Plan. The phenomenon has the potential to increase the likelihood of increasing demand and reducing supply in the period of this analysis 2015-2060.

Action Item

1. If an analysis on the effect of climate change on San Antonio water security has not been completed, the work needs to begin, so it can be used in the next water management planning process.

Water Shortage, 2060-2070

The SAWS 2012 Water Plan reveals a potential water-supply shortage in the period 2060-2070 if the City of San Antonio is subjected to drought-of-record conditions (see Figure 3A on page 108). The water shortage of 2060-2070 becomes an even more significant issue if, in fact, the MPO population estimates are the numbers for which San Antonio should be preparing. The shortage of 2060-2070 could become the shortage of 2040-2050 if population grows at the faster rate and drought-of-record conditions settle into the area in 2040.

Recommendation – The situation reinforces the need for SAWS and the City of San Antonio Planning and Community Development Department to settle on defining the most likely population scenario, with the goal of ensuring no under-estimation of population growth. The next version of the SAWS Water Management Plan needs to identify water sources to address this demand.

Action Steps

1. Finalize the population estimates through a consensus between San Antonio planning entities including SAWS and the City of San Antonio Planning and Community Development Department.

2. Develop demand estimates by using the population estimates and projected GPCD, incorporating special challenges, such as climate change and drought of record.

3. It is best if two lines of defense are created. Include in the water plan enough supply projects to cover demand estimates that include population, GPCD, climate change and drought of record.

4. New water resource projects, such as ocean desalination, can be included in the plan, but it will be even more effective if extra supplies can come from advanced water conservation, reduced lost water, a better organized recycled water program, the post-30 year Vista Ridge project, and a more accurately characterized ASR, as described in the main text of this report in the appendix.

5. The second line of defense includes the drought-management activities. The drought-management plan also needs to be in place and tested to account for unexpected infrastructure failures, even more severe drought and other challenges.

Water Management

Drought Management

The City of San Antonio has proven that drought management does not have to be viewed as a water-planning failure by a community. It is a legitimate, efficient water-management strategy that reduces peak water use at a low cost without hindering economic development or quality of life.

Recommendation – The City of San Antonio should formalize its recognition of drought management as an effective way to reduce peak demand in a measured way. The City of San Antonio should further utilize its water-policy education and public-communication process to mobilize its citizens to accept the water-management strategy as they do water conservation.

Action Steps

1. In the next San Antonio Water System Water Management Plan, identify drought management as a planned activity to reduce peak water use during a drought and varying levels of water use as necessary to deal with potential water emergencies.

2. Enlist the help of the Community Conservation Committee in including drought management components in the education and public-communication activities, citing water savings possible and dollar cost.

3. The result would be to ensure San Antonio citizens understand the important and efficient role that drought management plays in San Antonio water security. Further, the city's citizens should understand the activities that will be initiated in a drought or infrastructure emergency and the role these will play in dealing with the issue.

Lost Water/Non-revenue Water

San Antonio Water System non-revenue and lost-water rates have been high for six years. The estimated 36,305 acre feet of water that is "lost" between pumping and sale to ratepayers is as much as a large water-supply project would supply. The cost at $1,000/acre foot would be over $36 million. Of equal concern with the loss of the water is that the whereabouts of much of the amount still has not been determined.

Recommendation – To identify where the difference in pumped and sold water is being lost and take action to recapture the lost water in a way that makes economic sense.

Action Steps

1. City Council should ask for a report on the lost-water situation, requesting information on what is being done to identify where the water is lost, as well as a plan to recapture the water so it can be used and also provide revenue.

2. If City Council is satisfied with activities in this regard, members can direct SAWS to proceed with the plan.

3. If City Council believes not enough is being done, members should direct SAWS to produce a more ambitious plan for addressing the issue.

4. Implement the new plan so that actions can be taken to have access to the lost water and/or the lost revenue.

5. The plan should include provisions to prevent losing track of lost water in the future.

Special Note: Lost Water/Non-revenue Water Is Not a Simple Issue

The Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses draw the conclusion that SAWS should address the lost water/non-revenue water issue as a priority. The problem is two-fold: the nature of the lost water must be identified and then the issues that caused the lost/non-revenue water can be considered in terms of the costs to correct them.

SAWS representatives offer the opinion that there has been an extensive effort on their part to identify the sources of lost/non-revenue water. They have contracted with experts in the field to identify the sources of the lost/non-revenue water.

A second point SAWS makes is that the level of non-revenue water (15.13 percent in 2013) is not high for a water purveyor as large and complex as the San Antonio Water System. Representatives note that the Texas Water Development Board has not placed San Antonio in an excessive lost/non-revenue water category.

Edwards Aquifer Habitat Conservation Plan

The EAHCP is of major importance to the City of San Antonio's main water source, the Edwards Aquifer. The EAHCP stabilizes the city's access to the water, and does it in an inexpensive way. The Incidental Take Permit reduces the threat of lawsuits and federal intervention.

Recommendation – It is important for SAWS to continue its support of the EAHCP through active and creative leadership. SAWS leadership should include a report to City Council and the SAWS Board, as well as the CCC and water-resources committees, on the most important issues handled by the EAHCP in the previous year, and the role SAWS staff played in resolution of those issues.

Action Steps

1. Create a section on the SAWS website to provide the EAHCP agenda each month with a SAWS staff summary of each agenda item in terms of SAWS interests. This should be accompanied by a short summary of action SAWS took concerning the agenda item.

2. Produce a SAWS annual report on EAHCP issues to include goals for action in the next year on each issue.

3. The annual report described in Step 2 is presented to the SAWS Board and City Council, and possibly the business community and local university leadership as well, to ensure continuing front-of-mind awareness of and attention to the HCP.

Bexar Metropolitan Water District Integration into the SAWS System

This integration process was an example of a community's ability and action to deal with a problem (the Bexar Metropolitan customer service, financial status and water-supply issues) with remarkable efficiency and success. SAWS managed the incorporation of Bexar Met into its system with minimal disruption.

Recommendation – The integration effort was very successful, the tactics used to achieve the success and the ongoing impact to San Antonio should be communicated. Communicating the results is consistent with the history of public communication in San Antonio.

Action Steps

1. Prepare a "Report to the Community," relating the progress and success of integrating the Bexar Met System into SAWS. Place it on the SAWS website and provide it to the media before it becomes old news.

2. The "Report to the Community" should address the list of reasons the integration was initiated and relate the benefits accrued to both Bexar Met and SAWS ratepayers. Remaining challenges should also be identified.

3. Prepare a similar but less extensive "yearly report" each year.

San Antonio as a Water Neighbor

The relationship a community seeking and managing water supplies has with its neighbors is very important to success in water planning and water management. Neighbors can make the job harder or easier based on their attitudes toward their area water purveyor.

In the case of San Antonio, relationships with its neighbors have not been good. The result has been a general level of opposition in the legislature, in the media, in the courts and in regional forums. To its credit, however, the City of San Antonio, through its representative, the San Antonio Water System and its 2012 Water Management Plan, has worked to present a new San Antonio in terms of water policy and actions toward its neighbors. Actions that are good for neighbors as well as San Antonio include participation in the Schertz/Seguin Water Project and Pipeline; the Edwards Aquifer Habitat Conservation Plan; the Western Canyon ongoing excess water purchase; and the Trinity Aquifer pumping reduction in times of drought.

Recommendation – Actions identified in the SAWS 2012 Water Management Plan and this water policy report reflect that San Antonio is now a good "water neighbor." However, San Antonio's regional neighbors have a lingering belief that San Antonio is not a good water neighbor. This reduces cooperation on water issues that makes the job of obtaining and protecting water resources more difficult. These action steps will help change the perception that San Antonio is not a good water neighbor.

Action Steps

1. Identify the "good neighbor" actions need for a campaign to communicate their benefits by social and traditional media to specific neighbors affected and in general to internal (San Antonio) and external (statewide) audiences.

2. Implement a policy of officially considering the impact on regional neighbors of every water-policy option prior to decision-making on the option.

3. Add the "good neighbor" option, once selected, to the list described in Action Step 2.

4. Prepare a yearly check of good neighbor actions vs. actions that don't rate as making a positive impact on the neighbors affected to keep the issue in play in San Antonio water-policy decisions.

Water Quality

Edwards Aquifer Conservation Easements

The willingness of City of San Antonio taxpayers to support the use of tax revenues to purchase conservation easements to protect Edwards Aquifer recharge features is important to protection of the aquifer from contamination This also speaks of San Antonio's overall awareness of the importance of the recharge zone to its water supply.

Recommendation – It is important City of San Antonio officials celebrate the success of the conservation-easements activities and promote their continuation. The expansion of the effort seems to be a palatable way to relieve developmental pressure on the land over the aquifer. A discussion should be initiated to set a goal for conservation easements. Thirty-five percent (35 percent) is a goal to consider.

Action Steps

1. San Antonio City Council approved extensions of the program for a fourth version of the conservation easements (Proposition 1 on the May 2015 ballot). The value of the easements in helping protect the recharge-water quality and access to the aquifer would make the extension the recommended action.[8]

2. It is time proponents of conservation easements arrive at a goal such as the 35 percent recommended in this paper. Such a goal would make it easier to

complete the timeline being requested by elected officials uncomfortable with indefinite extensions of the conservation-easement program.

3. After this fourth version, the conservation easement should also be linked to the major effort to do a better job of protecting the contributing zone (see Water Quality, EARZ, and Contributing Zone Protections sections).

EARZ and Contributing Zone Protections

The City of San Antonio Unified Development Code (UDC) and the requirement for aquifer-protection plans for certain development activities provide protection for the recharge zone. Contributing-zone runoff is a major source of Edwards- and Trinity-Aquifer recharge. There is opportunity to better protect that runoff by expansion of regulations through an enlarged protected region.

Recommendation – The goal for this part of San Antonio water security is very ambitious. It includes two main parts: first, lead a regional effort to fill gaps and improve cooperative efforts to have EARZ rules that protect the water quality and recharge volume of the Edwards Aquifer and Trinity Aquifer Recharge Zones; second, organize a regional effort to implement development and recharge rates for the contributing zone.

Action Steps

1. Designate a subcommittee as part of the Comprehensive Plan effort to receive COSA EARZ development protection rules toward the end of presenting a set of rules to all of the communities in the region. The goal would be to achieve common rules across the region.

2. Organize a process of interaction and negotiation with all area governments with the goal of having them accept a set of effective workable rules across the region.

3. Set a negotiation target of two years to reach a consensus or compromise among all the local governments.

4. At some point at or near the two-year target point, determine if legislation would be useful, or necessary, to reach the goal of reasonable and consistent development rules across the region. If so, organize that effort with support of as many participating entities as are proponents of the legislative route.

5. As part of the EARZ rule process, COSA representatives should bring up the topic of the need to protect recharge water over the contributing zone.

6. With the participation of as many regional government entities as are willing, begin exploring protection options for the contributing zone.

7. Assemble a package of desirable actions and protections for consideration by the regional entities.

8. Legislative action will probably be necessary to allow and/or require compliance with the package of protections and actions developed in Step 7.

9. Set a target date and plan of action to achieve the desirable rules and activities identified for protection of water quality and joint action over the contributing zone.

Contamination Threat

The paper concludes, as part of its risk analysis, that surface-water sources and water sources with treatment plants and long pipelines are more susceptible to contamination than groundwater sources, such as the Edwards or Trinity Aquifers that are pumped from wells within the city limits. Contamination can result from intentional or accidental sources.

Recommendation – The authors were not provided access to SAWS' Water Vulnerability Assessment and Emergency Response Plan for confidentiality reasons. Since these are essential (and the law), COSA officials need to ensure they both exist and are comprehensive. Accidental contaminations, while not common, do occur on a regular basis because of human error. The best risk-management strategy is to review and update the Vulnerability Assessment and Emergency Response Plans and to ensure staff receives adequate training in these areas.

Action Steps

1. As part of Comprehensive Plan, City Council should review emergency response plans for water resources to ensure they are adequate and coordinated.

2. Document the coordination plan between SAWS and City of San Antonio Office of Emergency Management.

Low-Impact Development

Area local governments and developers are exploring Unified Development Code (UDC) changes to make it more attractive for property developers in non-aquifer-recharge areas to achieve status as a low-impact development project by replacing some of the development rules with more nature-mimicking best management practices. The San Antonio River Authority, the agency leading the effort, defines LID as a "group of techniques to mitigate the impact of urbanization on the hydrologic cycle."

Recommendation – The City of San Antonio Planning and Community Development Department and the San Antonio Water System are participants in the San Antonio-area LID effort. They are positioned to use the information learned in best management practices (BMPs) and the process of attempting to change the UDC as a model for another important effort, the development of a regional collaboration to create legislation, BMPs, cooperative agreements and other necessary activities to protect the contributing zone.

Action Step

1. Introduce, as an example, the work of the LID effort to City of San Antonio Planning and Community Development Department and San Antonio Water System staff designated as leaders of the contributing-zone effort.

Coal-Tar Sealant

There is a serious debate about the threat to water quality from coal-tar sealants and the polycyclic aromatic hydrocarbons (PAH) that are released. Austin has banned the use of coal-tar sealants within its city limits. This paper provides a sample of positive and negative references concerning a coal-tar-sealant ban.

Recommendation – Review the available evidence and decide if a coal-tar-sealant ban is desirable as a water-quality-protection action in San Antonio.

Action Steps

1. Designate a staff person or consultant (City of San Antonio Planning and Community Development Department) to review the available scientific literature and make a recommendation to City Council within one year. The Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses provides a sample of literature on both sides of the issue.

2. If the review of available science is not conclusive, COSA should sponsor a research project to produce more conclusive evidence one way or the other.

3. Use the new evidence produced by the local research to allow a decisive recommendation to City Council.

Annexation of Unincorporated Areas

For a water source as vulnerable to pollutants as the Edwards Aquifer, an effective set of development rules is important to reduce the chance of contamination.

The rules governing annexation of unincorporated areas within the City of San Antonio ETJ; SAWS' responsibility to provide infrastructure for water and wastewater to any development within the ETJ; the gaps that exist in recharge-zone protection within the jurisdiction of some area cities; and the need for region-wide action to address water-resource protection over the contributing zone make this an important topic.

Recommendation – The City of San Antonio should review this situation in light of protecting the Edwards Aquifer as its major water source.

Action Steps

1. The City of San Antonio should address the two issues identified in the section for review and action in the Comprehensive Plan process by creating a subcommittee or assigning them specifically to an existing work group on the process.

    a. Policy for SAWS to provide infrastructure for water and wastewater services in the ETJ without regard to development pattern and other issues.

    b. Adequacy of EARZ development rules overall and the difference between rules for unincorporated areas in the ETJ and annexed areas.

2. The assignment to review these topics will include producing a recommendation for action on each and a requirement to relate the recommendations to action on the EARZ development rule gaps in the region, and the development of regional action to address water-quality protection over the contributing zone.

Regulatory Agencies

Texas Water Development Board (TWDB)

TWDB is the vehicle for state-resource funding. Its funding levels and policies are important to San Antonio water supplies. San Antonio has benefitted from the availability of TWDB funds in the past for development funds for water projects, most recently the brackish-water-desalination project.

These funds allow water purveyors to pay low interest rates and often delay the payback period until the project funded is actually producing water to be sold. TWDB funds used for design and construction contribute to cash-flow advantages.

If SAWS continues to work closely with the Region L Planning Process so that San Antonio Water projects are prioritized as part of the Region L and State Water Plan, the water purveyor can expect to receive TWDB funds. Expansion of the Water Reuse System, and Water Conservation programs would fit into the SWIFT priorities. Aquifer Storage and Recovery, brackish groundwater desalination and seawater desalination are identified as areas for creation of new freshwater supplies and would also be viewed favorably.

Recommendation – Since the TWDB is the State of Texas' primary water-resource-funding vehicle, it is important SAWS and the City of San Antonio (COSA) continue to be alert to TWDB-funding issues. The City of San Antonio will benefit by more emphasis on the requirement for strong water-conservation and drought management for TWDB funding. COSA should actively pursue such rules.

Action Steps

1. Assign a staff person (SAWS) to review TWDB programming with the goal of maximizing use of and influencing the creation of resources of benefit to the water-policy portion of the City of San Antonio Comprehensive Plan.

2. The assignment is translated into a quarterly report to the SAWS leadership and Board, outlining the resources currently available from TWDB that would be useful for specific San Antonio water or wastewater programs.

3. The assignment also includes reviewing proposed or new legislation affecting TWDB resources useful to San Antonio water projects.

4. The designated staff person would produce a legislative agenda program each year, outlining legislation that, if passed, would contribute to San Antonio water security.

Texas Commission on Environmental Quality (TCEQ) and the US Environmental Protection Agency (EPA)

The TCEQ is not an aggressive state agency in terms of seeking an expanded role for itself. It is responsible for regulation of water-utility operations and regulation of environmental water quality. TCEQ is also the state-level delegate for the U.S. EPA. The relationship between the two agencies is often at odds. SAWS is in a settlement agreement with the EPA that requires improvements on its wastewater-treatment operations.

Recommendation – The authors recommend SAWS take the initiative to stay on top of developments on the issue of "Contaminants of Emerging Concern." EPA is taking the lead on CEC research. SAWS needs to designate a qualified staff person or unit responsible for the issue to the point that a report is made to the SAWS Board annually.

Action Steps

1. Designate a staff person (SAWS) to review TCEQ and U.S. EPA programming in the same manner as described for the TWDB (Action Steps 1-4) to ensure San Antonio is aware of current programs and proposed programs so issues can be addressed in a proactive manner.

2. SAWS should take responsibility to organize a Contaminants of Emerging Concern (CEC) effort that is coordinated as closely as possible with the EPA program and is included as part of the discussed EARZ Development Rules and Contributing Zone Water Protection Program.

3. A report to the SAWS water resources committee, known as the Citizens Advisory Panel, to be made on the CEC effort every year.

Edwards Aquifer Authority (EAA)

SAWS has joined the LULAC lawsuit against the Edwards Aquifer Authority. There is a good chance the litigants will win the suit and the City of San Antonio will end up electing 13 of the 15 board members instead of seven of the 15 members, as is now the case.

Recommendation – It is important that SAWS and the City of San Antonio have a well-conceived strategy developed to influence the results they want from the lawsuit, including maintaining the important work of the EAA and cooperation between all the government entities and stakeholders in the region. It is prudent for SAWS to seek a compromise with the regional interests, legislative interests, and downstream groups to increase Bexar County influence at the same time as keeping everyone on the Edwards Aquifer Authority team.

Action Steps

1. SAWS should provide a report to City Council describing the state of the LULAC lawsuit and hopes for accomplishment through its pursuit of the lawsuit. The goals of the lawsuit action would be expressed in terms of San Antonio water security and effects on relationships with regional neighbors.

2. SAWS should describe why an alternate strategy involving negotiation, rather than legal action, with the parties concerned would not accomplish the goals with less disruption to the EAA working relationships that achieved the EAHCP and other cooperative ventures.

3. Initiate contact with the EAA to see if EAA would respond to negotiations to achieve the SAWS goals for the lawsuit.

Local Groundwater Districts

Groundwater districts have limited geographic responsibility and a localized philosophy of regulatory responsibility. It is difficult for San Antonio and other central cities to deal with the different rules and potential for change that occur in the system. Water projects of regional scope are most likely to be accomplished if funders can expect stability in the rules that govern them. There are also some water sources, such as brackish groundwater, that need to be treated differently from freshwater sources if they are to be developed.

Recommendation – The City of San Antonio water-supply effort would benefit by legislation limiting the ability of local groundwater districts to direct rules against regional projects and to change rules after projects are permitted. The authors also recommend active support of legislation to put brackish-water development in the hands of a state agency.

Action Steps

1. Review the current legislative agenda concerning the issues of five-year permit renewals, brackish-groundwater-desalination regulatory authority, and other

inconsistencies between local groundwater districts that make efficient water planning difficult for San Antonio.

2. In the short time remaining in this legislative session, assess actions by San Antonio entities to support legislation that addresses the goals in Action Step 1 and mobilize any further support that is appropriate.

3. After the legislative session is over, prepare a legislative scorecard on the topics supported.

4. Prepare a plan to fill any continuing gaps for the next legislative session to include preparing proposed legislative language, identifying potential legislative sponsors, and identifying allies for the next session.

Water Cost

Water Project Costs

It is important for City of San Antonio officials to be able to compare water-supply options. SAWS does a good job in assigning water-unit costs but the numbers would be even more useful if they were explained by an appendix to the water plan. The explanations would be especially revealing if they described how inflation costs were assigned.

Recommendation – The next SAWS water plan should include an appendix explaining in more detail how water costs for each project provided in Figure 7A on page 146 were calculated. Comparison of the costs of various water projects is one of the main discussion points in determining a project's desirability. Water-project estimates sometimes change from plan to plan and costs applied to one project, such as pipeline or treatment facilities, are not included in the estimate of another project. Having the method of determination of the cost more clearly defined will result in a more accurate comparison and better decision-making.

Action Steps

1. Since SAWS uses the TWDB water project-cost method to calculate cost in most cases, the link to the process should be included as part of a new project-cost-determination appendix.

2. The appendix would also note any variation, with the logic for that variation for each of the water projects included in the plan.

3. The water project cost appendix will also include the history of cost estimates for Water Management Plan water projects.

Residential Water Rates

SAWS residential water rates are lower than the rates in Austin, Houston, and Dallas within the low and moderate water-use blocks. In the highest block (over 17,500 galllons/month),

only Austin has a higher rate. In addition to the curve rates reflected in Figure 8A and 9A on pages 150-151, the San Antonio Water System is a proposing a new rate structure (see "The Price of Water", San Antonio Express-News, June 21, 2015 on the MySanAntonio.com website) that increases rates for all but the lowest 27 percent of residential water users. Rates in San Antonio are re-examined on a regular basis by a Rate Advisory Committee (RAC) made up of stakeholders.

Recommendation – The history of relatively low water rates means the City of San Antonio has achieved its enviable water conservation success without heavy emphasis on high rates. The rate increases and steeper increasing block rates proposed in 2015 may provide a stronger pricing impact on water use. The impact should be closely monitored for use in future RAC discussions.

Action Steps

1. Include an analysis of the effect of current and proposed rates (if enacted) for consideration of the RAC in the future.

2. Increase the volumetric charges and level of increase of the increasing-block rates if it is determined it is desirable for the water-rate structure to contribute more to water conservation.

Commercial and Industrial Rates

Rates are important for several reasons. Low rates may be a tool for attracting new industries and firms. High rates may be a way to be selective about economic development. If your water rates are very high, commercial concerns or industries that use considerable water in their production processes may pass on a community to avoid the high water rates.

The key is to be clear about goals in the economic development area and then to organize the industrial and commercial water rate structure to help accomplish those goals.

In the case of San Antonio, the rates overall should be competitive with other large cities but industries or commercial concerns that hire employees, provide a service, or manufacture a product without using excessive amounts of water would be most desirable.

Recommendation – The Rate Advisory Committee (RAC) should consider the discussions offered in this section of this report in its deliberations.

Action Steps

1. Review the commercial and industrial wastewater and water rates in terms of their comparison to Dallas, Houston, and Austin to ensure they are in a competitive range.

2. Construct a water use/payroll dollars (or position) and water-use/product-produced calculation to include in consideration of economic development

prospects in terms of water efficiency. Determine what a desired level of efficiency is.

3. Determine if the rates should be changed (up, down, structure) to better meet San Antonio's goals for economic development.

Impact Fees

The concept of impact fees is simple but the reality is not. In San Antonio, the goal is to have new developments pay 100 percent of their water- and wastewater-infrastructure costs.

A recent headline stated that impact fees covered 46.6 percent of the cost of infrastructure for a new development. The current impact fee, however, is only part of the funds used to pay those costs. Estimates are made by SAWS of the development that will occur in a particular area of the ETJ. Also estimated is the cost of that infrastructure and how soon it may be required. Cash-flow issues are involved and total costs can end up being paid from current, past and future impact-fee accounts.

Impact fees can also be used to direct growth, counteract urban sprawl and contribute to EARZ protections in a community. In San Antonio, impact-fee waivers are available for developments that build projects in the inner city and other targeted development areas.

San Antonio reviews and revises its impact fees on a regular basis. The last review was in 2014.

Recommendation – Impact fees contribute to economic efficiency when they meet the infrastructure costs of new developments. This policy should continue to be pursued. Impact fees can also be an important factor in directing development to better protect aquifer-recharge zones. San Antonio should examine this potential.

Action Step

1. Prior to the next round of impact-fee consideration, the subcommittees described in the annexation and EARZ and contributing zones sections should consider the role impact fees could play in contributing to a new policy related to providing increased water-quality protection for the Edwards Aquifer recharge and contributing zone.

Water Resources

Edwards Aquifer Groundwater

There are a number of significant issues involved with use of the Edwards Aquifer as a water source.

The City of San Antonio is dependent on the Edwards Aquifer as its main source of water. The 2012 Water Management Plan indicates dependence will be reduced from 78 percent in 2012 to 30 percent in 2040.

Edwards Aquifer levels are volatile. They increase and fall in seasonal and longer patterns. Aquifer levels affect spring flow in the Comal and San Marcos Springs, on which a number of endangered species rely. The species' survival is protected by drought restrictions that reduce pumping by as much as 44 percent, as well as a habitat-conservation plan of ambitious management activities.

There is significant pressure for development over the recharge zone that increases the chance of contamination. The citizens of San Antonio have been willing to use tax dollars for conservation easements and Edwards Aquifer Recharge Zone (EARZ) development restrictions exist in most areas. It is a worthy pursuit to extend these EARZ restrictions to Shavano Park, Helotes, Hollywood Park and other jurisdictions not currently regulated. Contamination over one part of the recharge zone could affect the rest of the aquifer and, consequently, San Antonio's water supplies from the aquifer.

Recommendation – The importance of Edwards Aquifer groundwater to San Antonio water security requires that there be no confusion about the city's goals to reduce dependence on the source, and more importantly, there must be action to protect the water from contamination and recharge threats.

Action Items

1. Over the years and in the SAWS 2012 Water Management Plan, SAWS has made strong statements about a goal to reduce dependence on the Edwards Aquifer as the City of San Antonio's primary water source. So far, the situation has been one of making the statement, but not really making any advances in that direction.

   The 2012 Plan projects percentages that represent a reduced percentage of the total supply for future years but, in practical terms, the plan also relates the addition of about 10,000 acre feet more of Edwards permit to the inventory. For the next water-management plan, the City of San Antonio and SAWS need to decide if the quest to diversify is real or merely incidental to the availability of Edwards Aquifer water permits. It is a matter of credibility important to maintaining the confidence of area residents and regional neighbors.

2. It would be a disaster for the Edwards Aquifer water source to fall victim to its vulnerability to contamination. To better protect the city's most important water resource, City of San Antonio and SAWS action items in the Comprehensive Plan should include the action recommended in this paper about the gaps in EARZ rules, the initiative to protect water quality over the contributing zone, review of the coal-tar-sealant threat, expansion of the conservation-easement program, and continued leadership in the Edwards Aquifer Habitat Conservation Plan.

Recycled Water

The recycled-water program is a low-risk water project for COSA that plays an important role in reducing the need for more potable water. In gathering the information for this paper, it became clear that it is not an entirely transparent program. It is hard to pin down the exact amount of recycled-water use and equally hard to determine its availability. The program is also somewhat limited by landscape use of recycled water, with the result that supplies in the winter are not fully utilized.

Recommendation – SAWS should launch an effort to more clearly characterize the availability and use of recycled water. There appear to be at least 12,001 acre feet of recycled water not assigned, but there is also CPS and landscape water that need to be analyzed in terms of temporary or emergency use. A detailed plan for more thorough use of recycled water should be prepared. This will provide additional water supplies for the city's use.

Action Steps

1. Prepare a revised plan for the recycled-water program, verifying the numbers provided in the analysis emphasizing amounts of water available for distribution and the underutilized water such as that in the CPS contract and landscape-watering contracts. The plan would describe how and when the available 12,001 acre feet would be incorporated into the water-use total, and it would ensure the potential of the underemployed recycled water is better utilized.

2. The plan would also identify the projected availability of recycled water as San Antonio's population increases and more wastewater is collected. The action steps within the plan would describe when the new recycled water will be available and how it would be distributed or marketed.

Vista Ridge Water Project

The Vista Ridge project is rated a high-risk water supply because of the distance of the source from San Antonio, the number of regulatory agencies involved, the relatively short contract period, and the financial status of the major sponsor, Abengoa.

The project is innovative for some of the same reasons, and because it is a turnkey water-supply project. Abengoa and Blue Water, the sponsors, carry the primary risk for the costs of the project if the contracted water cannot be produced or delivered.

Not much has been said about the project after 2050 when the 30-year agreement ends but it is an important question because the contract's end coincides with the point when San Antonio water supplies do not match water demand (see Water Shortage 2060-2070 and Population Estimates sections on page 107 and 97, respectively. If SAWS assumes control of a functioning infrastructure and is able to renegotiate agreements with the landowners and groundwater districts providing the water, Vista Ridge will reduce the requirement for replacement supplies.

Recommendation – A key premise of the project was that it will not reduce the San Antonio water-conservation effort. The City of San Antonio, the SAWS public-input committees and the media should monitor this issue closely.

Action Steps

1. Develop a strategy to increase the chances the Vista Ridge will produce water for San Antonio after its 30-year contract. This is not a premature action because the likelihood of a continuing supply will be very important to plans to seek new supplies in the next Water Management Plan.

2. The promise of transparency and communication was a key part of gaining support from the public for the Vista Ridge project. The public should already be hearing about efforts to sell extra water during the early years of the contract and how arrangements are proceeding. The issue of Abengoa's financial status was also raised. A communication plan needs to be developed and implemented.

3. The project's relationship to the water-conservation effort is also an important feature of the public's acceptance of the Vista Ridge project. Preparations should be underway to address questions about the conservation effort ending in 2020, when the Vista Ridge water is scheduled to start being available.

Special Note: Vista Ridge Project Risk Rating Is Questioned

The San Antonio Water System offered concerns that the Vista Ridge project was not accurately represented in the Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses. Questions related to whether the pipeline length, the fact that the water required treatment, and the junk-bond status of one of the contractors, Abengoa, should contribute to the risk rating, and the authors' view of Vista Ridge as a high-risk project.

SAWS offered the points that:

1. Pipeline-construction quality determines pipeline risk issues, not pipeline length.
2. Treatment facilities should not be rated as a risk factor.

3. Since SAWS is paying for the water, the bondholders are more interested in its high bond rating than Abengoa's bond status.

SAWS also raised the issue that the Vista Ridge project should be considered a long-term project rather than just a 30-year project because the water purveyor has the option (and plans to take advantage of that option) to assume ownership of the infrastructure and relationships with the landowners (water rights) after the contract with Blue Water and Abengoa is over. The SAWS 2012 Water Management Plan does not emphasize this continuation of the project, but SAWS cited a PowerPoint presentation by CEO Robert Puente (Vista Ridge Water Supply Contract) to community leaders on October 3, 2014 as evidence of this intent.

The authors stand by their identification of pipeline length, treatments, and financial status of water-project contractors as legitimate risk factors to consider. See the discussion for risk ratings on page 22 and the Special Note attached to that section.

With regard to the extension of the Vista Ridge project, if it can be accomplished, it will add to available water supplies beyond 2060 to reduce dependence on the Edwards Aquifer and move back the water-supply-gap dates identified in the SAWS 2012 Water Management Plan and in Figures 1A(i) and 1A(iii) on pages 53 and 54 of this paper. The Special Note attached to that discussion identifies specifically how the water-supply gap and dependence on the Edwards Aquifer would be affected.

Brackish Groundwater

Brackish groundwater is identified in the Texas Water Plan as a priority water source to be pursued for the future. San Antonio will have access to some treated brackish water by 2016 and 30,505 acre feet per year by 2026, according to the SAWS 2012 Water Management Plan. The desalination project is rated as a low-risk water project. The technology is proven, the water supply huge and close, and tests have been successful. Use of brackish groundwater is also identified as an important source of water for meeting the state's future water needs. The Texas Water Development Board has provided funds for use in developing the project. Lessons learned on the brackish-water project may enable San Antonio to expand to other brackish sources.

Recommendation – The brackish groundwater desalination program will be an important part of the City of San Antonio's future water supplies. The 30,505 acre feet currently identified will become more valuable when the western water distribution pipeline is completed and if SAWS is able to store treated brackish water in the Twin Oaks ASR. SAWS needs to pursue that option with the Evergreen UWCD and other interested parties.

Action Steps

1. Begin discussions at SAWS to prepare and pass legislation in the next legislative session to allow treated brackish groundwater to be stored in the Aquifer Storage and Recovery facility to allow more efficient utilization of the supply.

2. Discussion along similar lines should also start with Evergreen UWCD.

3. There is considerably more brackish water available in the San Antonio area if regulations for its development are placed in state rather than local groundwater district hands. San Antonio needs to join other communities and aggressively pursue legislation to designate brackish groundwater apart from freshwater for the purpose of development and regulation.

Twin Oaks Aquifer Storage and Recovery (ASR)

This project is unique among the 12 described water-supply projects for the City of San Antonio because it is a storage system rather than a source of new water. Its low-risk nature and its importance to the Edwards Aquifer water value make it worthy of identification as a water-resource project.

The ASR stores surplus Edwards Aquifer water so it can be used across calendar years during high-demand times. The capacity is currently recognized as 120,000 acre feet.

Recommendation – SAWS ASR management should be improved and the capacity of the Twin Oaks ASR should be more definitively determined. If it is 200,000 acre feet, as some engineers have stated, the ASR becomes even more valuable as part of the overall water plan. Along the same lines, it seems SAWS should better characterize the time it takes the ASR to convert from injection to distribution and its capacity to return water to San Antonio.

Action Steps

1. Launch an engineering study to determine the storage capacity of the ASR. Is it 120,000 or 200,000 acre feet? The determination is essential as San Antonio is faced with mobilizing more water resources to meet higher population estimates for the future.

2. A second study should clarify the ASR capability to inject and recover water. The new estimates can take into account the western water distribution pipeline and should address and identify potential improvements in the movement of the ASR water. This uncertainty makes it harder to determine the full potential of the ASR in the water-supply equation.

Special Note: Capacity of the Twin Oaks ASR Facility Has Been Determined

In discussions with the authors and sponsors of the Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses over a final draft of the paper, San Antonio Water System officials did provide information that a study of the Twin Oaks Aquifer Storage and Recovery had been completed as of April 2014 by Alan R. Dutton at the University of Texas San Antonio.

The existence of the document, “Estimation of Volumetric Capacity of an Aquifer Storage and Recovery (ASR) Field Operated by San Antonio Water System, Bexar County,

Texas," indicates SAWS has completed an important part of the action steps suggested in this paper to make the Twin Oaks ASR a more defined part of the Water Management Plans for the future.

SAWS reports that the 200,000 acre feet capacity will be addressed in the next water-management plan.

Carrizo Groundwater (Bexar County)

The project is rated as a low-risk water supply because SAWS owns considerable land in the area and the water source is close to San Antonio. At present, there is no local groundwater district but SAWS has an agreement with the Evergreen Underground Water Conservation District to pump two acre feet per acre of land owned in the Twins Oaks area. SAWS is planning to pump that water and also pump an additional 14,600 acre feet. The additional water may mobilize the Evergreen UWCD and area residents to oppose this project.

Recommendation – The water could be very important in meeting demand in the future. SAWS should develop a strategy to try to obtain Evergreen UWCD and local landowner support. The effort should be built on the ability of the Carrizo to handle the pumping and the legality of the pumping.

Action Steps

1. Prepare the SAWS justification for use of additional Carrizo Aquifer water from Bexar County in terms of District 13 Desirable Future Conditions (DFC) and the Modeled Available Groundwater (MAG). SAWS should then present the arguments to the Evergreen UWCD. The EUWCD reaction will determine next steps.

2. Consider linking Bexar County Carrizo water use, brackish-groundwater desalination, and Aquifer Storage and Recovery action items to a single proposal to discuss with the Evergreen UWCD.

Medina Lake (BMA) Surface Water

Medina Lake is a high-risk water supply. The most obvious reason is the lake is sensitive to drought conditions to the degree that there is no water available for San Antonio's use at the present time. SAWS has decided to celebrate the value of all the water-supply projects inherited in the Bexar Metropolitan integration. The question needs to be raised as to whether these positive statements are backed up by documentable value.

Recommendation – SAWS officials have a contract to fulfill, but beyond that, an assessment as to the value of this water source in relation to the others available must be made. It is one thing to celebrate the value of a no-choice, inherited water-supply project with a take-or-pay contract, but it is more important a real value assessment be conducted.

Action Steps

1. Build on the risk rating provided in this water policy analysis for the Medina Lake surface-water source. This SAWS effort would determine its real value in the San Antonio water-supply package for the future.

2. The result of determining the value of the project to San Antonio will mean the next water plan will describe the water project's future, whether it be sold or abandoned at the first decision point in the existing contract, or be part of a plan to expand and/or extend its status as a San Antonio water-supply source.

Carrizo Groundwater (Gonzales County)

The project is high-risk because of the pipeline distance and local regulatory-agency involvement, but it is an example of success in saving San Antonio money through cooperation with other water purveyors. The Carrizo Aquifer supply source is less reactive to short-term droughts than the Edwards Aquifer, but its long-term future as a water source is unclear because of the involvement of so many water-short competitors for the water.

Recommendation – The authors recommend SAWS work closely with Schertz/Seguin Water Supply and the Gonzales County Underground Water Conservation District to maximize water use from the Carrizo Aquifer in Gonzales County while protecting the resource.

Action Step

1. Initiate discussions with the Schertz/Seguin Water Supply group to closely link SAWS Gonzales County Carrizo supplies to Schertz/Seguin supplies in dealings with the Gonzales County UWCD. The Schertz/Seguin Water Supply has more sympathy in the area and its project has less associated risk. The San Antonio project risk will be reduced if it is closely linked to the Schertz/Seguin supply.

Water Conservation

Water conservation is a low-risk water supply project. The supply is created within the boundaries of the city, the price is stable, the water is locally owned and no regulatory agencies are involved. San Antonio has a long history of water-conservation success. The water supply is created at a low cost by a combination of residential and commercial ratepayers without reducing economic activity or quality of life. The Water Management Plan in 2009 had dry-year goals of 126, which were reduced to 135 in the 2012 version of the plan.

Recommendation – There is inadequate justification to reduce water conservation goals. We recommend the goals reflected in the 2009 plan be restored.

Action Steps

1. Restore water-conservation goals to 126 GPCD to be accomplished at the rate of two GPCD/year in the next SAWS Water Management Plan.

2. Take advantage of the San Antonio reputation for water conservation success and leadership, elevating the campaign to celebrate that success through presentations, award nominations, etc. toward the goal of using the success, including as cost efficiency, to increase San Antonio influence in the legislature, with state agencies, and with the business sector in water issues.

3. Assemble the water conservation activities plan required to continue the two GPCD/year water-use reduction. Emphasize water conservation as a water-creation activity. Include the targeting of outside watering, peak-water-use reduction, and a compromise on irrigation policy that has been introduced by SAWS and discussed in this paper.

Special Note: Water Conservation Activities Will Not End in 2020 and the GPCD of 135 Will Not Be the End Goal.

The San Antonio Water System acknowledged that the GPCD goal of 135 gallons/person/day reflected in the 2012 Water Management Plan had already been achieved and more ambitious goals would be reflected in future water-management plans.

SAWS officials re-emphasized water conservation was a mainstay of its water-management efforts and that future versions of the Water Management Plan would reflect these efforts in more specific language.

Western Canyon Water

The Western Canyon water-supply source is Canyon Lake. This has been a relatively stable source of water for SAWS and the communities in northern Bexar, Comal, and Kendall counties. The project is determined to be a high-risk water-supply project because a lake is more susceptible to contamination than groundwater, the water price changes based on GBRA's independent calculations, the water is treated and relatively short-term contracts are involved. Also, SAWS has a responsibility to purchase the water supplies not needed by smaller cities until they need them in the future.

Recommendation – SAWS should review the value of the Canyon-region water-supply project in terms of long-term needs, along with the other small projects, but the advantages of a close, reliable, surface-water source as part of a cooperative arrangement with GBRA, Fair Oaks Ranch and other neighbors is desirable.

Action Steps

1. Build upon the risk rating in this water-policy analysis to produce a water-supply value index to rate water supplies not just in terms of risk but also in terms of

diversification issues (surface vs. groundwater, etc.), importance to San Antonio neighbors (dividends in legislature and other negotiations) and administrative demands.

2. Apply the rating to the Western Canyon and other small water-supply projects to determine their overall value to San Antonio water security. Use the determination to make decisions about keeping the water supplies at decision-making points in the various contracts.

Trinity Oliver Ranch

The Trinity Aquifer has been identified by state and regional sources as the most challenged water source in the area. Despite that label, it is considered a medium-risk supply because it is close, no treatment is required, and no endangered species are involved. But in addition to the unreliability of the Trinity Aquifer as a source, the number and nature of the contracts involved are a problem.

A number of San Antonio's neighbors rely on Trinity Aquifer water. The fact that SAWS controls a significant portion of the supplies and has a beneficial attitude towards the water source has benefited the city's neighbors. With SAWS in charge, the Trinity Aquifer supplies available to San Antonio are managed to maintain the resource and allow other Trinity Aquifer pumpers access to the limited water available.

Recommendation – Despite its rating as a medium-risk project, the limited firm yield and contract situation require SAWS review the source or the contracts producing the source as to their long-term desirability in the next water-management plan.

Action Steps

1. Build upon the risk rating in this water-policy analysis to produce a water-supply value index to rate water supplies not only in terms of risk but also in terms of diversification issues (surface vs. groundwater, etc.), importance to San Antonio neighbors (dividends in legislature and other negotiations) and administrative demands.

2. Apply the rating to the Trinity Oliver Ranch and other small water-supply projects to determine their overall value to San Antonio water security. Use the determination to make decisions about keeping the water supplies at decision-making points in the various contracts.

Lake Dunlap/Wells Ranch

This is one of the water-supply sources brought into SAWS by the merger with the Bexar Metropolitan Water District. The total water available may be as much as 11,250 acre feet from Lake Dunlap (via Canyon Lake) and Wells Ranch (Carrizo Aquifer). The Canyon Regional Water Authority treats the water. The project is rated as a high-risk water supply because of contract lengths, distance of sources from San Antonio and treatment required.

Recommendation – SAWS should assess this former Bexar Met water source for the long term in comparison to the other sources available.

Action Steps

1. Build upon the risk rating in this water policy analysis to produce a water-supply value index to rate water supplies not just in terms of risk, but also in terms of diversification issues (surface vs. groundwater, etc.), importance to San Antonio neighbors (dividends in legislature and other negotiations), and administrative demands.

2. Apply the rating to the Lake Dunlap/Wells Ranch and other small water supply projects to determine their overall value to San Antonio water security. Use the determination to make decisions about keeping the water supplies at decision-making points in the various contracts.

Water Supply and Demand, 2015-2060

Based on an analysis on supply and demand from 2015-2060 – see Figure 1A (i) on page 53 – there are two periods of water shortage for SAWS to consider.

The figures are constructed from population and water-demand data from the GPCD and Population Estimate sections in Appendix A on pages 97 and 100.

Figures 1A (i) and 1A (ii) on pages 53-54 show the percentage of the total San Antonio water supply each supply project provides in 2015 and 2060.

The most important point the pie charts illustrate is that despite strong statements in the 2012 Water Management Plan that action is being undertaken to diversify the San Antonio water supply, Edwards Aquifer water is still 67 percent of the supply in 2060. This percentage will potentially be reduced if new water-supply projects are identified to meet the supply deficits represented in Figure 1A (i) on page 48. The 2060 water-supply inventory does not include any of the projects where contract and dates have passed. The expectation would be that some contracts will be renegotiated or extended, but the 2012 Water Management Plan does not relate what the goal for existing short-term contracts will be.

Figure 1A (i) on page 53 illustrates several important points. The intersection of the demand-and-supply curves shows that a water-supply deficit will occur if drought-of-record conditions are experienced on or about 2041 if the GPCD is 126. If the GPCD is 135, as it would be under the water-conservation conditions described in the SAWS 2012 Water Management Plan, the deficit shows up on or about 2038.

Special Note – Water Supply Gaps and the Dependence on Edwards Aquifer Water

Figure 1A (iii) on page 54 reflects water supplies available during a normal rainfall year in 2060. The dominance of Edwards Aquifer water results because the total water source used in compiling the figure does not include water sources that are contracted for set periods, and no strong statements were made in the SAWS 2012 Water Management Plan that the contracted water projects would be extended further. The length of the existing contracts and available extensions are listed in the individual water-supply descriptions.

Twin Oaks Aquifer Storage and Recovery is not included in Figure 1A (iii) because it reflects water supplies that are available or utilized during normal rainfall years. The water stored in the Twin Oaks ASR is a supply designated for use in drought conditions. If ASR water is to be available for drought situations it cannot be used as a supply during years with normal rainfall. The ASR is more likely to be used to store Edwards Aquifer water during a normal year than it is to be providing water supplies.

In a review of the draft conclusions presented by this Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses, San Antonio Water System questioned the conclusion that Vista Ridge Water would not be available in 2060. Representatives acknowledged the 2012 Water Management Plan did not emphasize that the project would continue in operation after the initial 30-year contract period, but they provided a copy of a presentation by the SAWS CEO which

related plans to assume ownership of the infrastructure and relationships with the landowners with the water rights after the initial 30-year period. The PowerPoint presentation even went as far as to declare that the water-rights owners' payments would be increased to a 50-percent share when SAWS assumed the responsibility for the project.

If the 50,000 acre feet of water provided by the Vista Ridge Water Supply Project continues after 2050 through 2080, this would reduce the portion of the total supply provided by the Edwards Aquifer from 67 to 60 percent of the total supply.

It would also add 50,000 acre feet of supply to the supply available in drought of record and normal conditions by 50,000 acre feet. The additional water would move the point of insufficient supply available for drought-of-record conditions to about 2050, and to 2060 for normal conditions. The inadequate supply point would also depend on the GPCD achieved.

Sources of Information on the Legislation:

- House Research Organization bill analysis, 5-7/2015. http://www.hro.house.state.tx.us
- CGISCAN TXHB200, 2015-2016, 84th Legislature, 84® HB200-Enrolled version. http://www.legis.state.x.us/tlodocs/84R/billt
- HB655 House Research Organization. 4/21/15. http://www.hro.house.state.tx.us/pdf/ba84r/1
- HB1248/SB854. 4/15/2015. http://www.rcgcd.org/allbillsbysubject.pdf.

With normal rainfall, the water-supply deficit appears on or about 2050.

Figure 1A (i). Supply and Demand with MPO Population (2015-2060)

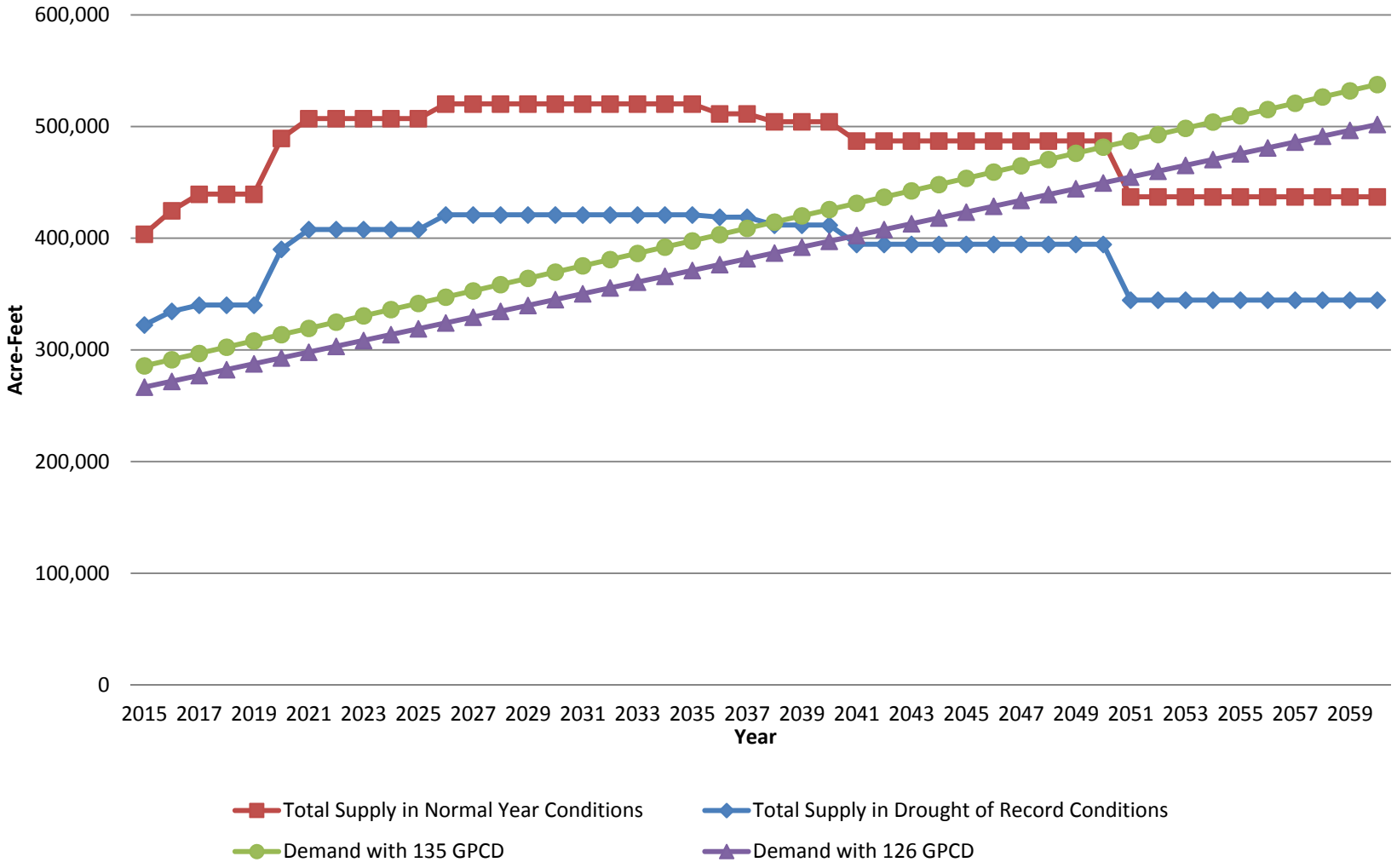


Figure 1A (ii). Total Water Supply for Normal Year 2015

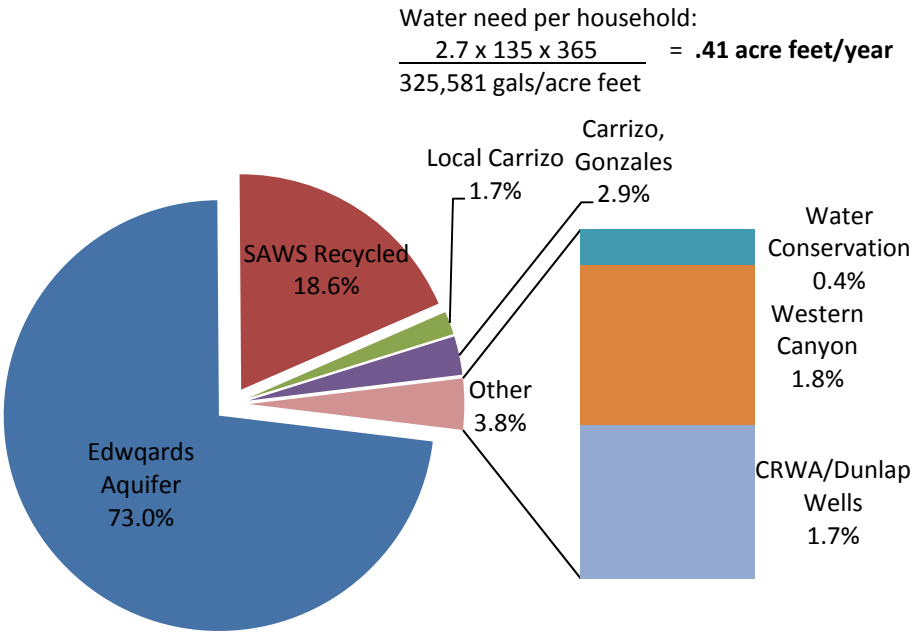
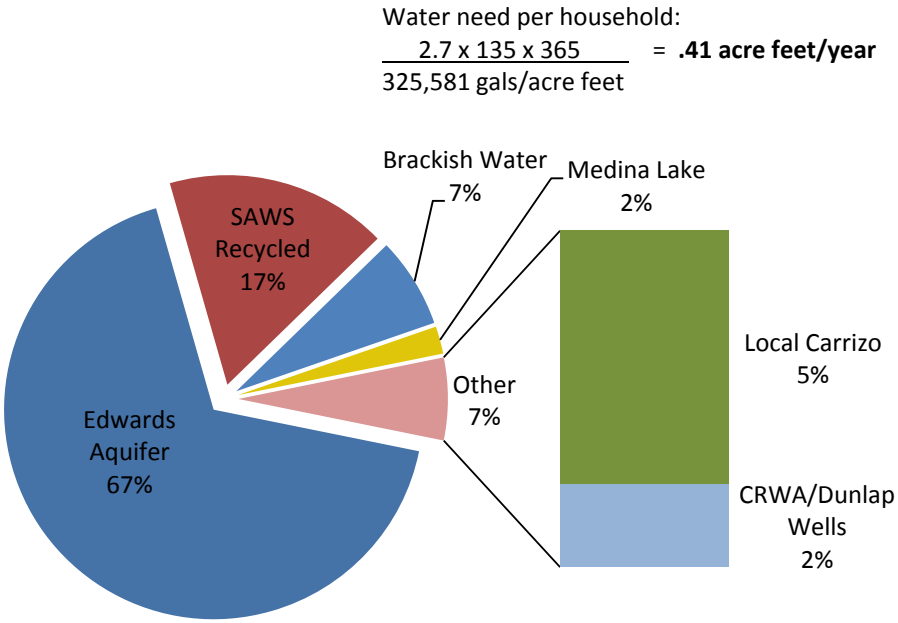


Figure 1A (iii): Total Water Supply for Normal Year 2060



Identified State Legislation and Local Ordinance Opportunities

1. Legislation to move the responsibility for brackish-groundwater regulation and permitting to TCEQ. This would recognize that development of the resource is a state priority and a segmented permitting process that results from local groundwater conservation district jurisdiction does not encourage water purveyors to make the large investments necessary to pump and treat brackish groundwater.

2. Legislation to lengthen the time between granting a permit for groundwater supply development and renewal of that permit. Renewal every five years by local groundwater districts is not enough time to encourage water purveyors to make the commitment of resources necessary to develop a water-supply project. The potential to lose a permit after five years is a disincentive for water-supply investments.

3. Consideration of a San Antonio ordinance change to remove the reward of relaxed EARZ development rules for areas annexed into the city jurisdiction.

4. Consideration of an ordinance change to join Austin in banning use of coal-tar sealants within the ETJ. Research results and arguments on both sides of the issue have been identified.

5. Legislation to allow and initiate required action over the expanded area of the contributing zone.

Special Note: New Legislation in 2015

Late in the 2015 legislative session, after this Water Policy Analyses report was drafted, legislation addressing some of the opportunities listed above and other important water-related issues was passed.

HB 30 did not move responsibility for permitting of brackish groundwater to a state agency, such as the Texas Commission of Environmental Quality, as suggested in the analyses, but it did direct Regional Planning Regions and Texas Water Development Board to identify zones in specific parts of the state, including the Carrizo-Wilcox Aquifer, where brackish water appears to be a potential water source.

HB 200 provides the opportunity for entities to appeal Desirable Future Condition (DFC) decisions by a Groundwater Conservation District. The legislation requires the DFC decision be backed up by appropriate science. The Texas Water Development Board is charged with the responsibility to complete the study in response to the appellant's petition.

HB 1248 allows for automatic renewal of groundwater permits every five years by a groundwater conservation district, unless said district has grounds and can defend the decision to deny the permit extension

HB 655 addresses issues in the use of Aquifer Storage and Recovery as a water storage facility. The Texas Commission on Environmental Quality is charged with responsibility for surface-water permitting, but no separate beneficial use beyond ASR storage must be declared.

Groundwater conservation districts have responsibility for permitting injection and retrieval wells, but charges may only be assessed for water amounts retrieved beyond that amount injected.

Water Planning and Water Management Grades

Grades	
A	Exemplary, recognized as leading example, and accomplishes goals for effort
B	Effective, recognized in accomplishing goal for effort, but not necessarily exemplary, lacking in one area.
C	Seems to be accepted by local ratepayers without any special recognition outside. Meets goals, but not exemplary or effective.
D	Does not meet goals and effort to correct not adequate.
F	Failure to meet goals and no effort to address or correct.

Water Planning

Population Estimates – D

The lack of agreement between the estimates used in the 2012 Water Plan and the figures used by the City of San Antonio Planning and Community Development Department is a problem. If SAWS' more conservative estimates are not correct, a water shortage could occur as soon as 2040 if drought-of-record conditions occur.

GPCD Demand Management – C

The plans reflected in the 2012 Water Plan are less ambitious than those presented in 2009, without strong justification for the retreat.

Public Input – A

Stakeholder input is a major positive characteristic of City of San Antonio water policy. The effort to seek and utilize public input is time-consuming and demanding, but results prove its worth. This study did not discover anything to predict any retreat from that excellent performance.

Climate Change – D

The SAWS 2012 Water Management Plan does not refer to climate change or take into account any possible impacts on water demand or supply. It has to be addressed in the next water management plan.

Water Management

Drought Management – A

The combination of public communication, education, and enforcement of drought-management tactics that rely on reducing landscape water usage continues to be very effective.

Lost/Non-revenue Water – D

SAWS has been slow to respond to an increasing rate of lost and non-revenue water. The rate is too high, the causes are not all identified and action to correct the causes has been slow.

Edwards Aquifer Habitat Conservation Plan – A

The achievement of a HCP plan and Incidental Take Permit is an important accomplishment for the City of San Antonio and the region. San Antonio provided important leadership in this process.

Bexar Metropolitan Integration – A

SAWS did an excellent job managing the consolidation of Bexar Met into the system. The process was transparent, encouraged public comment, and protected both Bexar Met and SAWS' customer interests.

City of San Antonio as a Water Neighbor – B

The change in SAWS' dealings with its neighbors, as reflected by the Schertz/Seguin shared pipeline, Canyon Lake agreement, reduced pumping of the Trinity Aquifer and the leadership role played in the Edwards Aquifer Habitat Conservation Plan, merits a high grade.

Water Quality

Edwards Aquifer Protection Program – A

The citizens of San Antonio have shown foresight and understanding of how the Edwards Aquifer works in their willingness to pay for the exemplary conservation-easement program through sales-tax revenues.

Regulation of Development Activities over EARZ and Contributing Zones – C

The rules for development over the Edwards Aquifer Recharge Zone are in place, but significant work needs to be done to regulate development to protect water quality of runoff. The conservation-easement program and the watershed-protection planning that exists are a good start.

Low-Impact Development (LID) – C

The SARA-guided effort is attempting to arrive at a "formula" for LID that will encourage wider use of its techniques in protecting water resources in the non-recharge zone portions of the greater San Antonio area. The effort involves an offering of an admirable array of resources and involvement by San Antonio-area local governments, but has not yet made an impact on development choices.

Coal-Tar Sealant – B

Imposing a coal-tar sealant ban is not a simple issue. The process of consideration should be thoughtful.

Annexation and Extension of Water Infrastructure – C

This is another complex issue that affects water quality. There is political pressure to act, but the process needs to be reviewed in terms of its impact on water-quality issues.

Regulatory Agencies

Texas Water Development Board (TWDB) – B

SAWS is involved in TWDB programming and utilizes available resources in its water-supply project development.

TCEQ and EPA – D

The Texas Commission on Environmental Quality inclination not to seek new responsibility and conflict with the Environmental Protection Agency may result in threats to the San Antonio water supply that must be monitored and addressed before they create a problem.

Edwards Aquifer Authority – B

The EAA works closely with SAWS and other Edwards Aquifer pumpers. The best example is the important EAHCP and the resultant Incidental Take Permit. It would be a great accomplishment to negotiate an agreement to the LULAC lawsuit.

Local Regulatory Agencies – C

It has been difficult at times because of the inclination of the groundwater districts to oppose regional water sharing, but due to SAWS' persistence, the results have been successful.

Water Costs

Water Project Costs – B
There is an opportunity for SAWS to provide more information in the Water Management Plan and cost assignments are relatively easy to review and compare.

Texas Water Rate Structures, Residential – B

SAWS rates are relatively low, population growth is occurring, water-conservation efforts are successful and the bills are paid, so the rates and the process to review and determine them appear successful.

Commercial and Industrial Water Rate Structures – B

The story for commercial rates is similar to that of residential rates. Economic development is continuing at a fast rate.

Impact Fees – B

The discussion on the topic was energetic and resulted in a compromise that shares development costs between project developers and existing ratepayers. Economic development and population growth continue at a fast rate. Impact fees are effective in paying for the costs of infrastructure.

APPENDIX A: CITY OF SAN ANTONIO

Water Supply Projects

1. Edwards Aquifer Groundwater			Rating
Amount of Water:	Total Water	294,530 acre feet	
	Owned	249,254 acre feet	
	Lease 10 years	45,250 acre feet	
	Sought	10,900 acre feet more [1]	
Cost of Water:		$331/acre foot (when no restrictions)	
		$541/acre foot (during drought management) [2]	
Cost Stability:	Active Water Market		(0)
Ownership State of Water:	85% Permanent 15% Leased		(-)
Length of Contract:	Varies 1-10 years		(0)
Distance of Source from San Antonio:	Confined zone where wells are located; is in San Antonio		(-)
Endangered or Threatened Species Issue:	8 species at Comal and San Marcos Springs are addressed with the Edwards Aquifer Habitat Conservation Plan		(+)
	Whooping crane habitat is related to environmental flows down Guadalupe and San Antonio Rivers		
	At least three mussels are listed as endangered or threatened in the Guadalupe River		
	Three beetles exist in karst formations in Bexar County and surrounding areas		
Treatment Required:	Only chlorine		(-)

Contamination Threat:	Development over the Edwards Aquifer Recharge Zone, and Edwards is a fast-recharge aquifer.	(+)
Drought Restrictions: (Drought Sensitivity)	Yes, 5 stages up to 44% reduction based on aquifer level at Monitoring Well 17 and spring-flow rates at Comal and San Marcos Springs.	(+)
Regulatory Agencies Involved:	Edwards Aquifer; San Antonio is represented on the EAA Board.	(-)
Other Issues:	Dependence on the Edwards Aquifer as the primary source of water	(0)
Rating:	4	(-)
	3	(+)
Total:	-1	Low Risk

Edwards Aquifer Groundwater

According to the 2012 SAWS Water Plan, the Edwards Aquifer provided 46 percent of the San Antonio Water System supply in 2012 and will provide 33 percent of the supply in 2030, as SAWS proceeds with the plan to diversify its water supply and decrease dependence on the Edwards Aquifer.[3]

The water from the aquifer is pumped from 92 wells within the city limits of San Antonio with an average depth of 1,500 feet and pumping capability of 16,000 gallons/minute.[4]

Edwards Aquifer water is potable as pumped. The only treatment required is chlorine.

The aquifer is a karst (limestone) structure so the water has high levels of calcium, magnesium and other minerals (averages 250-350 TDS). The pH is approximately 7.3.[5]

Recharge of the Edwards Aquifer occurs quickly in response to rainfall over the collection and recharge zones through recharge features that open at the surface and carry water into the aquifer. The average recharge from 1934 through 2011 was 676,000 acre feet/year.[6]

The water in the aquifer generally flows from the west to the northeast.[7] Aquifer levels above 618 feet mean sea level (MSL) at Monitoring Well #17 result in spring flow at Comal Springs in New Braunfels and San Marcos Springs in San Marcos.[8]

The Comal and San Marcos Springs are an important part of the San Antonio use of Edwards Aquifer as a water source. Protection of endangered species unique to the springs limits available water use. Flow from the springs into the Guadalupe River is also an important water source for downstream agriculture and communities, such as Victoria. The Guadalupe River also provides habitat for endangered mussels and water for San Antonio Bay, the habitat of the whooping crane.

The Edwards Aquifer Habitat Conservation Program (EAHCP) addresses protection of the species at Comal and) Springs, but protection of the other species is still unresolved. A decision on the lawsuit brought by the Aransas Project in June of 2014 determined the level of water represented by water rights in the Guadalupe River did not threaten the whooping cranes. The decision affects City of San Antonio water supplies because spring flow from the Comal and San Marcos Springs is a major part of Guadalupe-Blanco river Authority (GBRA) water flow.[9] Levels of spring flow are affected by Edwards Aquifer levels.

The Edwards Aquifer Authority (EAA) is charged with regulation of water use from the Edwards Aquifer. Senate Bill 3 established that 572,000 acre feet of permits would be available from the aquifer. In 2000, the permits were roughly divided between agriculture, municipalities and industry in the proportion of 40 percent, 49 percent and 11 percent over the portions of seven counties in the EAA jurisdiction. In 2014, the proportion has changed to 30 percent for agriculture, 62 percent for municipal water users, and 8 percent for industrial users. The San Antonio Water System is the largest pumper, with 294,530 acre feet of permits (249,254 acre feet owned and 42,250 acre feet leased)[10]

San Antonio increased its Edwards water holdings through purchases and leases obtained in the active Edwards Aquifer water market.

According to the 2012 Water Management Plan, SAWS' goal is eventually to achieve ownership of 10,900 more acre feet of Edwards Aquifer water. Once the amounts are reached, the quest for more Edwards water will end and the diversification of SAWS water resources will accelerate.[11]

Significant Issues

There are a number of significant issues involved with use of the Edwards Aquifer as a water source.

The City of San Antonio is dependent on the Edwards Aquifer as its main source of water. The 2012 Water Management Plan indicates dependence will be reduced from 78 percent in 2012 to 30 percent in 2040.

Edwards Aquifer levels are volatile. They increase and fall in seasonal and longer patterns. The aquifer levels affect spring flow in the Comal and San Marcos Springs, on which a number of endangered species rely. The species' survival is protected by drought restrictions that reduce pumping by as much as 44 percent, as well as a habitat-conservation plan of ambitious management activities.

There is significant pressure for development over the recharge zone that increases the chance of contamination. Citizens of San Antonio have been willing to use tax dollars for conservation easements and Edwards Aquifer Recharge Zone (EARZ) development restrictions exist in most areas. It is a worthy pursuit to extend these EARZ restrictions to Shavano Park, Helotes, Hollywood Park and other jurisdictions not currently regulated. Contamination over one part of the recharge zone could affect the rest of the aquifer and, consequently, San Antonio's water supplies from the aquifer.

2. SAWS Recycled Water		Rating
Amount of Water:	125,000 acre foot [1]	
Cost of Water:	$319/acre foot [2]	
Cost Stability:	Internal costs and power costs	(-)
Ownership State of Water:	Direct Reuse, Owned	(-)
Length of Contract:	Contracts with recycled water users	(0)
Distance of Source from San Antonio:	The treatment plant is 22 miles south of SA. There is a complete ring (130 miles) of purple pipe for distribution.[3]	(0)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Primary, secondary and chlorine	(+)
Contamination Threat:	Very secure, no storage	(-)
Drought Restrictions: (Drought Sensitivity)	Steady source because it relies on indoor and commercial water use	(-)
Regulatory Agencies Involved:	TCEQ, City of SA input to regulatory agency (TCEQ is a state agency).	(0)
Other Issues:	Public aversion to using the water over the recharge zone is limiting Peak use on landscapes is an inefficiency Environmental flows for San Antonio River	(0)
Rating:	5 1	(-) (+)
Total:	-4	Low Risk

Recycled Water

The City of San Antonio Recycled Water Program is the largest direct-recycled program in the United States.[4] Direct recycling means that the untreated and treated water never leave a SAWS pipeline or treatment plant until provided to the end user. Indirect-reuse water is water transported or stored in a surface water river or lake.

SAWS effluent flows have averaged 140,425 acre feet for over 20 years with no increase in that period.[5] Of that total effluent flow, the Recycled Water Program balance is 125,000 acre feet.[6] This is water available for reuse.

The majority of the water is used for environmental flows down the San Antonio River (50,000 acre feet) and CPS Energy power production (50,000 acre feet).

As Table 1A reveals, the contracted recycled-water program to golf courses, institution landscapes, and manufacturing makes up only about 10 percent of the total. Approximately 12,000 acre feet of water in this category are still available.

The SAWS recycled water program is not a simple water-supply source to analyze. Since recycled water is counted as conserved water rather than potable water, it is not calculated as part of the GPCD (gallons/capita/day). Depending on what part of the recycled water is counted, it saves a significant amount of potable water. If the 12,999 acre feet used by ratepayers is counted, it reduces the average GPCD about 6.5 percent (estimated total water use equals 200,000 acre feet). Include average use of recycled water by CPS Energy (CPS), the municipal power company, in its power production as industrial water, and the reduction of GPCD due to recycled water use is over 20 percent (38,089 acre feet, average use by CPS and the 12,999 acre feet). The environmental flow water would not be calculated as part of GPCD.[7]

Early in the history of the recycled-water program it was a hard sell to encourage customers to replace potable water with recycled water. As a result, pioneer customers benefitted the most with low rates and flexible contracts. CPS Energy received an especially good deal in terms of price and was given the option to increase its access to the water source.[8]

In recent years, customers have recognized the advantages of access to reuse water in terms of low cost and avoidance of drought restrictions. In addition to the price advantages and less restrictive drought restrictions, SAWS provided many contracted customers a cost-share rebate of $500/acre foot for every acre foot of potable water that was replaced over 10 years. The cost differential between potable water and reuse water has been reduced, and SAWS no longer subsidizes the conversion to reuse water.[9]

SAWS is also giving preference to water customers using a steady amount of reuse water vs. those using the water only in the summer for landscapes.

Significant Issues

SAWS and its customers reassessed the value of reuse water. In addition to the policy changes concerning its distribution, SAWS made a major statement in recognition of the

value of reuse water in 2014. The water purveyor applied for a beds-and-banks permit with the Texas Commission on Environmental Quality (TCEQ) that would allow it eventually to treat any water in excess of environmental flows and use it in its reuse system. The filing estimated the available water to be 211,000 acre feet after 50,000 acre feet was reserved for environmental flows.[10]

The request was supported by the San Antonio River Authority (SARA) in recognition that it reserves environmental-flow levels in compliance with the findings of the 1988 City of San Antonio Regional Water Resources Plan.[11]

The Guadalupe-Blanco River Authority (GBRA), however, opposes the permit request. Such a permit would potentially reduce flow from the San Antonio River into the Guadalupe River just before it flows into San Antonio Bay. The GBRA is counting on the flow to be much larger than just the required flows from the San Antonio River. If the larger flows are available, the GBRA can more fully utilize Guadalupe River water for municipal, power and agricultural supplies.[12]

It appears at this writing that the Texas Commission on Environmental Quality (TCEQ) will reject SAWS' Indirect Reuse permit request. A TCEQ official has stated the agency is not inclined to grant permits for indirect water reuse unless specific projects have been identified for its use.[13]

The agreement recruiting CPS Energy to base its electric-generation cooling on the use of recycled water was good for CPS, SAWS, and ratepayers of both organizations. The commitment of funding from CPS helped justify expenditure of capital costs early in the recycled-water program when there were questions about its viability and cost.

CPS, therefore, has access to an inexpensive water source in times when Edwards Aquifer and surface water are increasingly more valuable and regulated.

Recent developments in the CPS power-production line-up may also allow a review of its needs. As CPS closes coal-burning plants in favor of less water-hungry natural gas plants, the recycled water need may change.[14]

In addition to the 12,001 acre feet currently available for consumptive uses, only 38,089 acre feet per year (AFY) on average are used by CPS and 7,661 AFY by the contracted sources in manufacturing, landscapes, and golf courses.[15]

If San Antonio is going to have access to its future new efficient flows, it seems important to maximize use of the supplies currently available and begin planning development of infrastructure and uses for these future supplies.

The apparent disinclination by TCEQ to allow SAWS to "reserve" its future effluent flows does not prevent the water purveyor from using the water as it is available in its existing and an expanded direct-recycling program. The current infrastructure has the capability of distributing the 12,001 acre feet currently available.

Table 1A.
Recycled Water Contract Volumes December 23, 2014

Effluent flows have not increased in more than 20 years.

- 10-year average flow = 140,425 acre feet per year (AFY)

Current minimum planning yield = 125,000 AFY

Water Balance

Recycled water program supply Distribution capacity 35,000 AFY	25,000 AFY
Downstream releases	50,000 AFY
CPS Energy contracted volume	50,000 AFY
Total from water recycling centers – program water balance	125,000 AFY

Recycled Water Customers

	Contract Volumes AFY
Recycled water program supply 25,000 AFY	
Recycled water customers	12,999 AFY
• Golf courses 3,166 AFY	
• Irrigation & landscape 3,517 AFY	
• Industrial & mixed use 6,316 AFY	
River Walk & Salado Creek *	5,823 AFY
	(5,823 AFY)
*River Walk & Salado Creek - Note this flow is considered part of the downstream release and occupies capacity in the distribution system but is available for contracted consumptive use.	
Available volume	12,001 AFY
Recycled water program supply	25,000 AFY

Source – Thompson, 2014[16]

3. Vista Ridge Water Project		Rating
Amount of Water:	Total Water 50,000 acre feet Delivery Begins 2020	
Cost of Water:	$3.4 billion for 30 years $2,300/acre foot	
Cost Stability:	High costs but stable [1]	(0)
Ownership State of Water:	Contracted water	(+)
Length of Contract:	Length of agreement 30 years and then SAWS assumes ownership of pipelines [2]	(+)
Distance of Source from San Antonio:	• 142 miles • Carrizo Aquifer in Burleson County • 3,400 leases with landowners	(++)
Endangered or Threatened Species Issue:	The pipeline route will pass through some karst caves area, but endangered species will not be a major issue.	(-)
Treatment Required:	Yes, treated by contractor	(+)
Contamination Threat:	Slow to recharge Carrizo Aquifer	(-)
Drought Restrictions: (Drought Sensitivity)	No	(-)
Regulatory Agencies Involved:	Local groundwater districts without San Antonio representation	(+)
Other Issues:	Junk bond status of Abengoa Water, the main contractor, adds risk [3]	(+)
	Using rural water source may encourage belief that San Antonio is not a good regional partner.[4]	0
Rating:	3	(-)
	7	(+)
Total:	+4	High Risk

Vista Ridge

The Vista Ridge Water Project is different from typical SAWS water projects in several ways.

The most unique characteristic is the project's relationship to the water purveyor. The contract was obtained through a request-for-proposal process that sought a turnkey water source. The San Antonio Water System (SAWS) will pay for the water delivered to its border as outlined in the negotiated specifications.[5]

The water leases, permitting, treatment and pipeline construction are the responsibility of the contractor, which in this case, is the Spanish conglomerate, Abengoa, and an Austin-centered firm, Blue Waters Limited.[6]

Delivery begins in 2020 and, after 30 years, the pipeline and treatment plants become SAWS property. The leases also end after 30 years, which will be an issue if SAWS plans to use the project for a water source beyond the current contract period.[7]

Among the issues to be considered for the Vista Ridge project:

1. It will require that SAWS increase water rates by 16 percent.[8]
2. The project will begin delivering water in 2020. At that time, it appears SAWS will have a surplus of water.
3. The contract with Blue Water/Abengoa is for 30 years. After 30 years, SAWS assumes ownership of the project infrastructure. Technically, however, the leases and permits will end.

Advocates for the project say these issues listed can be handled and the availability of this water will make a large difference to the city in encouraging economic and population expansion. They mention selling excess water to communities along the pipeline route.[9]

Advocates of the project have also taken the initiative in assuring the successful San Antonio water-conservation program will not be reduced despite the fact SAWS will be in a surplus water situation for several years.[10] For critics of the project and even project supporters, it seems hard to imagine SAWS ratepayers will understand a 16 percent-plus rate increase if the "plus" relates to unsold water from the Vista Ridge project due to conservation efforts by SAWS ratepayers, especially when continuation of the conservation efforts requires funding.[11]

Critics have also questioned whether the Vista Ridge project is another example of SAWS and the City of San Antonio reverting to an insensitive mode with regard to their roles in the region. The Vista Ridge project could well be perceived as San Antonio ignoring the interests of its rural neighbors to obtain more water for its own growth, and stifling the future of the Burleson/Lee County area so there is water for new San Antonians to water their lawns.[12]

Significant Issues

1. Selling Water along the Vista Ridge Pipeline

If a water-marketing firm were going to select a prime area to sell excess water supply, the proposed route of the Vista Ridge pipeline would be one of the most desirable areas available. It roughly follows Interstate 35 between Georgetown and San Antonio to include Round Rock, Austin, Kyle, San Marcos and New Braunfels – arguably the highest-growth corridor in Texas. The Region L and Region K Regional Water Plans identify growing water demand in the area and supply projects that compete for inadequate available supplies to meet their needs.[13]

Although the initial exploration for potential purchasers of temporarily surplus water supplies for the Vista Ridge project along the I-35 corridor has not identified likely purchases, it seems a reasonable strategy if selling excess water is a goal.[14]

2. Funding Both Water Conservation and the Vista Ridge Project

Claims by Vista Ridge advocates that both aggressive water-conservation goals and the Vista Ridge water project can and will be funded simultaneously are going to be hard to justify to ratepayers.

If the effort were described as it is represented in the 2012 version of the SAWS Water Plan, it would be more realistic. This plan, coincidentally, only calls for water-conservation programming that reduces per-capita water use until 2020. Further, the plan only identifies a goal of 135 GPCD to be achieved for dry-year demand by 2020.[15] This is hardly an ambitious goal when the GPCD was 124 in 2012, 126 in 2013 and 124 in 2014.[16]

An increase of the goal of 135 GPCD is warranted if the 2012 Water Plan is to be the representation of an “aggressive pursuit of water conservation.”

3. Abengoa Financial Situation

Advocates for the RFP process that resulted in the selection of the Blue Water/Abengoa proposal identified one of its most important points as being that the contractor assume all risk. If any of the important parts of this project fails, the responsibility and cost fall to the contractors.

The most desirable partner in this case would be a financially strong contractor capable of correcting failed parts, and refinancing, as necessary, with full confidence of creditors. Abengoa, apparently, is not in the category of exceptionally strong financial corporations. An article in the *San Antonio Express News* noted Abengoa is highly leveraged and carries a bond rating that is well into “junk” territory.[17]

In the same article, SAWS CFO Doug Evanson said SAWS was keeping track of the Abengoa financial status, but there was no assessment as to what SAWS would do if Abengoa failed or if the junk-bond status resulted in very high interest rates for financing. This issue merits concern and in-depth analysis to determine how much cost and risk it adds to the project.

4. San Antonio Role In The Region

It is difficult to weigh the interests of rural areas that have demand for more water resources. In Texas, local regulatory entities and market forces largely determine if water can be moved from areas of plenty to areas of need. Local groundwater conservation districts are created to regulate groundwater use and offer permits for that use. Landowners own the water under their land and may sell it.
This is what happened in the case of Vista Ridge.[18] The actual owners of the water have leased access to it for a period of time and permits have been obtained for transport of that water.

San Antonio's role in the Vista Ridge project is not heavy-handed. Local landowners have leased their water for use in the project and the local regulatory agency has granted the permits.

In response to an inquiry concerning the quote, SAWS CFO Doug Evanson offered the following responses.[19]

1. There is always risk in water-project development and implementation. The Vista Ridge Project is different from traditional water projects where the water purveyor assumes all risk, but SAWS did attempt to think through every nuance.[20]

2. Abengoa is one of many firms that operates in the realm of junk-bond status. It is currently rated at various level of a B credit rating by Moody's and other rating entities, but it is rated as "stable" and the stock prices have doubled from $9.14/share in November 2014 to $18.93 in April 2015.[21]

3. The financing for the Vista Ridge project will include $100 million of Abengoa funds but the rest of the $700 million package will be bond money raised as part of a separate package relatively independent of Abengoa. Bondholders will be more interested in SAWS' outstanding credit rating and the fact that the bills will be paid for actual water made available with O+M funds. The primary question prospective bond investors will ask is whether the water is available?[22]

4. The provisions of the Vista Ridge agreement offer SAWS options to take over the project. Depending on the amount of water available, takeover provisions may require equity costs but, at 35,000 acre feet/year, CFO Evanson said it would involve just debt assumption. SAWS could also leave the program if it were in its best interests because the provisions were not being fulfilled.[23]

4. Brackish Groundwater			Rating
Amount of Water:	Phase 1 Phase 2 Phase 3	12,210 acre feet 12,210 acre feet 6,105 (30,525 acre feet total) [1]	
Cost of Water:	After Phase 3	$1,138/acre foot	
Cost Stability:	Power costs may fluctuate [2]		(0)
Ownership State of Water:	Phase 1-2016 Phase 2-2021* Phase 3-2026* Yes, Owned [3]		(-)
Length of Contract:	N/A		
Distance of Source from San Antonio:	22 miles		(0)
Endangered or Threatened Species Issue:	None		(-)
Treatment Required:	Reverse osmosis and high power requirements		(+)
Contamination Threat:	Not vulnerable		(-)
Drought Restrictions: (Drought Sensitivity)	None		(-)
Regulatory Agencies Involved:	TCEQ, Wilson County and Evergreen Underground Water Conservation District, San Antonio has no representation on the Evergreen UWCD. TCEQ is a state agency.		(+)
Other Issues:	The concentrate must be disposed of in an environmentally appropriate manner.		(+)

	Disposal wells are planned in Wilson County into the brackish Edwards Aquifer.[4]	
Rating:	4	(-)
	3	(+)
Total:	-1	Low Risk

Brackish Groundwater

The Brackish Groundwater Desalination Program utilizes water with between 1,300 and 1,500 mg/L total dissolved solids (TDS) to produce potable water through use of a reverse osmosis treatment process. The technology uses large amounts of electricity to force the brackish water through filters that remove all but 150 mg/L TDS from the new water. The process produces a concentrate equal to about 10 percent of the total water treated with a concentration of approximate 10,000 TDS water.[5]

The concentrate is injected into the brackish Edwards zone in Wilson County. The water in that part of the aquifer is approximately 30,000 TDS.[6]

Among the advantages of using brackish groundwater is that large quantities are available in the area. Because of the depth of the wells and the technology required to use brackish water, it is not in high demand. The San Antonio Water System (SAWS) is one of the few entities in the area with the financial capability to utilize this water source. Capital costs of an estimated $411.4 million will be required to develop the infrastructure for the project.[7]

Despite the high cost and seeming lack of interest in brackish groundwater early in the process, an opposition developed strong enough to force the Evergreen Underground Water Conservation District's (EUWCD) originally supportive regulations to change and become more restrictive. The opposition, largely centered in Atascosa County, also helped motivate SAWS to abandon its regional brackish project for a more Bexar County-centered project.[8]

The opposition referred to the needs of future generations in the EUWCD area and reflected the anti-big-city attitude increasingly common in rural areas adjacent to big cities short of water resources.[9]

One of the management issues with brackish groundwater desalination is that the operations work best when production is relatively steady. If the desalination plant at Twin Oaks must produce 1,018 acre feet/month (12,210 acre feet/year) for maximum efficiency in Phase 1, it must also be able to distribute that 1,018 acre feet to SAWS customers every month.[10]

There are several limiting factors in addressing this requirement:

- Winter demand is an issue. With various water supplies available, it will not always be easy to find users for all water produced.

- Of even more concern is the fact that the current distribution situation relies on a single pipeline that has a 60-million gallon capacity but can only be used in one direction at a time. The SAWS Water Plan calls for the completion of a second pipeline from Twin Oaks in 2016. The pipeline will be approximately 45 miles long from the Twin Oaks facility to the Anderson pump station at Hwy 151 and 1604. This will give the system more flexibility. In an extreme case, treated brackish groundwater could be pumped north for ratepayer use while Edwards water could be pumped south for storage in the ASR.[11]

Significant Issues

The brackish-groundwater desalination project is important to the City of San Antonio for many reasons:

1. It will eventually provide up to 30,505 acre feet of new water for city use.

2. Just 10 years ago, the projected price sounded high, but with the addition of the Vista Ridge water-supply project and other high-cost projects, these costs look more moderate.

3. The project uses a water supply that is very large and not likely to be tapped by other water users.

4. The project is another example of San Antonio leading the way in utilizing water supplies and technologies identified as important to all Texans. It joins ASR, recycled water, water conservation and drought management in that category.

5. Brackish-water supplies are so large in the area, and experience with the technology gained from this project may be useful for future utilization of the resource.

The completion of the western pipeline will help make the brackish water supply a more viable water project for San Antonio's future needs. A second action that would contribute further to the importance of the treated brackish supply would be if this water could be stored in the ASR along with Edwards Aquifer water. This would mean treated brackish water would be stored when demand from SAWS ratepayers is low, and available for use when demand is high.

5. SAWS Twin Oaks Aquifer Storage and Recovery			Rating
Amount of Water:	Current	68,000 acre feet	
	Capacity	120,000 acre feet [1]	
Cost of Water:	Edwards Water Costs of≈$400/acre foot for the water and an extra $110/acre foot net recovery costs		
	Current	$510[2]	
Cost Stability:	Relatively stable		(-)
Ownership State of Water:	Permanent		(-)
Length of Contract:	N/A		
Distance of Source from San Antonio:	Confined zone where Edwards Aquifer wells are located is in San Antonio. Injection wells are 22 miles south of the city		(-)
Endangered or Threatened Species Issue:	None		(-)
Treatment Required:	None		(-)
Contamination Threat:	Limited		(0)
Drought Restrictions: (Drought Sensitivity)	The current supplies are available in a drought, but it is more difficult to refill ASR in drought.		(0)
Regulatory Agencies Involved:	Agreement with Evergreen Underground Water Conservation District, permit with TCEQ		(0)
	No representation on Evergreen, but it does not have jurisdiction in ASR area		
Other Issues:	• ASR is an underground storage facility not an original source.		

		• The ASR must be filled in times of low demand from Edwards to be used in times of high demand.	(+)
		• At the present there is only a single pipeline that must be used for both directions.	(+)
Rating:	4		(-)
	2		(+)
Total:	-2		Low Risk

SAWS Twin Oaks ASR

The San Antonio Water System's Twin Oaks Aquifer Storage and Recovery facility is located in the far southern tip of Bexar County. The basic operation is to inject chlorinated water from the Edwards Aquifer when demand is low into the Carrizo Aquifer for storage. Water can then be recovered from the same 29 injection wells for use by San Antonio businesses and homes when demand is high.[3]
Conditions that make the Twin Oaks ASR an important water management tool for San Antonio include:

- Edwards Aquifer water is bought, leased and sold through an active water market. The permitted water is available for use in the current calendar year with no accumulation of unused permit capacity across calendar years.
- Edwards Aquifer water is subject to regulations that impose restrictions reducing access to as much as 44 percent of permit capacity based on levels of the aquifer measured at the J-17 test well and/or spring flow at the Comal and San Marcos Springs.
- Edwards water injected into the Carrizo Aquifer stays segregated from the Carrizo water and forms a bubble-like concentration of Edwards water at the injection well site. This characteristic reflects the fact that the Carrizo is a sand aquifer with low transmissivity.[4]

Because of the availability of the ASR, SAWS is able to store permitted Edwards water for use in high-demand periods rather than lose access to the water as the calendar year passes. In practical terms, it means that San Antonio ratepayers are not always subjected to severe drought regulations because SAWS can fulfill the required cutbacks by using ASR water instead of newly pumped Edwards water.

The original concept identified an expected capacity of 22,000 acre feet of storage that would fit the use of the ASR as a seasonal or peak-demand facility.[5] SAWS has had as much as 96,000 acre feet in storage and the 2012 Water Management Plan the official capacity as 120,000 acre feet. A study completed in 2014 sets the capacity at 200,000 acre feet to be a more accurate figure.[6]

Increased storage capacity and several years of successful operation of the ASR have resulted in the Twin Oaks ASR being identified as the major water-management activity of the Edwards Aquifer Habitat Conservation Plan (EAHCP). SAWS will continue to use the ASR as a seasonal and drought tool but it will also hold water reserved for drought-of-record conditions. This water will be owned by the region and administered by SAWS to maintain spring flow during severe drought conditions at Comal and San Marcos Springs.[7]

This role as the primary spring-flow protection activity adds several more positive impacts to the balance sheet for ASR.

1. The role as EAHCP spring-flow-management activity saves the City of San Antonio and the region millions of dollars because a new ASR or other water-resource project did not have to be built.[8]

2. The availability of the Twin Oaks ASR for a regional role in a drought-of-record situation also is an important contribution to counter any perceived reputation for avoiding regional cooperation.

Significant Issues

The Twin Oaks ASR has proven its value in maximizing the value of owning Edwards Aquifer water, and as a drought-management tool with regional significance. There are some factors, however, that, if addressed, could improve that value even more.

1. There is only a single pipeline between SAWS Edwards Aquifer production wells and the Twin Oaks injection and recovery wells. Water can only flow one way, and changing the flow direction has major implications for water distribution. The limitation of the one-way pipeline will apparently be addressed in 2016 by construction of the western distribution line. Not only will the line allow subtle management activities, such as flow moving in both directions, it will also double the system's ability to move water from or into the Twin Oaks ASR.[9]

2. There is uncertainty regarding the total capacity of the ASR. The lack of solid capacity estimates calls into question the predictability and reliability of the system.[10] Uncertainty about the total capacity of the Twin Oaks ASR to store water is matched by a similarly disturbing description of the capacity of the system to move water from or into the ASR. In fact, the data is unclear if the capacity is 60 million gallons/day, or 40 million gallons/day.[11] This uncertainty undermines confident assessment of the ASR that can be applied to SAWS management options.

3. Pursuit of a policy to allow treated brackish groundwater to be stored in the ASR so the treatment plant can operate at the most efficient continuous state (see brackish groundwater desalination section).

Fine-tune management of the ASR to maximize its storage function. This may mean upgrading the retrieval and pumping capacity.

6. Carrizo Groundwater (Bexar County)			Rating
Amount of Water:	2014 2017 2022 2026	6,400 acre feet/year 7,000 acre feet/year 14,000 acre feet/year 21,000 acre feet/year [1]	
Cost of Water:	$590/acre foot [2]		
Cost Stability:	Stable		(0)
Ownership State of Water:	Owned Water		(-)
Length of Contract:	N/A		(0)
Distance of Source from San Antonio:	29 miles [3]		(0)
Endangered or Threatened Species Issue:	None		(-)
Treatment Required:	Carrizo water must be treated to make it compatible to the Edwards water that is the main supply source for the City of SA. Twin Oaks has a treatment capacity of 30 MGD gallons/day or ≈ 33,632 acre feet/yr. [5]		(+)
Contamination Threat:	Very Low		(-)
Drought Restrictions: (Drought Sensitivity)	N/A		(0)
Regulatory Agencies Involved:	EUWCD does not have formal jurisdiction over the area but an agreement exists for 6,400 acre feet, but none for planned expansion.		(-)

Other Issues:	• A single one way at a time pipeline with a 60 MGD capacity exists in 2014. • A western pipeline to double the capacity to 120 MGD is scheduled for completion in 2016.[6]	(0)
Rating:	4	(-)
	1	(+)
Total:	-3	Low Risk

Carrizo Groundwater (Bexar County)

The 2012 Water Plan indicates 6,400 acre feet of water is available from the Carrizo Aquifer under land owned by SAWS at the Twin Oaks site. The plan also mentions another 1,000 acre feet are available as a result of the integration with Bexar Metropolitan Water District. The 6,400 acre feet are covered in an agreement with the Evergreen Underground Water Conservation District (EUWCD) negotiated between SAWS and EUWCD in 2002 to prevent an election in Bexar County to expand EUWCD's jurisdiction and to enlist its acceptance of the Twin Oaks ASR.[7]

The pumping of the 6,400 acre feet is a factor in countering the natural subsurface drift of the stored Edwards water in the ASR within the Carrizo Aquifer.

The capacity to pump 1,000 acre feet of Carrizo Water brought to the San Antonio Water System (SAWS) by the Bexar Met integration is not covered in the EUWCD agreement.

Beyond these 7,400 acre feet, the SAWS 2012 Water Management Plan describes an expansion for pumping Carrizo water in Bexar County in 7,000 acre feet increments until 21,000 acre feet were available in 2026. The plan indicates the planned expansion does not exceed the Desired Future Conditions (DFCs) identified by Groundwater Management Area 13 (GMA 13) for the Carrizo Aquifer. The 2012 Water Plan does not describe any planned discussions or an effort to seek agreement with EUWCD on the planned expansion.[8]

The expansion of water-supply activities in the Twin Oaks area by way of ASR, brackish groundwater desalination and the local Carrizo expansion make the western distribution pipeline very important. Water from all those sources will not be as useful for San Antonio if there is only one pipeline with a 60 MGD capacity (≈67,264 acre feet).[9]

Significant Issues

Expansion of the local Carrizo production to 21,000 acre feet will certainly mobilize concerns from the Evergreen Underground Water Conservation District and from Carrizo well pumpers in Bexar County and beyond.

The 2012 Water Management Plan mentions the well-mitigation program will have to be revisited, implying that well levels of neighbors to the new SAWS pumping area will be affected.[10] There appears to be some danger the EUWCD and area pumpers will reconsider the decision not to expand the EUWCD jurisdiction to cover southern Bexar County.

Such a development will complicate the described expansion, and arguably, more importantly, will interfere with plans for the ASR and brackish groundwater desalination activities in the area.

It is incumbent on SAWS to initiate discussion with EUWCD to ensure future Carrizo production.

7. Medina Lake (BMA) Surface Water		Rating
Amount of Water:	19,974 acre feet in the lake 9,214 acre feet run of river [1]	
Cost of Water:	$474/acre foot ($69/acre foot for the raw water, raw-water rate related to GBRA water rate and will increase) [2]	
Cost Stability:	Relatively Stable	(0)
Ownership State of Water:	Contracted Water	(+)
Length of Contract:	A contract exists with Bexar/Medina Atascosa Water Control and Improvement District #1. Contract is in place until December 31, 2049 [3]	(+)
Distance of Source from San Antonio:	On western edge of metropolitan area	(-)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Treated downriver at surface water plant.	(+)
Contamination Threat:	Medina Lake at a low level would be especially vulnerable	(+)
Drought Restrictions: (Drought Sensitivity)	Yes. No water is available from the Medina Lake project in the current state of rainfall and lake levels.[4]	(++)
Regulatory Agencies Involved:	TCEQ, state agency	(0)

Other Issues:		• Treatment plant has a capacity of 13,000 acre feet/year • Medina Lake Dam requires major repair [5]	(+)
Rating:	2		(-)
	7		(+)
Total:	+5		High Risk

Medina Lake (Bexar-Medina-Atascosa Counties Water Improvement District #1)

The Medina Lake Dam was built in 1913 by the forerunner to the Bexar-Medina-Atascosa Counties Water Improvement District #1 (BMA). At the time of its construction, the Medina Dam was the largest in Texas and fourth largest in the United States. It has a surface area of 6,066 acres and a capacity of 254,823 acre feet of water.[6] After a long history of providing irrigation and recreation water, the BMA and Bexar Metropolitan Water District negotiated a water deal in 1991, with amendments in 1992, 1995, 1999, 2003 and 2008.[7]
The water-supply project involved 19,974 acre feet of lake water and 9,214 acre feet of run-of-the-river water. Bexar Met built a water-treatment plant with the capacity to treat 9,214 acre feet/year.[8]

Unfortunately, in the midst of the 2011-2014 drought, Medina Lake was only about 4.5 percent full and not providing any water to San Antonio.[9] The lake is important to aquifer recharge and some residents in the area are drilling new, deeper wells and some have had to rely on trucked water to drink.[10] The general consensus is it will take two years of generous rains to refill the lake and recharge the aquifer in the area.[11]

Significant Issues

Medina Lake has a long history as an important water source in the area west of San Antonio and, since 1991, in San Antonio. Unfortunately, there are a number of issues to address if it is again going to be a useful water source.

The most obvious, of course, is the refilling of the lake and recharging of the aquifers in the area. Other issues include the state of the dam. In 2002, the last time that water levels were high, officials cautioned the dam required major repairs. Some have been completed but questions about the dam's state of repair remain.[12] For a number of years, the state of the irrigation distribution system has been a point of discussion. Work has proceeded on the irrigation ditches and some have been replaced with pipe.[13]

The dam and irrigation channels are not the San Antonio Water System's direct responsibility, but they obviously are important issues to address if the Medina Lake water project is going to resume its role as a reliable low-cost San Antonio water source.

8. Carrizo Water (Gonzales County)		Rating
Amount of Water:	11,688 acre feet/year Leased 5,550 acre feet could be added from other utilities along the pipeline leased [1]	
Cost of Water:	$1,224/acre foot [2]	
Cost Stability:	Relatively expensive but stable	(0)
Ownership State of Water:	Leased Water	(+)
Length of Contract:	Water will be available beginning in 2014. Contract until 2040 and is renewed every 5 years.[3]	(+)
Distance of Source from San Antonio:	50-mile pipeline [4]	(+)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Yes, at plants in Guadalupe and Gonzales County	(+)
Contamination Threat:	Hard to recharge, low threat	(-)
Drought Restrictions: (Drought Sensitivity)	None	(-)
Regulatory Agencies Involved:	Gonzales County Underground Water Conservation District (GCUWCD), San Antonio has no representation	(+)
Other Issues:	• The project "rents" pipeline space from the Schertz/Seguin local	(0)

	government cooperation and buys surplus water from the entity in addition to using its own water pumped from Gonzales County wells.	
	• The Gonzales County Underground Water Conservation District (GCUWCD) reports it expects pumping to lower aquifer levels to DFC limits in 2050.[5]	
Rating:	3	(-)
	5	(+)
Total:	+2	High Risk

Carrizo Groundwater (Gonzales County)

The project is characterized as the kind of cooperative effort that San Antonio should have been involved in for years in an effort to diversify its water resources while cooperating with its neighbors.[6] By renting pipeline space from the existing Schertz/Seguin Local Government Cooperation pipeline rather than going it alone, the San Antonio Water System (SAWS) supposedly saved 30 percent of total costs or $88 million.[7]

The agreement will also allow San Antonio to purchase up to 5,550 acre feet of additional water beyond the projected 11,688 acre feet provided by its Gonzales County Carrizo wells.[8]

Significant Issues

The Regional Carrizo Project sets a desirable example for efficient sharing of pipeline and treatment capabilities by several water purveyors.

On a less positive note, this water project is likely to be affected by Water Management Area 13 Desired Future Condition (DFC) limits sometime in the near future. The Gonzales Underground Water Conservation District has reported to the Region L Water Planning Group that, based on modeling completed at its direction, pumping from the Carrizo Aquifer in the district will reduce levels in the aquifer to below DFC levels by 2050. When that reduction occurs, the groundwater district will have to reduce pumping by all permit holders.[9]

9. Water Conservation		Rating
Amount of Water:	SAWS 2012 Water Management Plan calls for the addition of 1,644 acre feet/year of new water until 2020, a total of 16,500 acre feet/year at 2020.[1]	
Cost of Water:	≈$400/acre foot* at 10 years, $4,000/acre foot in first year of implementation.[2]	
Cost Stability:	Costs are low and relatively steady	(0)
Ownership State of Water:	Owned water	(-)
Length of Contract:	N/A	(0)
Distance of Source from San Antonio:	In the city	(-)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Technological and behavior changes are required. It requires a major and ongoing education program.	(+)
Contamination Threat:	None	(-)
Drought Restrictions: (Drought Sensitivity)	None	(-)
Regulatory Agencies Involved:	None	(-)
Other Issues:	Requires that many ratepayers participate and continue to use best management practices	(+)

Rating:	6	(-)
	2	(+)
Total:	4	Low Risk

Water Conservation

Water conservation is a very important part of the City of San Antonio water supply. It was one of the water supply-creating activities that increased supply when drought, the courts, the legislature, and the city's neighbors made it clear San Antonio had to reduce its dependence on the Edwards Aquifer.

The City of San Antonio has evolved from a city with a reputation for a selfish and unappreciative attitude about groundwater from the Edwards Aquifer to a city that has implemented the most effective water-conservation program of any large city in the United States.

The City of San Antonio used the same amount of potable water in 2007 it did in 1987 despite its population growing by 400,000.[4] Several major infrastructure efforts have made significant contributions to that statistic (polybutylene pipe replacement in 1980 and a large recycled-water system) but the downward trend in residential and commercial water use is well documented (Figure 2A, page 102).

Key water-conservation programming activities:

- Replacement of polybutylene pipe
- Implementation of the recycled water program
- Distribution of approximately 250,000 high-efficiency toilets and plumbing fixtures
- Youth-education programs
- Industrial and commercial rebates for water saving technology
- Rebates for landscape conversions to more efficient plantings
- Education events such as Spring Bloom Giveaway, Garden Jazz, and neighborhood gatherings
- Volunteer group financial support for neighborhood education programs
- Rain-sensor and other irrigation-technology improvement distributions
- Widespread distribution of the *Landscape Care Guide, Xeriscape Landscaping Guide, Native Plant Bulletin, Wildscape Bulletin* and other publications
- Financial support for horticulture research to introduce more water-efficient plants and cultural practices

- Media programming for water conservation
- Business and residential water-conservation award recognition
- Seasonal irrigation email program relating lawn water needs to the weather
- Non-profit community group partnerships to distribute high-efficiency plumbing fixtures
- *Plumbers to People* assistance to low-income homes
- Restaurant, hotel, apartment, laundromat and car-wash technology conversion support
- SAWS landscape website
- Landscape conversion coupons for lawn replacement, hardscape, and irrigation removal[4]

The water-conservation programming is not static. Recently, the emphasis has changed from residential programming to landscape programming for homeowners because the San Antonio Water System (SAWS), with the input of its Community Conservation Committee, has determined this is where the water-savings opportunities most readily exist.

SAWS treats water conservation as a water-resource project in its 2012 Water Plan. The goal is to reduce dry-year water use GPCD from 143 in 2011 to 135 by 2020.[5]

The water-conservation plan, if achieved, would make 1,644 acre feet of water available for new uses each year and a total of 16,500 acre feet by 2020.[6]

The water plan reflects that some water-conservation efforts after 2020 will be required to maintain the levels achieved, but that it does not expect GPCD to fall below 135 in a dry year.[7]

SAWS has done a good job of analyzing the cost savings in wastewater treatment and postponement of new supplies due to water conservation. In 2002, BBC Researchers and Consultants analyzed water-conservation investments. They offered the conclusion that a $4-7 return was realized for every $1 invested in the effort.[9]

The San Antonio Water System 2012 Water Plan treats water conservation as a supply project. Such an attitude is unusual for a water purveyor, as water conservation has traditionally been considered demand reduction (see GPCD discussion on page 100). Being treated as a water-supply project allows water-conservation investments to be more easily defined in terms of the cost of the water they produce (save). The funds spent on water conservation can be compared to the funds spent on new water supplies provided by reservoirs, groundwater pipelines, and other, more traditional water-supply projects.

Water supply created by water conservation is different in that the funds are invested once up front and the supply is provided for several or many years after the investment. A high-efficiency toilet, for example, would cost somewhere around $125 to provide. It saves ≈12,600 gallons in

Year 1 and the same amount in future years. The investment of $125 provides .39 acre feet of new supply (or savings) in 10 years at a cost of $320.51/acre foot.[9]

In the case of high-efficiency plumbing, a 10-year supply window is very much understated because once an inefficient toilet is replaced, the new plumbing is high-efficiency equipment. The high water-use technology is no longer on the market (federal legislation).[10]

The disadvantage of this cost-up-front situation is the water supply is not immediately available. It becomes available in installments. The advantage is it is inexpensive compared to other supply sources.

Despite the exceptional performance of the SAWS water-conservation program over the last several decades, the SAWS Water Plan does not reflect a continuing performance of improved water-use efficiency after 2020.

The plan relates a GPCD reduction from 143 for a dry year, such as 2011, to 135 by 2020. After 2020, the dry-year GPCD is projected to stay at 135 for the duration of the plan.[11]

Since the City of San Antonio water-conservation performance is one of the best, if not the best, for a large city in the U.S., there could be an argument that 135 GPCD is better than other cities and improving beyond that lead is not viable. However, the argument loses some power when the previous plan versions before 2012 are examined. The goal of 116 GPCD figured prominently in those earlier plans. SAWS planners offer the argument that the 116 GPCD was a normal-year number, not a dry-year number.[12]

In the introduction to the plan, SAWS relates the 116 GPCD to a dry-year number of 126 to explain the apparently less ambitious conservation goals in the 2012 plan. There is also mention of inaccurate pumping data used in the years prior to 2012.[13]

Significant Issues

This apparent reduction in the goals for water conservation reflected in the 2012 plan merits consideration.

Contributing to the evidence for concern is that the GPCD for 2013 was 126 and the estimated rate for 2014 was 126. The trend line provided by SAWS in Figure 2A (GPCD, page 100) reinforces the idea the 135 GPCD goal is not very ambitious, based on the evidence of past performance reflected in the trend line.

Conservative goals for water supply from continuing water-conservation investment could, on one hand, be acknowledged as an insurance policy in terms of water supply and not be closely examined. That strategy, however, would make it more likely that water-conservation supply-creation funding would be less of a priority than it should be.

Water-conservation supply in the SAWS experience has cost approximately $400/acre foot, the same as leased Edwards Aquifer water and very much less than the new SAWS water projects such as Carrizo (Schertz/Seguin), brackish groundwater, and Vista Ridge water.[14]

If the SAWS water plan reflected the goal of reaching 126 GPCD, that would equate to another 14,996 acre feet of water (1,644 acre feet for every one GPCD improvement) at a cost of approximately $400/acre foot.[15]

To take advantage of this opportunity, SAWS would have to continue full conservation funding and continue to set ambitious goals that are reasonable based on past performance. In reviewing water-conservation budgets for the last 10 years, it is apparent SAWS' water-conservation expenditures varied between $5 million and $6 million/year.[16]

10. Western Canyon Project		Rating
Amount of Water:	4,000 acre feet base amount guaranteed 9,000 acre feet available, 7,100 acre feet average [1]	
Cost of Water:	$1,030/acre foot and is adjusted	
Cost Stability:	Cost is adjusted. [2]	(+)
Ownership State of Water:	Leased from GBRA. The 4,000 acre feet is the basic commitment and SAWS must purchase additional water that is available from Fair Oaks Ranch, and other contractors. Extension options exist. [3]	(+)
Length of Contract:	Contract with GBRA to receive water until 2037.	(+)
Distance of Source from San Antonio:	The pipeline is short. Treated water is delivered by GBRA to either the Winwood water tank (Hwy 10 and Fair Oaks Parkway) or the Oliver Ranch tank (Hwy 281 and Bulverde Rd). [4]	(-)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Treated by GBRA	(+)
Contamination Threat:	A lake is vulnerable.	(+)
Drought Restrictions: (Drought Sensitivity)	Yes, but limited.	(0)
Regulatory Agencies Involved:	Surface water, TCEQ is a state agency	(0)

Other Issues:	None	
Rating:	2	(-)
	5	(+)
Total:	+3	High Risk

Western Canyon Project

A contract between the San Antonio Water System and the Guadalupe-Blanco River Authority (GBRA) to allow SAWS to buy surface water from Canyon Lake has been in place since 1998. Delivery of water, however, did not begin until 2006.[5]

The agreement only covers approximately 7,100 acre feet/year but it was significant because it provided the first surface water for SAWS use and has been cited as a significant step in accomplishing some diversification of the SAWS water supply.[6]

The Western Canyon Water Project is also significant because it involves cooperation with GBRA and a number of other area entities (Boerne, Fair Oaks Ranch, Bulverde, Johnson Ranch, Cordillera Ranch, Tapatio Springs/Kendall Co. Utility Co, Lerin MUD and Lomas subdivision). SAWS has agreed to purchase the water each year, within the entities' agreement with GBRA but beyond what they can use while their populations and demands grow.[7]

The project agreement ends in 2037 but the SAWS Water Plan notes there are options to extend the agreement.[8]

Significant Issues

The Western Canyon is a relatively small surface-supply project that represents close cooperation with a number of regional neighbors. It is also the water project that was the center of controversy over the years as SAWS pursued and then retreated or was snubbed, as it tried to diversify its water supply.[9]

11. Trinity Oliver Ranch			Rating
Amount of Water:	Normal	8,800 acre feet	
	Stage II	5,500 acre feet	
	Drought of Record	2,000 acre feet [1]	
Cost of Water:	$976/acre foot		
Cost Stability:	Stable		(0)
Ownership State of Water:	Leased, Contract Length		(+)
	Oliver Ranch-15 years after 2010 with 10-year option, 3,000 acre feet/year		
	Bulverde Snecker Ranch project 15 years, 1.5 month after 2006 with possible 6-year Extension, 5,000 acre feet/year		
	WECo-17,000 acre feet/year, if available, 15-year lease with 2-5 year extensions		
	Massah Corporation-15 year contract as of 2010 with 10-year extension possible [2]		
Length of Contract:	Shorter than 45 years		(+)
Distance of Source from San Antonio:	Very close to high-growth areas in Northeast San Antonio		(-)
Endangered or Threatened Species Issue:	None		(-)
Treatment Required:	None		(-)
Contamination Threat:	Considerable development and wells but slow recharge [3]		(0)
Drought Restrictions: (Drought Sensitivity)	Yes, see amount of water above.		(++)

Regulatory Agencies Involved:	Trinity Glen Rose Underground Water Conservation District, Bexar County representatives	(0)
Other Issues:	None	
Rating:	3	(-)
	4	(+)
Total:	+1	Medium Risk

Trinity Oliver Ranch

The San Antonio Water System 2012 Water Management Plan notes the value of the Trinity Aquifer water sources because of their proximity to the high-growth areas of northeast San Antonio. The plan is rather confusing in describing the volume of resources available as 8,800 acre feet in normal rainfall years, but only a 2,000 acre feet firm yield.[4] On the SAWS website, it describes the various Trinity leases as providing upwards of 20,500 acre feet of water.[5]

The average cost assigned, $976/acre foot, is also quite expensive. Parts of the Trinity supplies were in agreements that came to SAWS from Bexar Metropolitan Water District.[6] The WECo contract was very controversial in terms of cost, water availability and purchase requirements.[7] SAWS insisted on re-negotiating the contract.

Significant Issues

Based on the accounts of the various Trinity Water sources in the SAWS Water Plan and the media, the Trinity water supply is not a reliable supply. It is also relatively expensive and administratively demanding in terms of the number of contracts involved and fluctuation in water availability.

SAWS is also under considerable pressure from Trinity well owners (other than its suppliers) to reduce pumping from its Trinity sources during drought periods to relieve pressure on Trinity Aquifer levels.

It appears that less than desirable contracts exist between SAWS and Trinity water suppliers. It seems reasonable that the value of Trinity water leases be re-examined and justified in terms of other supplies as the opportunity presents itself.

12. Lake Dunlap/Wells Ranch (CRWA)			Rating
Amount of Water:	Lake Dunlap	4,000 acre feet, surface water	
	Wells Ranch	2,800 acre feet [1]	
Cost of Water:	$1,041/acre foot[2]		
Cost Stability:	Adjusted with GBRA water costs		(+)
Ownership State of Water:	Leased		(+)
Length of Contract:	Contracts are with the Canyon Regional Water Authority, 500 acre feet of the Lake Dunlap water is leased to City of Cibolo through 2018.[3] GBRA is ultimate source of Lake Dunlap water. [4]		(+)
Distance of Source from San Antonio:	Delivery points at Lake Dunlap near New Braunfels. Wells Ranch sources are Carrizo wells in Guadalupe and Gonzales Counties, 30+miles		(+)
Endangered or Threatened Species Issue:	None		(-)
Treatment Required:	Treated by CRWA		(+)
Contamination Threat:	Surface water and groundwater		(0)
Drought Restrictions: (Drought Sensitivity)	Limited potential for reductions		(0)

Regulatory Agencies Involved:	Canyon Regional Water Authority, GBRA	(-)
Other Issues:	N/A	
Rating:	2	(-)
	5	(+)
Total:	+3	High Risk

Lake Dunlap/Wells Ranch (CRWA)

The agreement for these water sources were inherited by the San Antonio Water System as part of the Bexar Metropolitan integration. There was a relatively long period of consideration by SAWS about whether the agreement was in the best interest of San Antonio ratepayers.[5]

The Canyon Regional Water Authority (CRWA) is a member-owned water wholesaler operating treatment plants on Lake Dunlap (16.4 million gallons/day) and the Hays/Caldwell Plant east of San Marcos (6 million gallons/day). The plants treat raw water from Canyon Lake and Lake Dunlap. A third treatment plant on Leissner Road in Guadalupe County treats Carrizo Aquifer water (7.2 million gallons/day).[6]

Members of CRWA include Cibolo, City of La Vernia, County Line Special Utility District (SUD), Crystal Clear Water Supply Corporation, Green Valley Special Utility District, Springs Hill Water Supply Corporation, East Central Special Utility District, Martindale Special Utility District, Maxwell Water Supply Corporation. GBRA has had disagreements with CRWA and has threatened to end the agreement with CRWA to supply water through Lake Dunlap.[7]

Significant Issues

This water-supply project is one of several small water-supply projects that were originally part of the Bexar Met System. Complications include the fact that GBRA is a major factor in the reliability of the Lake Dunlap water. Additionally, the CRWA member responsibilities and input are under scrutiny.[8]

Water Policy Issues: Water Planning

Population Estimates

In reviewing whether the San Antonio Water System water plan provides adequate water to meet the projected demands of anticipated population growth in San Antonio through 2060, one important factor to consider is the population estimates on which SAWS based its projected demand. Are they the same as the population estimates projected by the City of San Antonio?

The City of San Antonio Planning and Community Development Department provided the population estimates under the 1.0 Migration Scenario from the Metropolitan Transportation Plan Update for Bexar County (from the Metropolitan Planning Organization, or MPO) as their population prediction.[1] That projection estimates population in the County to reach 2,817,067 in 2040. Projecting the data through 2060, the estimate for Bexar County in 2060 would be 3,555,708 people.

In 2010, SAWS/DSP did a census-block analysis that determined the SAWS/DSP was responsible for 92 percent of the Bexar County population (1.58 million of the 1.71 million).[2] Following through on that determination, SAWS' water plan provided a demand curve based on 2,249,685 people in 2040 and 2,599,818 in 2060.[3]

The further into the future the projection, population estimations are notoriously hard to make. In the Region L Water Plan, the Water Planning Region projects Bexar County's population in 2060 will only be 2,904,319, less than the population projected from the MPO estimates. In 2040, the Region L population estimates are 88 percent of the MPO estimates (2,468,254 compared to 2,817,067).[4]

The authors of this paper are using the MPO projections, but alert readers there are several population estimates for 2060. The SAWS Water Management Plan for 2012 discusses the difficulty of arriving at a universally accepted estimate.[5]

Significant Issues

Figure 1A clearly illustrates the differences between the projected Alamo MPO population estimates and the estimates SAWS used. The SAWS plan addressed demand for only 78 percent of the number of people reflected in the MPO projection for San Antonio.[6]

Using the more conservative population estimate from the 2016 Region L Water Plan for Bexar County, the SAWS water plan makes provision for about 90 percent of the Bexar County population in 2060.[7]

From this analysis, it is clear SAWS used very conservative population estimates in its 2012 Water Plan. The significance of using conservative population estimates may result in water supplies that are not sufficient to meet the expected population growth. Other issues, such as expected GPCD and supply surplus, will be factors to relate to this apparent under-estimation of population growth.

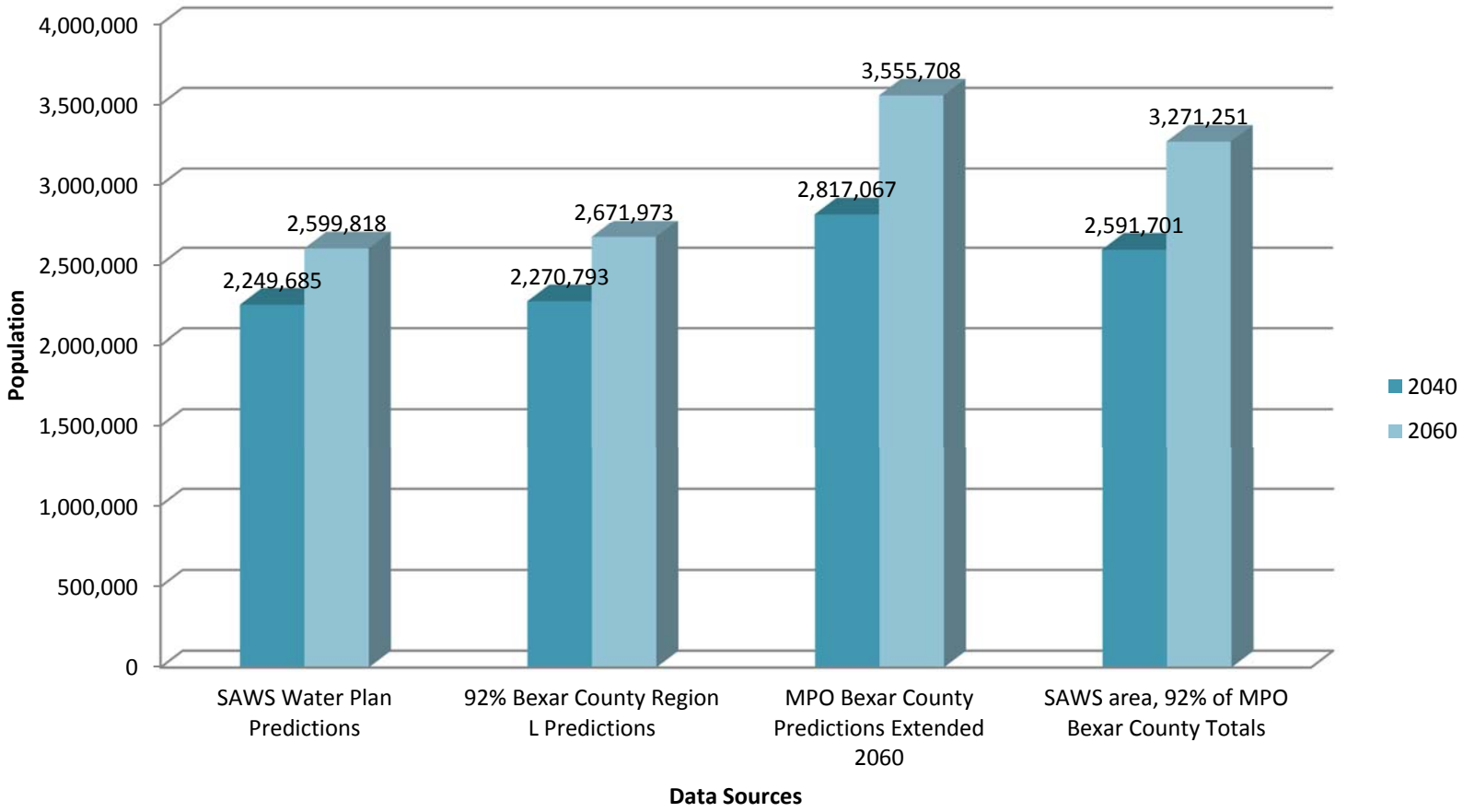
SAWS acknowledged it has access to the MPO population estimates and is reviewing this impact in consideration of the next SAWS water plan.[8]

In its simplest form, the issue reveals the population estimates used by SAWS to determine demand and projections to 2060 are less than the MPO estimates provided to the authors by the City of San Antonio Planning and Community Development Planning Department. SAWS 2012 Water Management Plan is projecting less population, with a difference of 14 percent fewer persons in 2040 and 21 percent fewer persons in 2060.[9]

Using the water requirement needs of 1644 acre feet required for each 10,000 persons, the differences between the SAWS estimate and the MPO estimate would involve 56,227 acre feet of additional water in 2040 and 110,383 acre feet of water in 2060.[10]

SAWS should reconcile the population estimates and demand estimates to meet the more current population estimates. This may result in the need to identify additional water-supply sources.

Figure 1A. Projected Populations 2040 and 2060 for San Antonio from SAWS 2012 Water Plan, Region L Water Plan and MPO Population Estimates



GPCD, Demand Management

Water demands can be expressed as amount of water needed by various population and economic units. The San Antonio Water System, with its history of successful water-conservation results, expresses demand per unit of population (person) as gallons per person per day (GPCD). Its measure integrates commercial, industrial, and residential water use into one number linked to population.

Such a water demand expression is appropriate if the relationship of economic activity to population remains consistent. It would not be an accurate way to plan if the type of industry changed, and/or the amount of water used by the activity changed. It does not appear the City of San Antonio Development Plan projects any such change.

In 2011, the driest and hottest year on record in San Antonio, the GPCD was 143. The SAWS Water Plan for 2012 adopted that figure as the dry-year base amount. From there, the water plan reflects a reduction in dry-year base to 135 GPCD by 2020.[1]

The SAWS Water Plan reports that each reduction in one gallon of GPCD is the same as 1,644 acre feet, enough water for 10,000 people.[2]

Through 2020, the SAWS Water Plan reflects a continuing water-conservation effort and reduction of per-capita water use of one gallon/person/day each year.[3]

Significant Issues

The conservation goal projected for the 2012 Water Plan (135 GPCD, dry year, by 2020) is considerably less ambitious than the goals expressed in the 2009 Water Plan. In the 2009 Water Plan, the goals were to reach 126 GPCD (dry year), 116 GPCD (normal year), and 106 GPCD (wet or drought-restriction year).[4]

The 2012 plan relates why the GPCD goals are so different, noting the changes represent corrections required because of adjustments in the population/household figures, corrections in the amount of water pumped due to inaccurate meters, and the reality presented by 2011 when per-capita water use reached 143.[5]

The explanations provided for the less ambitious conservation goals certainly must be considered in preparing water-conservation demand-reduction goals. However, there is reason to question the 135 GPCD goal.

Figure 2A shows the per-capita water use in 2012, 2013, and 2014 (estimated) are 128, 126 and 126 respectively. Those years were not as severe in terms of low rainfall or high temperatures as 2011, but they were years where aquifer levels stayed low enough that San Antonio was under drought restrictions for the entire period.

No definition is provided by the 2012 Water Management Plan for what qualifies as a dry year but Figure 2A clearly shows a trend line representing the 10 driest years that more than one GPCD reduction is par for the course. The line represents a reduction of two GPCD per

year. The trend line representing the GPCD average yearly reduction is even higher at ≈2.25 GPCD.

The 2012 Water Management Plan does not provide any explanation as to how the 135 GPCD goal was selected. The trend lines displayed on Figure 2A do not seem to show any leveling off or other characteristic that would support 135 GPCD as the point where demand-management results will no longer produce results.

It is clear however from Figure 2A that some dry years in the last 10 years result in higher GPCDs than dry years before that period.

The data and SAWS history of demand-management success merit more than a water-conservation goal of only one GPCD/year and an ending goal of 135 GPCD.

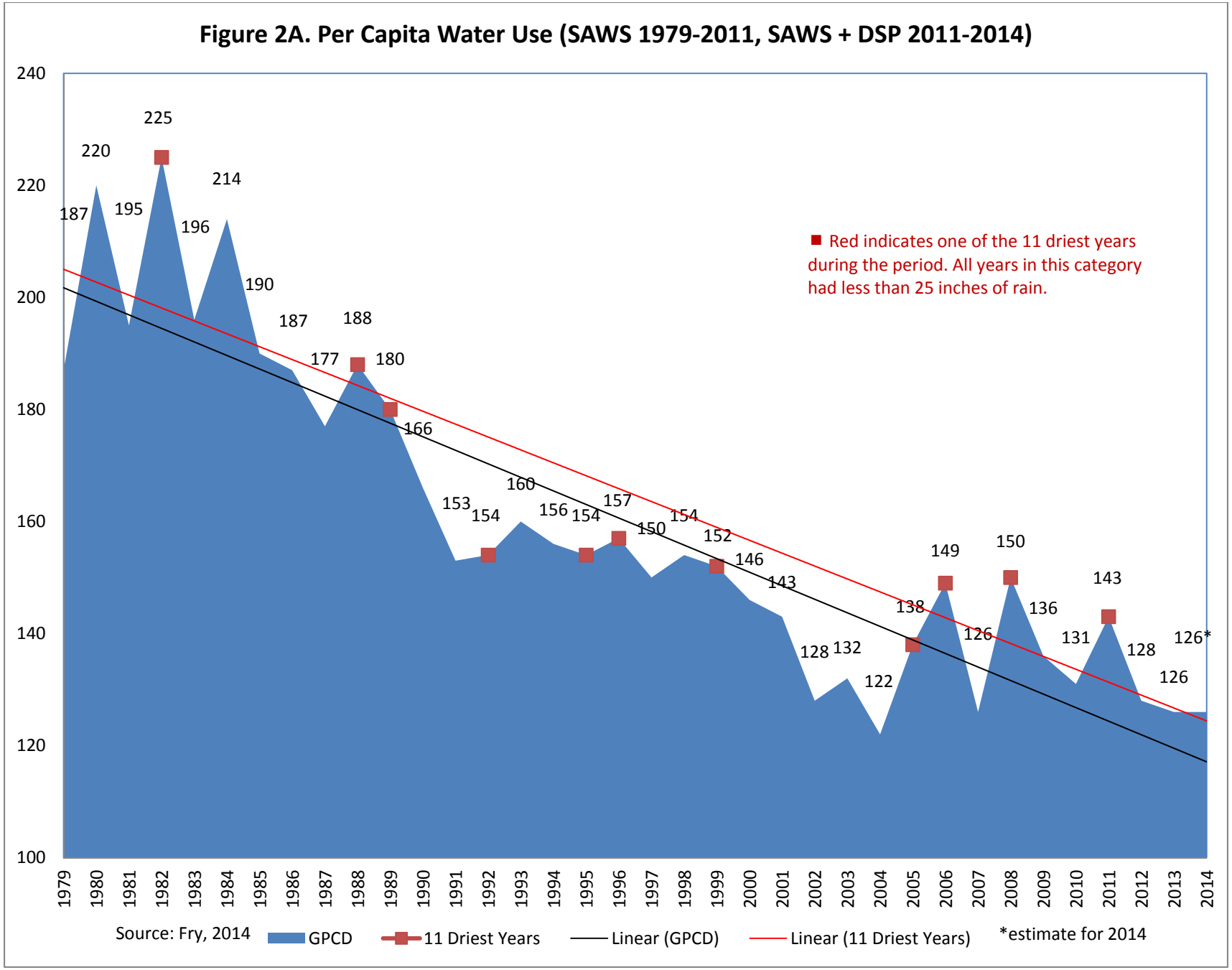


Figure 2A. Per Capita Water Use (SAWS 1979-2011, SAWS + DSP 2011-2014)
240
220
200
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2014
■ Red indicates one of the 11 driest years during the period. All years in this category had less than 25 inches of rain.
Source: Fry, 2014
GPCD
11 Driest Years
Linear (GPCD)
Linear (11 Driest Years)
*estimate for 2014

Public Input and Communication

The City of San Antonio is well known for its water-conservation and drought-management success. Typically, an assessment of the reasons for that success would credit citizens' recognition of the challenges that the region faces in terms of climate, including erratic rainfall and high evaporation rates. The analysis would also mention the impetus for protecting the endangered species and the need to share the water from the Edwards Aquifer with other stakeholders (reinforced by court cases and media attention). The leadership provided by elected officials who recognized the challenges and were willing to seek solutions would also be mentioned. All of these reasons for success are related to a strong public-communication effort and a history of citizen input.

The authors are not sure when it became part of the formula, but are convinced an attitude of seeking public input and stakeholder buy-in is an important part of City of San Antonio's water policy success. Two important developments in the evolution of public input are the Committee on Water Policy and the still-functioning Community Conservation Committee.

1. **Citizens Committee on Water Policy –** In reaction to the intervention in management of Edwards Aquifer water by the federal courts and criticism from the state legislature, San Antonio Mayor Bill Thornton established the Citizens Committee on Water Policy in what appeared to be an attempt to take back the initiative in local water management. The group produced a set of water-action recommendations that were refined by SAWS through the process of 61 public meetings. In 1998, a 50-year water plan was approved by the San Antonio City Council. The plan included recommendations on water conservation, rate increases, aquifer storage and recovery, recycled water, a Canyon Lake pipeline and reservoirs.[1]

2. **The Community Conservation Committee (CCC)** was established in 1997. Representatives of a large number of stakeholders, including neighborhoods, landscapers, environmentalists, Master Gardener volunteers, chambers of commerce, carwashes, manufacturers, the hotel and restaurant industry, academic institutions, non-profits and other groups were identified as essential to its membership.

   Among the group's most memorable accomplishments was its recommendation to the SAWS Board for a dedicated conservation fund created from 4th tier residential water use and from every commercial meter. The fund would be used exclusively for conservation programming. The CCC membership and its supporting stakeholders carried the resolutions to stakeholder organizations and to the SAWS Board.[2] In another action initiated in 2003, the CCC membership and the stakeholders it represented worked with staff for nearly two years to develop a water-conservation and drought-management ordinance that passed the San Antonio City Council in August 2005 with a unanimous vote.[3]

Other public-input vehicles used by SAWS to produce and promote successful water policy in San Antonio included:

- **Citizens Advisory Panel (CAP)** provides input and outreach on water resource projects being considered and/or the nature of their implementation.
- **Rate Advisory Committee** reviews on a regular basis the rate structure for SAWS water to balance operational, community, and financial needs.
- **Capital Improvements Advisory Committee** provides advice to the SAWS Board on Impact Fees to help recoup the costs created by new developments.
- **Bexar Met Integration Advisory Committee,** a 16-member citizen committee advised SAWS on accomplishing a smooth integration of Bexar Met services and infrastructure.[4]

As important to water policy development as stakeholder input is, outreach led by stakeholders is equally important to water policy implementation. The San Antonio water-policy experience has unique examples of this outreach.

1. **Media, Social Media and Internet Communication** – Water has been a top story in San Antonio media for at least the last 30 years. Media coverage has been and continues to be balanced with considerable attention given to provide both sides of any water policy issue. In recent years, SAWS has also initiated communication through social media and through an effective website. The SAWS-initiated communication on the Internet and through social media have not made any special attempt to provide all sides of an issue but neither have they been heavy handed in their approach. The opposition to projects such as the Vista Ridge water project has seemed equally adept at communicating through the media, Internet and social media.
2. **Volunteer Group Involvement** – A unique and most effective vehicle for public input and outreach has been alliance with volunteer groups like the Bexar County Master Gardeners, Gardening Volunteers of South Texas, Mitchell Lake Audubon docents, Master Naturalists, and Botanical Center docents to develop and deliver water-conservation and drought-management programming. SAWS provides administrative funding for volunteer coordination, and funds based on educational contacts. This dedicated corps of nearly 1,000 volunteers represents every neighborhood, economic group, and ethnic group in the city. They have been advocates for the conservation programs into which they have had input and of which they feel ownership. They have huge influence on their peers and neighbors in bringing them onto the team.

Significant Issues

It takes constant effort to enlarge, or even maintain citizen support for a community's water policy. San Antonio has been exceptionally skillful at the process. The authors recommend the City of San Antonio continue to take the time and make the effort to enlarge the San Antonio water team. Transparency must be maintained, outreach efforts organized, and promises fulfilled.

Two areas of programming that provide a test of the continued dedication to public communication in San Antonio's water-policy development and implementation are the Vista Ridge water project and the relationship between the San Antonio Water System and the landscape industry on the role of irrigation in water-conservation programming.

The advocates of the Vista Ridge project were conscientious in encouraging a public dialogue on the project. They were successful in receiving public support partially because they responded to the public's demand that the water-conservation effort not be reduced because of the project. Promises were made to maintain conservation at a high level and the public's expectation is that it will be kept informed of the continuing water-conservation effort as part of an equally ambitious public-communication effort.

The landscape industry in the San Antonio area has been a participant in the public discussion about water conservation since it began. In the present state of programming, the role of irrigation is a primary topic of discussion, with SAWS staff promoting a reduction of any irrigation on landscape and the landscape industry favoring a more moderate stance. The test will be if SAWS can work with the landscape industry to develop a mutually acceptable stance rather than launching policies on the topic without support of the industry.

Climate Change

The Cities of Fair Oaks Ranch and San Antonio Water Policy Analyses are not designed to make a detailed analysis of the impact of climate change on water security, but it is an issue that needs to be considered.

In 2000, a paper, “Effects of Climate Change on a Water Dependent Regional Economy: A Study of the Texas Edwards Aquifer”[1] estimated climate change in the Edwards Aquifer area will increase municipal water demand by 1.5 percent in 2030 and 3.5 percent in 2090.[2] The study also estimated recharge would be reduced, and to protect the endangered species at Comal and San Marco Springs, Edwards Aquifer pumping would have to be reduced by nine percent (2030) and 20 percent (2090).[3]

Significant Issues

The SAWS 2012 Water Management Plan does not address climate change and the next version must. The potential for demand to increase and supply to be reduced must be estimated and accounted for in the San Antonio and Fair Oaks water plans. It is especially significant for San Antonio, where a water supply shortage will be possible as early as the decade of 2040 if the region is subjected to drought-of-record conditions.

Water Shortage, 2060-2070: Seawater Desalination and Other Conceptual Projects for the Long Term (2040-2070)

Seawater desalination held a relatively prominent place in the San Antonio Water System water plans in place prior to the 2012 Plan. It is now relegated to status as a "conceptual project for the long term (2040-2070)."[1]

It shares that status along with expansion of brackish desalination; additional ASR capacity or ASR operations; new fee-line conservation paradigms and future regional water project(s) through a Request For Competitive Sealed Proposals (RFCSP).[2] These "conceptual" projects are related to Figure 3A on 108: Potential Permitted Supply Gaps to be Addressed in the Long Term.[3] The figure identifies water-supply gaps in the period 2060-2068 if drought-of-record conditions occurred in that period. The gaps range from 38,790 acre feet in 2062 to 101,163 acre feet in 2067.[4]

It is, of course, very difficult to project population growth and water needs 55 years into the future, but estimates that the currently operated and planned water projects would not provide adequate firm yield to meet drought-of-record needs in 2062 are frightening in several ways.

The population projections being used by the City of San Antonio for this analysis are much higher than the population projections used by SAWS in the 2012 plan. The population figure produced by SAWS in its service area for 2070 is 2,799,559. The MPO population estimates provided by the City of SA for this analysis reach that total in 2050, 20 years earlier than the SAWS plan.[5]

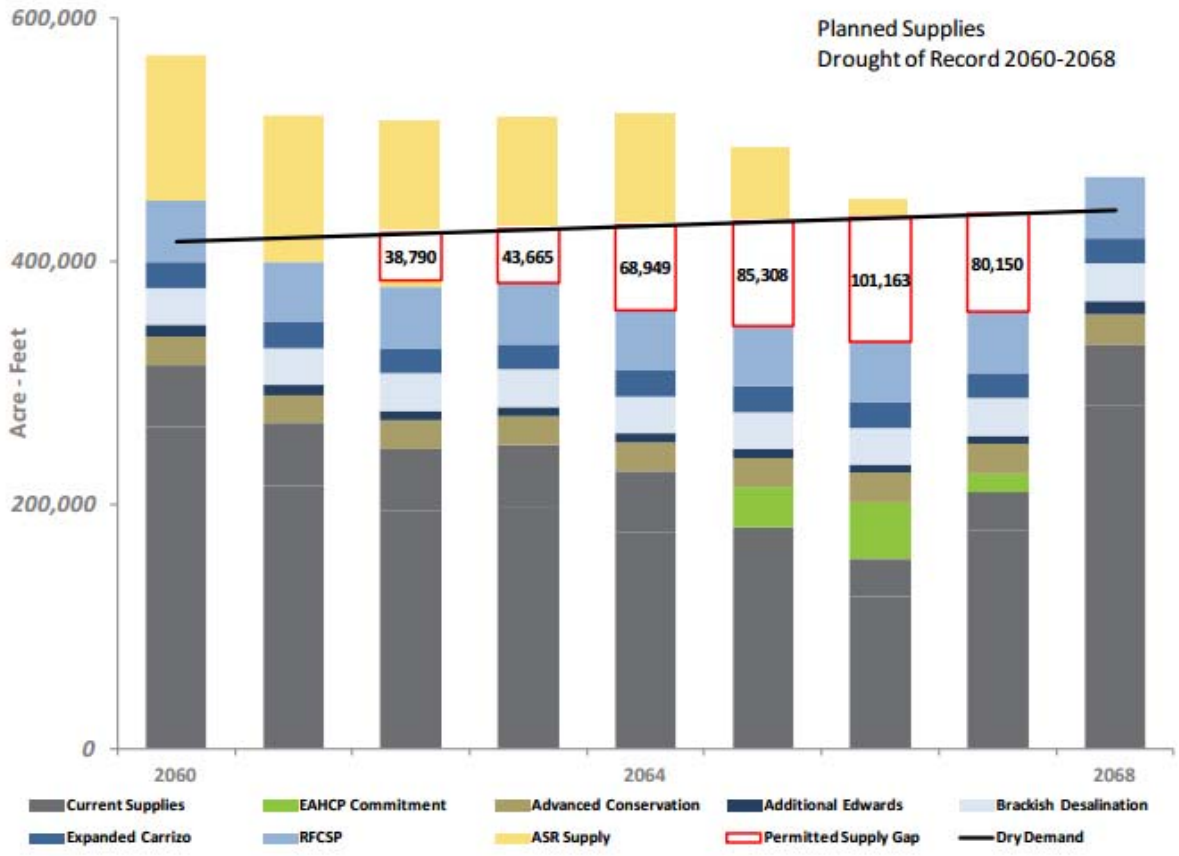
Significant Issues

The population estimate discrepancy will need to be reconciled in the next version of the Water Plan. The difference is significant, especially in light of the water shortage for 2060-2070 acknowledged by SAWS if a drought of record occurs during that time.

The relationship between water needs and population estimates raises a question as to whether a shortage may occur as early as the 2040-2050 period if the City of San Antonio's MPO population estimates are accurate and if a drought-of-record period is in place in 2040-2050.

Figure 3A.

Potential Supply Gaps to be Addressed in Long Term[6]



Water Policy Issues: Water Management

Drought Management

Drought management has long been an effective tool for San Antonio in complying with the reduced availability of Edwards Aquifer water during drought periods when access to Edwards permitted water is reduced by as much as 40 percent (now 44 percent, with the new emergency restrictions incorporated into the Edwards Aquifer Habitat Conservation Plan).

San Antonio Water System drought restrictions rely on reduced use of water for landscape irrigation. The necessary water-use savings can be accomplished by reducing lawn watering by an increased amount as restrictions move from Stage I to Stage IV.

The restrictions were established with considerable stakeholder input, including that of the landscape industry and horticulturists.

The evidence seems to indicate the necessary water savings are accomplished without reduction of economic activity or economic cost. Lawns and other landscape plants are temporarily stressed and appear less attractive but no permanent damage results. The only change in water-use practices occurs in landscape watering and even there, the reduced water availability has only a temporary effect. The disruption to the landscape industry is matched by an increase in opportunities due to the growing market for more water-efficient plants; more soil, mulch and compost; more efficient irrigation technology and other water-efficiency products.[1]

Significant Issues

The SAWS Conservation Department has done a good job of analyzing the water savings possible through drought management. In 2009, SAWS determined that 30,000 acre feet of water use was reduced with the implementation of drought restrictions.[2] Because of the availability of ASR (see ASR section, page 76) and the compliance of San Antonio citizens with drought restrictions, SAWS has never had to implement restrictions beyond Stage II. If the 30,000 acre feet were valued at $1,000/acre foot (low for a water-resource project), $30-million worth of water at peak demand times was saved at a cost of about $650,000.[3]

In the 2016 Region L Water Plan, the Regional Water Planning Group has assigned costs to SAWS drought-management efforts of $357/acre foot for the 14,674 acre feet of water saved in the decade of 2020. The cost is increased to $896/acre foot in the decades of 2040 and later.[4]

The costs are calculated from costs provided by the Texas Water Development Board (TWDB) that are out of date and not justifiable in terms of the SAWS drought-management techniques.

SAWS' acceptance of that cost assignment should be re-examined as this has the potential to justify the addition of new water-resource projects to replace drought-management as a water-supply strategy when it is questionable the costs are actually related to the SAWS brand of drought management.

The willingness to comply with SAWS drought restrictions is the result of several factors.

1. SAWS citizens and stakeholders have had considerable input in the creation of the drought restrictions. The restrictions save the required water from peak demand and do not drastically affect quality of life, economic activity or landscapes.

2. The education program related to conservation and drought-management is effective and ongoing. The education effort includes sympathetic and daily coverage in all forms of the media.

3. Enforcement is a serious activity accomplished by regular police officers on special status for the San Antonio Water System.

Lost/Non-revenue Water

Lost water, also called non-revenue water, is the difference between the water pumped and the water sold. There are a number of categories of non-revenue water. The key issue with lost water is that it is water that is permitted, pumped, treated and perhaps even distributed, but does not produce revenue for the water purveyor.

Every water purveyor has some non-revenue water. The Texas Water Development Board (TWDB) and the Edwards Aquifer Authority have begun to give the lost-water statistic attention, because it can represent a large amount of water that is not used in a beneficial manner.

The Texas Water Development Board has a lost/non-revenue-water analysis to determine if the amount and characteristics of the lost-water total requires the water purveyor to use part of any funds it receives from TWDB to correct the situation prior to using the funds for other water sources. SAWS is close, but does not yet fall within that classification.[1]

Table 2A and Figure 4A on pages 112 and 113 report the lost/non-revenue total in the SAWS service area over the last 10 years. In 2013, the reported rate was 15.406 percent. It is expected that the rate in 2014 will be the same.[2]

A 15 percent lost-water rate is significant. In SAWS' case that represents an approximate total of 36,305 acre feet per year.[3]

The first step in addressing a lost-water situation is to determine where the non-revenue water is going. Is it leaky distribution lines, inaccurate pumping data, firefighting water, stolen water, unmetered water, inaccurate consumer metering, line flushing, inaccurate bookkeeping, forgiven water bills or various other categories? Only when the lost-water contributing factors and amounts are identified can it be determined how much it will cost to reverse all or part of the losses.

In some cases, all or a portion of the lost water will be tolerated because it is not sound business management to spend the money required to correct the situation that causes it. In all cases, however, the amount and source of the non-revenue water should be identified so that the problem can be corrected if it does make business sense.

In response to the authors' request for the amount and characteristics of its lost water, SAWS reported the exact nature by volume is not known at this time. As of December 1, 2014, SAWS is working with a contractor (Water Systems Optimization, WSO) to assist in characterizing the lost-water total.[5]

Significant Issues

The SAWS statistics indicate the amount of lost water has been relatively high for six years.[6] The amount, approximately 36,305 acre feet per year, is as much water as a large water-supply project.

Even though the SAWS system is large and complex, it is hard to justify the long period of time that has elapsed between recognition of this large lost-water total and now.

In terms of Edwards water at $380/acre foot, the value would be $12,920,000/year. At a cost of $1,000/acre foot, less than the newest SAWS projects of the Regional Carrizo Program, brackish groundwater and Vista Ridge water, this lost water would have a value of $36,000,000 per year.[7]

The SAWS lost/non-revenue-water issue should be addressed as a priority.

Table 2A. SAWS Annual Pumpage (Lost Water)
Water Loss

Year	Annual Gross Production (MG)	Annual Metered/Billed Water (MG)	SAWS Internal System Use Metered Water (MG)	ASR Storage (MG)	Annual Accounted Water (MG) (*Metered/Billed + ASR Storage)*	Unaccounted Water (MG)	% Water Unaccounted
2013[2]	76,137	63,475	203	2,630	66,308	11,830	15.14%
2012[1]	70,338	55,320	174	3,742	59,236	11,102	15.78%
2011	74,628	59,149	162	3,927	63,238	11,390	15.26%
2010	68,299	53,657	131	8,319	32,107	6,192	9.07%
2009	67,533	52,532	135	5,549	58,216	9,317	13.80%
2008	71,328	58,828	134	3,805	62,767	8,561	12.00%
2007	61,744	49,511	123	6,701	56,335	5,409	8.76%
2006	66,350	57,724	129	2,962	60,815	5,535	8.34%
2005	63,357	55,005	131	4,366	59,502	3,855	6.08%
2004	53,040	49,366	114	1,809	51,289	1,751	3.30%

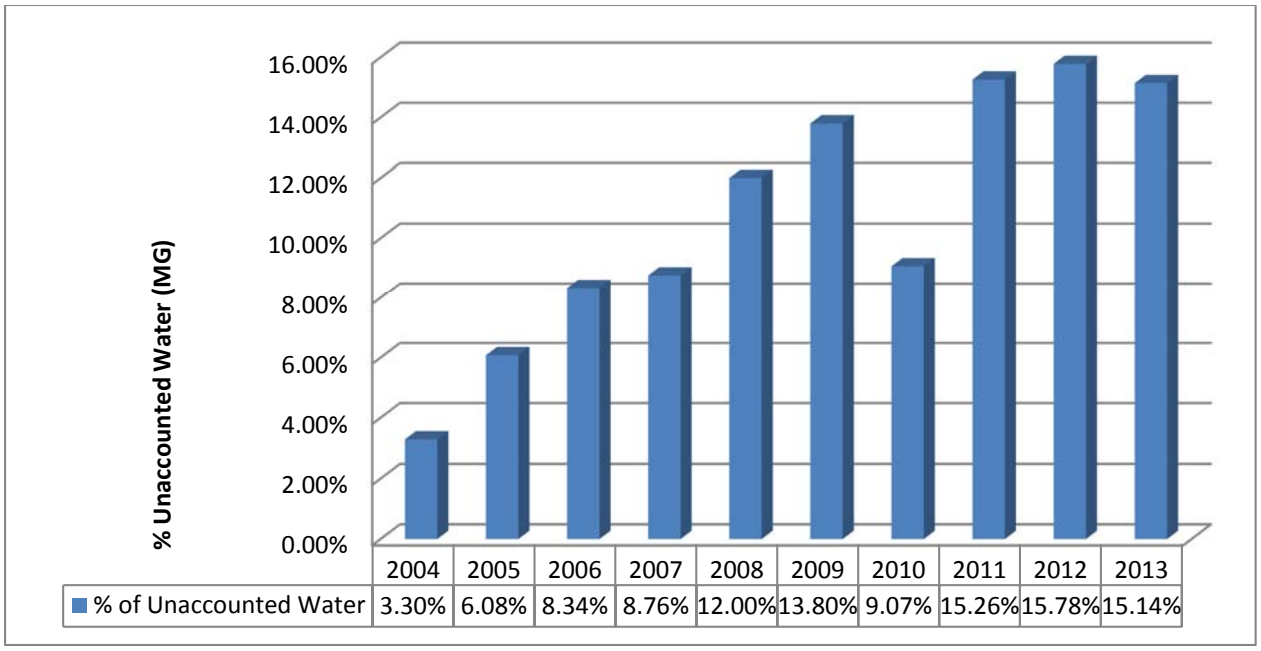
(2) 2013 data from TWDB Water Audit Report, SAWS & DSP combined data.

(1) 2012 data do not include DSP

(*) Anomalies in some of the 2002 data make the calculation unreliable

Source[8]

Figure 4A.
Unaccounted Water (% and MG)



Edwards Aquifer Habitat Conservation Plan

The Edwards Aquifer Habitat Conservation Plan (EAHCP) was the result of five years of negotiation between 26 representatives of stakeholders involved with Edwards Aquifer water. The negotiations began in 2007 just before the state legislature passed Senate Bill 3, legislation that formalized the requirement that the negotiations proceed and identified required stakeholder representation.[1]

There were two main goals for the EAHCP effort:

1. Development of a plan to manage the Edwards Aquifer in a manner that protects the seven endangered animal species and wild rice at Comal and San Marcos Springs.

2. Arrival at a management scheme that achieves an Incidental Take Permit to reduce the threat of court or federal intervention and stabilize the availability of water from the Aquifer for all pumpers.[2]

After approximately five years of negotiation (2007-2012), agreement was reached among the 26 entities on the steering committee. The U.S. Fish and Wildlife Service also accepted the management plan, and an Incidental Take Permit granted for 15 years from 2013 through 2028.

A review of the Edwards Aquifer Habitat Conservation Plan convinced the U.S. Fish and Wildlife Service that it had an excellent chance of maintaining enough spring flow at Comal and San Marcos Springs through a series of management activities, improvement of habitat at the springs, and a formalized monitoring and adjustment of the activities (adaptive management) to insure spring-flow goals are achieved.

The budget for EAHCP is approximately $18 million/year. The management activities[3] begin with:

1. **Voluntary Irrigation Suspension Program Option (VISPO)** – A dry-year irrigation option for agricultural producers wanting to take advantage of a yearly subscription payment that increases when the dry-year option is called. It has been called for 2015 because the J-17 index well was below 635 feet MSL on October 1, 2014. Forty thousand acre feet of irrigation water use that would normally be pumped will not occur in 2015.

2. **Edwards Aquifer Regional Water Conservation Program (EARWCP)** – A total of 8,400 acre feet of water – SAWS (8,000 acre feet), San Marcos (300 acre feet) and Texas State University (100 acre feet) – was “lent” to the program for 10 years. The “lent” water will be replaced by water conserved as a result of EAHCP Regional Water Conservation Program conducted by regional communities with EAHCP funds.

3. **Replacement Water** – SAWS ASR stores 40,000 to 126,000 acre feet of regional water to be used to replace SAWS aquifer pumping during drought conditions that approximate drought-of-record conditions. This is the most important HCP activity based on impact on spring flow.

4. **Additional Drought-Pumping Reduction Stage** – A fifth stage is being added to the current four stages of water-use reductions activated as the level of the aquifer levels or spring flow fall to specified flows and monitoring-well levels as the drought progresses. The new restrictions means that water pumping will be reduced by four percent to 44 percent of permit value in a severe drought.

In addition to the management activities, the EAHCP includes funding for studies on the habitat requirements of the endangered species and it includes analysis of actual spring-flow effects of the various activities.

Legislation (SB 3) to initiate the Edwards Aquifer Recovery Implementation Program (EARIP) and the resultant Edwards Aquifer Habitat Conservation Plan have a number of impacts on the City of San Antonio water supply. These are generally positive, but some challenges may arise as the EAHCP proceeds.[4]

Positive:

1. The likelihood of another intervention by the federal courts as happened in 1995 is greatly reduced with the Incidental Take Permit.

2. Total permitted water of 572,000 acre feet and the drought restrictions are part of state law, making it less likely that they will be changed.

3. The Science Committee determination that pumping from the Edwards Aquifer would have to be reduced by 85 percent in Stage 1 to protect spring flow was rejected by all parties in favor of the current EAHCP.

4. The yearly costs of $18 million is affordable compared to early estimates and project calculations that up to $1 billion in capital costs and $60 million/year would be required to protect the endangered species.

5. The work by the diverse set of stakeholders, including environmentalists, agriculture, downstream interests, industrial pumpers, small cities and San Antonio, represents a major accomplishment in regional cooperation. There is no reason to believe that this cooperation will not continue.

Potential challenges:

1. There are provisions in the EAHCP to evaluate the results of the management activities to insure the impact on spring flow is as predicted. Programming could require adjustment.

2. Phase II of the HCP specifically identifies the inclusion of the SAWS western distribution pipeline (yet to be constructed) into the ASR management activity if the effect of the ASR activity is not as influential on spring flow as predicted.

3. Studies currently being conducted as part of the EAHCP may change the assumptions concerning required spring flow and other important issues that serve as the basis of the EAHCP.

4. The EAHCP extends only for 15 years. Although it is anticipated the HCP as constituted will be extended for years to come, that may not be the case.

Significant Issues

The EAHCP is of major importance and influence on the City of San Antonio water-supply situation. It is important in representing the City of San Antonio, the San Antonio Water System continue to provide leadership to the effort.

Such leadership requires SAWS concentrate sufficient staff resources to the evaluation of management activities, spring-flow assessments and HCP renegotiation to ensure San Antonio's interests are well represented. Leadership also requires SAWS complete the western water-distribution pipeline. It is important for the SAWS Board and San Antonio City Council to receive regular reports from SAWS outlining the leadership SAWS has provided in EAHCP activities in the previous year.

Bexar Metropolitan Water District Integration into SAWS System

With 93,000 connections, the Bexar Metropolitan Water District was a water purveyor for a city of about the same size as Corpus Christi.[1] There was considerable debate about the condition of the water purveyor, and some of the issues identified were:

- Bexar Metropolitan did not have adequate water resources to meet demand in a drought of record. It was estimated it would be 25,000 acre feet short in such a situation.[2]
- The Bexar Metropolitan financial situation was precarious and its credit status questioned.[3]
- Bexar Metropolitan rates were different for various parts of its service area. The reasoning for the differences was questioned.[4]
- Bexar Metropolitan rates were generally higher than SAWS rates in a similar situation.
- There were complaints about the response time and efficacy of leak and other repairs.
- The water-resource agreement with Water Exploration Co. (WECo) was identified as unacceptably one-sided in favor of the contractor.[5]
- Bexar Met owned 20,000 acre feet of Edwards Aquifer rights and leased 14,500 acre feet.[6] The purveyor also had water rights from CRWA (Lake Dunlap and Wells Ranch), Medina Lake and Trinity Aquifer groundwater.[7]

On November 11, 2011, through legislation sponsored by Senator Carlos Uresti, a vote of Bexar Metropolitan Water District customers was held. With a 74 percent majority, they decided absorption into the San Antonio Water System was a better way of meeting future water needs than to remain an independent entity. [8]

Among the features of the integration effort outlined by SAWS were:

- All staff would be retained and integrated into the SAWS work force. The legislation protected all staff earning $50,000 or under.[9]
- No rate increases would be instituted in the Bexar Metropolitan service area until the rates in the original SAWS jurisdiction reached Bexar Met levels.[10]
- The Bexar Metropolitan portion of the combined Water System would remain in a special status for up to five years to protect SAWS ratepayers.[11]
- Customers in the District Special Project (Bexar Metropolitan) would immediately be eligible to participate in the SAWS Water Conservation Program.[12]
- A Bexar Met Advisory Committee was established to help guide the integration process.[13]

The WECo agreement was renegotiated to include terms that were more reasonable for the SAWS/DSP water purveyor.[14]

In terms of water resources, Bexar Met brought the following supplies into SAWS in 2012. The water resources represented are not firm-yield.[15]:

- 20,000 acre feet of owned Edwards Aquifer water and 14,500 acre feet of leased water
- 19,974 acre feet of Medina Lake water and the Medina Lake treatment plant with approximately 13,000 acre feet/year treatment capacity
- 17,000 acre feet of Trinity Aquifer water
- 6,800 acre feet of water from Lake Dunlap and Wells Ranch though the CRWA system.

Arguments against the merger included:

- An accusation by Bexar Met that SAWS was interested only in plundering Bexar Met water resources.
- The distraction of having to deal with the Bexar Met integration that could negatively affect SAWS' efforts to find new water resources and deal with other issues.
- Anxiety the takeover would stimulate numerous lawsuits.

Arguments in favor of the merger included.[16]

- The combined resources of the two entities would lead to efficiencies in water supply, infrastructure, customer service, and improved financial and synergistic management.

As of November 2014, the integration effort seemed to have been accomplished with minimal controversy and dispute.

Significant Issues

The Bexar Metropolitan situation required some action by San Antonio. Customer service, and the financial and water-resource situations were not acceptable.

Integration into the San Antonio Water System was the logical solution, but the option also had some serious challenges. Tackling the integration in the midst of the EARIP, EPA wastewater issues, and the search for new water resources was not ideal.

To its credit, SAWS has managed the integration in a very competent manner. There were no major missteps or bad publicity. SAWS needs to be recognized for an excellent job in accomplishing this controversial, complex merger.

San Antonio as a Water Neighbor

Through its recent history San Antonio has not been rated as a good neighbor in terms of water issues.[1] San Antonio's neighbors have long memories and can list many issues that characterize the city as the 900-lb gorilla or other descriptions that are not flattering.[2]

The springs communities of San Marcos and New Braunfels cite San Antonio's long reluctance to diversify its water supplies in favor of dependence on the Edwards Aquifer.

The Guadalupe-Blanco River Authority (GBRA) relates a long history of indecisiveness on involvement in the Canyon Lake project and then the city's reneging on the GBRA project in the mid-2000s.

Atascosa, Wilson, and Gonzales Counties cite forays into their jurisdictions to attempt to access Carrizo fresh water and even Wilcox brackish water.

Added to specific, real or imagined unneighborly behavior over water is the general antagonism that residents of more rural areas seem to have for large central cities in their regions. Some of the rural residents have purposely fled the central city and nurture a distaste for the urban way of life. The characteristics of "bad neighbor" reappeared as one of the issues in the Vista Ridge project acceptance. San Antonio was described as using its superior access to money to obtain water the rural neighbors might need sometime in the future.[3]

San Antonio also originally passed up the opportunity to partner with Schertz/Seguin in favor of mounting a rival quest to obtain Carrizo water in the same areas for its own pipeline.

Significant Issues

The authors question the bad-neighbor tag related to the Vista Ridge project. Landowners have leased their water to contractors who are selling it to SAWS. The contractors have permits from the area's groundwater districts and have jumped through all the hoops. No one is being deceived and people who own the water are responding to a market opportunity.

The SAWS 2012 Water Management Plan relates other examples of SAWS and San Antonio being good neighbors. For example, SAWS is now sharing pipeline space with the Schertz/Seguin Local Government Corporation (SSLGC) in a cooperative arrangement that reduces costs for all parties.

In the Western Canyon project, SAWS utilizes the water and pays the cost of water that smaller communities, such as Fair Oaks Ranch, own but do not need until a later point in their population development. Everyone benefits from the arrangement.

The list of actions that merit "good neighbor" status also include the role SAWS is playing in the Edwards Aquifer Habitat Conservation Program. San Antonio pays 70 percent of the total cost of the agreement and makes its Aquifer Storage and Recovery (ASR) facility available to the region, saving everyone many millions of dollars.[4]

In terms of its Trinity Aquifer water-supply leases, SAWS reduces its pumping of the Trinity Water to very low levels during droughts, even though it has take-or-pay arrangements from some of its contracts.[5] The only explanation offered is that by reducing its pumping, SAWS makes it possible for its neighbors to access the limited remaining water.

The authors are not sure how many good deeds San Antonio needs to perform in water policy situations to emerge with a good-neighbor rating from its neighbors but its performance, as reflected in the 2012 Water Management Plan, is impressive. The authors commend SAWS for its behavior as a good neighbor and recommend it make more of an effort to take credit for this performance.

Water Policy Issues: Water Quality

Edwards Aquifer Protection: Conservation Easements

The citizens of San Antonio have a relatively long history of voting to use sales-tax funds to purchase land and buy easements to protect sensitive lands over the contributing and recharge zones to the Edwards Aquifer.

Through use of 1/8 cent of this sales-tax revenue, $235 million has been authorized and $183 million raised and spent to protect 128,347 acres of property.[1] The 128,347 acres represents 18 percent of the contributing and recharge zones in Uvalde, Bexar and Medina Counties.[2]

As Table 8 indicates, the first venture in 2000 (Proposition 3) targeted land purchases. The land included in the Friedrich Park Wilderness Area in Bexar County was purchased through Proposition 3.

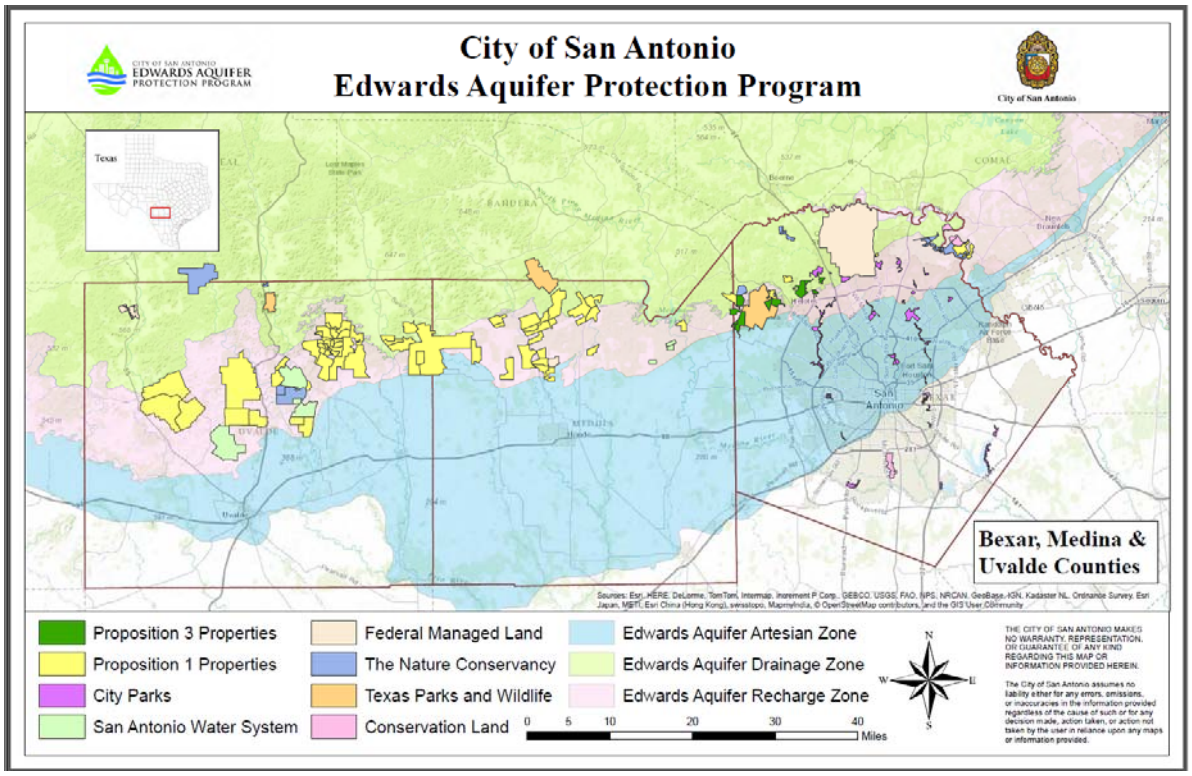
The propositions passed in 2005 and 2010 changed to purchase easements rather than the property. The change allowed the funds to protect more acreage because easements are less expensive than land purchases. The 2005 and 2010 propositions also allowed purchase of easements in Medina and Uvalde County. That change recognized recharge from those counties was important to the aquifer and that easements were less expensive than those in Bexar County. Figure 5A shows the location and extent of the Proposition 3 and Proposition 1, lands along with the other properties in protective status.

Table 3A.

City of San Antonio Edwards Aquifer Protection Program Conservation Easements[3]

Title	Date	Amount Authorized	Acres Purchased	Easement Acres
Proposition 3	May 2000	$45M	6,553	-
Proposition 1	May 2005	$90M	-	90,150
Proposition 1 Continued	Nov 2010	Additional $90M	-	31,534
Totals		$225M	6,553	121,684

Figure 5A.



Source: Rivard Report. October 17, 2014[4]

Proposition 1 easements are negotiated by two entities, the Green Space Alliance and the Nature Conservancy. The Edwards Aquifer Protection Program of the City of San Antonio and the Edwards Aquifer Authority conduct monitoring of the easements. Representatives of both entities may enter the properties to ensure the provisions of the easements are maintained.[5]

The Edwards Aquifer Protection Program allows the taxpayers of San Antonio to help protect their water sources by limiting development and impervious cover in the contributing and recharge zones.

The program is also popular with landowners who want to preserve the rural and agricultural nature of their land. Landowners receive significant payment for the easements that prevent development or major land-use changes. The rules prevail even in a land sale or inheritance. The decreased value reduces real-estate taxes and takes economic pressure off the landowner to seek higher-value development.[6]

In 2015, Franco Sanders Romero is the chairperson of the City of San Antonio's Conservation Advisory Board (CAB) and she leads the effort to pass a fourth version of the Protection Program Extension Proposition (Proposition 1 on the ballot) to extend the use of sales-tax funds to purchase conservation easements over the contributing and recharge zones of the Edwards Aquifer.[7] The issue involves $180 million (in addition to the $100 million for easements represented by Proposition 1, Proposition 2 includes $80 million for linear parks. [8]

Significant Issues

In addition to the importance of conservation easements in helping protect essential contributing and recharge areas, the history of citizen willingness to vote to use sales-tax revenue for conservation easements is important. It supports the idea that San Antonio voters understand the relationship between the recharge area and their water supply. They also are willing to spend tax funds to protect the recharge zone.

EARZ and Contributing-Zone Protections

The land-use regulations of the City of San Antonio Unified Development Code (UDC) include specific protections for the Edwards Aquifer Recharge Zone District (EARZ), developed in cooperation with the San Antonio Water System. The authors have reviewed prohibited-use categories and agree these are appropriate. Additionally, the city code includes a systematic program requiring aquifer protection plans for certain development activities. Again, the authors agree with this approach and its means of implementation.

It has long been known that the major source of recharge to the Edwards Aquifer is infiltration of water from streams as they cross the recharge zone.[1] While the exact magnitude of streambed infiltration vs. diffuse land-surface infiltration is still under investigation, Slade et al.'s (1985) finding that 85 percent of recharge to the aquifer occurs from streambed influx is generally accepted as a representative value.[2] Thus, the overwhelming majority of recharge begins as rainfall runoff from the contributing zone uphill of the porous recharge zone.

The importance of addressing potential water quality problems in contributing zone runoff is underscored by State of Texas legislation and TCEQ procedures. Specifically, 30 TAC 213.21, as implemented by TCEQ, requires formulation of a "Contributing Zone Plan" (CZP) to protect runoff-water quality during development activities that may disturb soil or otherwise cause contamination. This is an important approach. The rapid nature of flow in karstic aquifers like the Edwards increases the importance of source-water protection.[3]

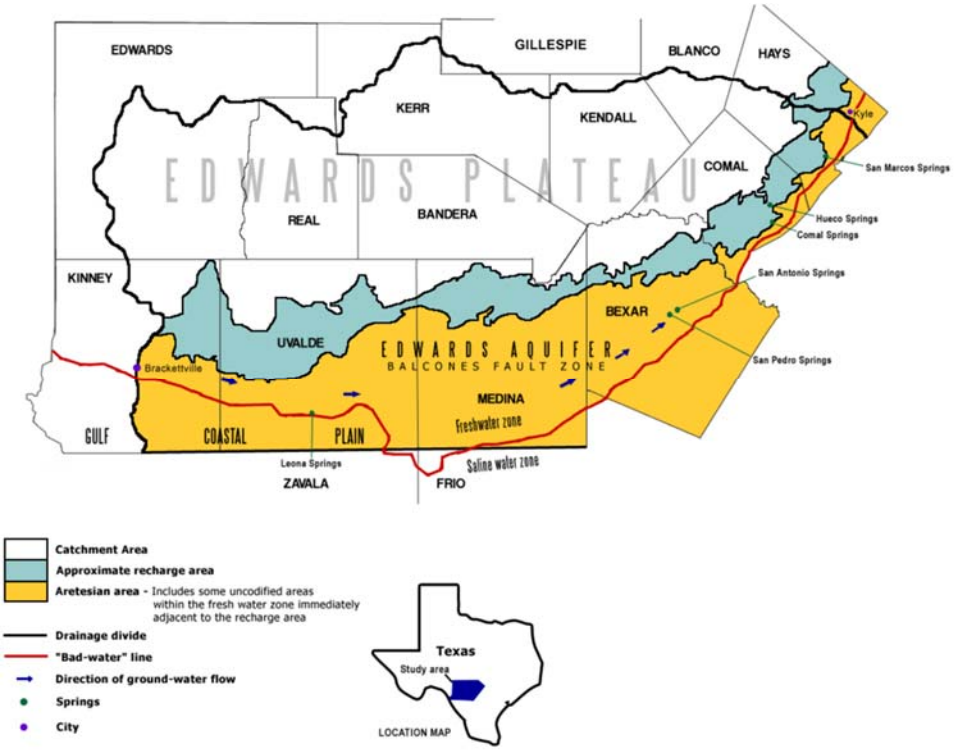
Significant Issues

However, by statute, only the contributing zone in the following counties are considered in current procedures: Bexar, Comal, Hays, Kinney, Medina, Travis, Uvalde, and Williamson. This limitation ignores the vast majority of the contributing zone area (see Figure 6A on next page). Of particular concern should be areas of Kendall and Bandera counties draining to the Cibolo Creek, Medina River and Hondo Creek watersheds as these three streams are most proximate to SAWS water-supply wells.

The fragility of water quality in this area has already been recognized by the impressive efforts to develop and implement a watershed protection plan for Upper Cibolo Creek.[4] As the San Antonio metropolitan region continues to expand outward, expect increasing urbanization to threaten water quality by increasing the potential for runoff-borne contaminants to enter recharge streams, as has been seen for the Upper Cibolo drainage area.

A long-term plan should be developed for protecting water quality of runoff from contributing-zone regions. This plan must expand its geographic scope beyond the current counties defined by state statute. Details of the plan are beyond the scope of this assessment. However, we recommend it encompass the full range of programs with which the region has gained valuable experience: conservation easements, land purchases, and watershed protection planning. Beyond the Upper Cibolo Creek plan, significant expertise on watershed protection has been demonstrated for the Upper San Antonio River.[5]

Figure 6A.
Edwards Aquifer Contributing Zone



Map shows the full extent of the Edwards Aquifer Contributing Zone (white outlined in black, marked as “Catchment Area” in legend)
Source: Excerpted from SAWS data 2015.[6]

Contamination Threat

Among various infrastructure systems, drinking-water utilities have perhaps the most intimate relationship with the general public – water systems literally extend into people's homes. Thus, the potential for conveyance of a chemical or biological hazard through a drinking-water system should be carefully considered.

In response to the 2001 terrorist attacks in New York and Washington, the U.S. Federal Government passed the "Public Health Security and Bioterrorism Preparedness and Response Act of 2002" (P.L. 107-188). This law required community drinking-water systems serving more than 3,300 persons to complete (1) a vulnerability assessment and (2) an emergency-response plan based on the results of the vulnerability assessment.

The authors of this study have not been able to review either of these documents from SAWS. Thus, the information, analysis, and opinions expressed in this section will be based on general knowledge and expertise.

Risk of Intentional Contamination

While the post-9/11 era has placed significant emphasis on the possibility of terrorism in the United States, the risk posed by an external actor intentionally attempting to contaminate a large water system such as SAWS is very low. While there have been several incidents over the past few decades of groups or persons believing they could do so[1], to the authors' knowledge, there is no documented case in contemporary U.S. history of a successful intentional water-contamination event. Several factors make this type of event very difficult to achieve:

- Disinfectant chlorine levels in potable water systems are sufficient to neutralize many biological and chemical agents
- The large volumes and flow rates present in a major city water system would require very large quantities – e.g., trailer loads – of a contaminant to overcome dilution effects
- Equipment necessary to input these large quantities of contaminant would be large and visible
- Access points to the distribution network appropriate to distributing a contaminant to many users tend to be in central and visible locations
- The most critical locations in the distribution network (e.g., pump stations, storage tanks) are protected with multiple types of physical security.
- Internal actors (e.g., utility employees and contractors) could theoretically overcome some of these obstacles. However, standard protocols including cross-checking and redundancy in operations and monitoring can eliminate the possibility that one person or a small group could succeed in an attack.

The risk of an intentional contamination event is very low and SAWS should perform industry-standard reviews of its physical security, monitoring, personnel review, and other relevant procedures on a regular basis.

Accidental Contamination

In contrast to intentional events, accidental contamination events have occurred in numbers significant enough for concern and meaningful analysis. Blackburn et al. (2004) reported just under 300 accidental contamination events in U.S. community water systems for the period 1971-2002.[2] Hrudey and Hrudey (2004) provide detailed descriptions of over 70 events worldwide over the 1974-2004 period.[3]

On occasion, these events have had devastating consequences – e.g., over 400,000 cryptosporidiosis illnesses and 54 deaths in Milwaukee in 1993, and a "Do Not Drink or Boil" order affecting 500,000 water users in Toledo, Ohio, in 2014.[4] Meta-analysis of these studies by Rasekh and Brumbelow (2013) investigated a range of risk factors and determined the following based on the facts of historical events[5]:

1. Accidental contamination events were roughly split evenly between groundwater-and surface-water-supplied systems.
2. Human error played at least a partial role in causation for about 56 percent of events.
3. Human error was the dominant cause in about 25 percent of events.
4. Contaminant intrusion into the water system occurred 89 percent of the time at a water treatment plant/production well, 9 percent of the time in the pipe network, and 2 percent of the time at storage tanks.

Bristow and Brumbelow (2006) reviewed accidental water-contamination events to find that prior emergency planning, including planning of communication to water users, plays a significant role in the eventual consequences of such an event.[6]

SAWS' specific infrastructure characteristics are relevant to these findings. The large number of system input points (e.g., well fields and pump stations) with associated chlorinators provides a significant quantity of potential failure points for the disinfection process – the most vulnerable point for contaminant intrusion. Technological advances in recent years can be used to advantage, but it should be remembered that human error is causally significant. The rapid recharge nature of the karstic Edwards Aquifer slightly increases the possibility of source-water contamination versus a clastic aquifer, but any groundwater source is much less vulnerable than a surface-water source.

Significant Issues

Consistent with the development of a revised Comprehensive Plan, the whole policy of SAWS' automatic responsibility to provide infrastructure for water and wastewater services in the ETJ should be reviewed. Among the questions addressed that need to be addressed are "Does the policy encourage urban sprawl and wasteful expenditure of

public funds?" On the other side of the argument, does the current policy reduce the chance of Edwards Aquifer recharge contamination and threats to new homeowners due to inadequate water-resource development and/or individual septic systems?

A second important issue involves difference between EARZ development rules for unincorporated areas in the ETJ vs. rules for annexed properties within the city limits. Why do the differences exist and are they appropriate?

The issues under this topic gain special significance if the Comprehensive Plan development is parallel to an effort to establish an adequate and consistent policy of development rules across the entire recharge and contributing zone.

Low-Impact Development

It is not obvious to most area citizens, but there is a major, behind-the-scenes effort to make low-impact development (LID) easier to use in the region. The San Antonio River Authority (SARA) has initiated the effort because LID is a set of development criteria that,if used, make it less likely pollutants, such as heavy metals, bacteria and eroded soil will reach tributaries and the San Antonio River. [1] SARA defines LID as a "group of techniques to mitigate the impact of urbanization on the hydrologic cycle."[2]

Low-impact development is synonymous with terms such as "voluntary use pattern" and "conservation use pattern."[3] The idea is that instead of requiring developments or other new construction to follow the currently prescribed practices of runoff control, plantings, irrigation, easements and drainage structures, builders would assess the characteristics of the property concerned and utilize alternative pollution and conservation-control strategies that are more site-specific.[4] Some of the tactics mentioned include rain gardens, permeable pavements, cisterns, natural channel design protocol and other nature-mimicking features.[5] The goal is to preserve natural and even historical features of a piece of land while reducing chances of erosion, increased impermeable cover and plant-cover removal.[6]

The current Uniform Development Code (UDC) does have a provision for LID development but no one uses it, possibly because it requires 50 percent of the site considered be taken up with the LID-type features and a belief that it is a more expensive development option.[7]

Proponents of a change to the requirement want to make it easier to comply. They are suggesting a reduction to 40 percent of the land surface reserved for LID features and liberalizing the definition of LID features to include adding golf courses and walking trails.[8] The proposed rules would, however, not allow easements, utility rights of way, or equestrian paths in the total.[9]

For more information on the current discussions and provisions for the proposed UDC changes, visit the SARA website (www.sara-tx.org).

Two groups were formed by the San Antonio River Authority to work on the proposed UDC changes. The Agency Advisory Panel includes representatives from SAWS, Bexar County, City of San Antonio, Edwards Aquifer Authority and the Texas Department of Transportation (TxDOT).[10] The Development Stakeholder Group includes representatives of the development industry, real-estate interests and other interested parties.[11]

In addition to staffing the LID advisory groups, SARA has prepared a "Low-Impact Development Technical Guidance Manual" that offers free assessment services to property developers and an LID competition to promote low-impact development throughout the larger San Antonio community.

The manual includes descriptions of LID best management practices (BMPs), cost estimates and regulatory guidance, in addition to other information. The assessment service will help developers consider some of the LID-type features their property has and how the development may benefit from the LID option.

Significant Issues

The low-impact development effort led by SARA is a development proposal limited to areas outside the Edwards Aquifer recharge zone. The SARA website links visitors to the Texas Commission on Environmental Quality for more information on development requirements over the Edwards recharge zone.[12] The development alternative offers the option to combine less intrusive property use with more natural pollution and erosion-protection techniques for projects that voluntarily sign on to the concepts.[13]

The effort to make LID sustainable development more attractive through liberalizing the requirements (code modification), education, incentivizing the use of LID, and providing outreach to local government partners may serve as an example for the Cities of San Antonio and Fair Oaks Ranch to consider as they explore and organize a “contributing zone” effort.[14]

Coal-Tar Sealant

One of the risk evaluation factors in the San Antonio water policy analysis is "threats to water quality." The analysis is not meant to be an in-depth study of water-quality threats or challenges but it will note water-quality issues that need to be considered.

The coal-tar sealant question appears to be an example of an issue with claimed negative water-quality effects that can be addressed by legislation or local ordinance. Examples of legislative action to ban the use of coal-tar sealants include the states of Minnesota and Washington. Local bans exist in many counties and cities throughout the U.S. Austin was a pioneer in passing an ordinance banning the use of coal-tar sealant when it related high polycyclic aromatic hydrocarbons in area waterways to nearby parking lots recently coated with coal-tar products. The arguments for reduction of the use of coal-tar products are persuasive to some communities and states, but not all.

The United States Geologic Survey and some university researchers offer research results that identify coal-tar sealants as a major source of polycyclic aromatic hydrocarbons, a material identified by various entities as a carcinogen.[1] *Chicago Tribune* reporter Michael Hawthorne in his article, "Coal-tar industry fights bans on sealants" cites sources of research on both sides of issue but concludes the anti-coal-tar research is more convincing.[2]

The Pavement Coating Technology Council and other industry sources disagree. They describe the body of research as flawed and cite the results of their own funded research [3]. A considerable portion of the PCTC-funded research is authored by Kirk O Reilly, PhD, and published in *Environmental Forensics*.[4] The industry's arguments have convinced legislatures in Maine, Illinois, Michigan, and Maryland to defeat ban initiatives.[5]

Significant Issues

The authors of the City of San Antonio Water Policy Analysis recommend that City of San Antonio policymakers review the available research results to determine if coal-tar sealants provide a threat to San Antonio water quality and if an ordinance regulating use of such materials will address any water-quality threats identified. Eleven sources of information on the coal-tar issue are attached for use in the review.

Pro Ban: http://tx.usgs.gov/sealcoat.html

1. Barbara J. Mahler, Peter Van Metre, Judy L. Crane, Alison W. Watts, Mateo Scoffins, and E. Spencer Williams, "Coal-tar-based pavement sealcoat and PAHs: Implications for the environment, human health, and stormwater management." USGS, Austin, TX http://tx.usgs.gov/coring/pubs/MahlerESTsealcoatFeature2012.pdf

2. E. Spencer Williams, Barbara J. Mahler, Peter C. Van Metre, "Coal-tar pavement sealants might substantially increase children's PAH exposures" *Environmental Pollution*. Elsevier. May 2012. http://www.sciencedirect.com/science/article/pii/S0269749112000279

3. Peter C. Van Metre, Barbara J. Mahler, “Contributions of PAHs from coal-tar pavement sealcoat and other sources to 40 U.S. lakes” USGS, Austin, TX, 2010. http://tx.usgs.gov/coring/pubs/Van%20Metre%20PAH%20sources%20STOTEN2010.pdf

4. Van Metre, P.C., Mahler, B.J., Wilson, J.T., and Burbank, T.L., 2008, Collection and analysis of samples for polycyclic aromatic hydrocarbons in dust and other solids related to sealed and unsealed pavement from 10 cities across the United States, 2005–07: U.S. Geological Survey Data Series 361, 5 p. http://pubs.usgs.gov/ds/361/pdf/ds361.pdf

5. Van Metre, P.C. and Mahler, B.J., PAH Concentrations in Lake Sediment Decline Following Ban on Coal-Tar-Based Pavement Sealants in Austin, Texas. http://tx.usgs.gov/coring/pubs/PAHConcentrationsArticle.pdf

Con Ban: http://www.pavementcouncil.org/scientific-journals

1. Robert P. DeMott, Thomas D. Gauthier, James M. Wiersema, Geoffrey Crenson, ”Polycyclic Aromatic Hydrocarbons (PAHs) in Austin sediments after a ban on pavement sealers” *Environmental Forensics* Vol. 11, Iss. 4, 2010. http://www.tandfonline.com/doi/abs/10.1080/15275922.2010.526520#.VPigAfnF_y0

2. DeMott, RP, Gauthier, TD (2014). Comment on “PAH concentrations in lake sediment decline following ban on coal-tar-based 1 pavement sealants in Austin, Texas”. *Environmental Science & Technology* DOI: 10.1021/es5046088. http://pubs.acs.org/doi/abs/10.1021/es5046088

3. Brian Magee and Janet Keating-Connolly,“ Comment on ‘Cancer risk from incidental ingestion exposures to PAHs associated with coal-tar-sealed pavement’” *Environmental Science & Technology* 2014 48 (1), 868-869. http://pubs.acs.org/doi/abs/10.1021/es404184q

4. O'Reilly, K. (2014). Article title misstates the role of pavement sealers. *Environmental Pollution* 191:260-261. http://www.sciencedirect.com/science/article/pii/S0269749113006180

5. ARCADIS (2013). Peer review of coal-tar-sealed pavement risk assessment report prepared for the Pavement Coatings Technology Council. 17 p. http://www.pavementcouncil.org/pavementcouncil/Peer%20Review%20CTS%20Report_Revised2.pdf

6. O’Reilly, K., Pietari, J. and Boehm, P. (2012). A forensic assessment of coal tar sealants as a source of Polycyclic Aromatic Hydrocarbons in urban sediments. *Environmental Forensics*, 13:185-196. http://www.tandfonline.com/doi/abs/10.1080/15275922.2012.676598#preview

Annexation of Unincorporated Areas

There are pressures on the City of San Antonio to more readily annex unincorporated areas in the county.[1] Bexar County Judge Nelson Wolff contends that the fast-growing areas need more access to services that only can be provided by the City of San Antonio or incorporation into their own city.[2] Bexar County cannot provide those services because it is limited to revenues provided by the property tax. A municipal government has access to the property tax plus a portion of the sales tax. In San Antonio's case, the city also receives revenue from CPS Energy and the San Antonio Water System, based on gross receipts.[3]

On the other side of the issue, the city must deliver a full set of city services to any areas that are annexed and claims that it is obligated to ensure that paying for those services is not relegated unfairly to current City of San Antonio residents. The city is also limited to an annual annexation plan that does not exceed 10 percent of its current land area or may annex no more than 30 percent of its land area if carrying over from its previous years.[4]

Potable water and sewer services are not on the list of required new services as part of annexation because SAWS already has that responsibility due to its ETJ requirements. SAWS must provide municipal water and sewer services to developments that request them and developers must agree to pay the impact fees.[5]

Another important water-related result of annexation is that the annexed areas evolve to less restrictive EARZ restrictions than they do as unincorporated parts of the SAWS ETJ.[6]

Significant Issues

Consistent with the development of a revised Comprehensive Plan, the City of San Antonio should review the policy that automatically requires SAWS to provide infrastructure for water and wastewater services in the ETJ. Among the questions to be considered are " Does the policy encourage urban sprawl and wasteful expenditure of public funds?" On the other side of the argument, does the current policy reduce the chance of Edwards Aquifer recharge contamination and threats to new homeowners due to inadequate water-resource development and/or individual septic systems. A second important issue involves differences between EARZ development rules for annexed properties within the city limits. Why do differences exist and are they appropriate?

The issues under this topic gain special significance if the Comprehensive Plan development is parallel to an effort to establish an adequate and consistent policy of development rules across the entire recharge and contributing zone.

Water Policy Issues: Regulatory Agencies

Texas Water Development Board (TWDB)

The Texas Water Development Board is the state's primary water planning and financing agency. TWDB has three main responsibilities.[1]

1. Collect and disseminate water-related data
2. Plan for the development of the state's water resources
3. Administer cost-effective financing programs.

The TWDB mission is "to provide leadership, planning, financial assistance, information and education for the conservation and responsible development of water for Texas." [2]

The TWDB is a state agency with responsibilities important to the City of San Antonio water program. Among those responsibilities are[3]:

- TWDB is responsible for the production of a state water plan and support for regional planning efforts used to construct the state plan.
- Local water projects must be included in the regional plan in order to be considered for any of the funding sources available from the TWDB.
- TWDB specifies how water purveyors must calculate lost and non-revenue water and collects the information. Lost water over a specified amount must be addressed with TWDB or local funds before the funds can be used for other projects.
- TWDB specifies each water purveyor must have a water-conservation plan that passes muster with the TWDB before any funding can be considered.
- There is a long list of funding sources available through TWDB. Among the most important are the Texas Water Development Fund, the Water Research Grant Program, and State Water Implementation Fund for Texas (SWIFT).

TWDB through its Water Development Fund is providing a low-interest loan to SAWS to cover part of the costs of the brackish-groundwater-desalination project.

SWIFT is the newest funding opportunity from TWDB.

SWIFT Funds for Water Supply Projects

House Bill 4, passed by the Texas Legislature in 2011 and approved by voters as Proposition 6 in 2013, made provision for a $2 billion State Water Implementation Fund for Texas (SWIFT). This money will be available for low-interest, flexible-term loans for water-resource projects. At least 20 percent of the funding is reserved for water conservation or reuse projects and another 10 percent is reserved for rural projects.[5]

The legislation did not provide a specific definition of a water-conservation project. A popular definition of water conservation is to "make new water resources available through practices and technology that allow activities that use water to be completed at current levels with less water." This definition is in keeping with a statement in the legislation about SWIFT funds being used for "water-conservation or reuse projects designed to reduce the need … to develop additional water resources." [6] A definition of "rural" is referenced in the legislation.

Rural political subdivision means:

1. A non-profit water supply or sewer service corporation, district, or municipality with a service area of 10,000 or less in population or that otherwise qualifies for financing from a federal agency

2. A county in which no urban area exceeds 50,000 in population." [7]

3. To be considered for SWIFT funding, water-resource projects must be sponsored by a local government or public water purveyor and must already be in the current state water plan, which is made up of regional plans.

"Loan, Not a Grant"

SWIFT funds are available to water purveyors and local governments as a loan, not a grant; the money must be repaid. The assistance is desirable in many situations, however, because the interest rates will be low and the terms flexible. If SWIFT funds make it possible to fund a project and only pay the loan back when the water is available for sale to and paid for by ratepayers, that is a major advantage.

The Texas Water Development Board (TWDB) created rules for prioritization of the water-resource projects for funding. The legislation says TWDB should base those rules on input from the regional water-planning groups. The groups are currently prioritizing the projects in their regional plans by looking at them in terms of:

1. The decade in which the project will be needed

2. The feasibility of the project, including the availability of water rights for purposes of the project and the hydrological and scientific practicability of the project

3. The viability of the project, including whether the project is a comprehensive solution with a measureable outcome

4. The sustainability of the project, taking into consideration the life of the project;

5. The cost-effectiveness of the project, taking into consideration the expected unit cost of the water to be supplied by the project.[8]

The TWDB will further consider projects in terms of whether they:

1. Serve a large population

2. Provide assistance to a diverse urban and rural population
3. Provide regionalization
4. Meet a high percentage of the water supply needs of the water users to be served by the project.[9]

In addition, the TWDB must also consider at least the following criteria:

1. Local contribution to finance the project
2. Financial capability of the applicant to repay the provided funding
3. Ability of the TWDB and applicant to leverage state funding with local and federal funding
4. An emergency need for the project:
    a. Less than a 180-day supply is available
    b. Federal funding has been used or sought.
5. Readiness of applicant to proceed with the project:
    a. All preliminary planning and design work has been completed
    b. Applicant has acquired the required water rights
    c. Funding from other sources has been secured
    d. Applicant is able to begin implementation.
6. Applicant has filed a water audit with the TWDB
7. Prioritization given by the regional water planning group.[10]

Significant Issues

As the primary state agency involved in water planning and water-resource funding, the TWDB is very important to water security. Toward the end of being better able to take advantage of the services provided by TWDB, water-planning officials need to stay tuned and even seek to influence TWDB policies whenever possible.

Supporting appointment of commissioners sensitive to San Antonio-area issues is a worthy endeavor. It is also critical that funding for SWIFT, the Texas Water Development Fund water research and other TWDB funding programs be adequate to do the job.

Policies that affect how the funding is made available to water purveyors is also important. Policies that reward a strong conservation program as a prerequisite for receiving TWDB funds encourage successful conservation programs. Policies that reward water resource

innovations, such as brackish groundwater desalination, aquifer storage and recovery, and direct recycling, are also desirable.

In his book, “Head above Water,” author and water expert Robert Gulley noted that SAWS mobilized more staff than any other Edwards Aquifer Recovery Implementation Program (EARIP) participant, and organized a team of like-minded participants to the end of influencing the results of the EARIP effort.[11] A similar effort related to TWDB resources, including SWIFT, would be worth the investment of staff time.

Texas Commission on Environmental Quality (TCEQ) and United States Environmental Protection Agency (EPA)

The Texas Commission on Environmental Quality is the state agency charged with environmental regulation and enforcement. While this mission includes a wide range of responsibilities, the two areas of jurisdiction most relevant to SAWS are:

1. Regulation of water-utility operations, including water quality as delivered to consumers
2. Regulation of environmental water quality, including quality of treated wastewater discharged to receiving water bodies.

In performing these regulatory functions, the Texas Commission on Environmental Quality frequently acts as a state-level delegate for the federal government U.S. Environmental Protection Agency (EPA), although the relationship between these agencies is complex and has included some conflict in the past. Critical federal laws relevant to the two regulatory jurisdictions named above are, respectively, (1) the "Safe Drinking Water Act" (SDWA), originally passed in 1974 and amended multiple times since, and (2) the "Clean Water Act" (CWA) originally passed in 1972 and since also amended on multiple occasions.

SAWS' present water-supply operations are in compliance with SDWA requirements.[1] Wastewater infrastructure and operations have included CWA violations due to discharge of untreated wastewater during significant storm water events. However, SAWS has entered into a settlement with EPA to upgrade wastewater infrastructure to end these violations. Under the settlement terms, SAWS will make these improvements over a period of 10 years, with some limited work allowed within 12 years. Costs to SAWS under the settlement include a $2.6 million civil penalty and an estimated $1.1 billion in project costs.[2]

State and federal law and regulation relevant to CWA and SDWA issues have been relatively constant for several years. While some might argue with this statement due to various items of enforcement and reporting at the state and federal level[3], these items have generally been progressive implementations of existing law and regulation, not additions of wholly new concern. A typical example of the gradual nature of these processes is the groundwater rule first proposed by EPA in 2000, finally promulgated by EPA in 2006, and adopted for implementation by TCEQ in 2012.[4]

TCEQ, in its own current strategic plan, echoes the "Philosophy of Texas State Government" to include "government should be limited in size and mission…" (p. 3). That document's review of "Current Activities & Opportunities" relevant to the Clean Water Act (CWA) and Safe Drinking Water Act (SDWA) topics (pp. 177-184) emphasizes gradual implementation and efficiency improvements in regulatory activities, as well as technical assistance to water utilities for compliance. The agency does not express interest in expanding regulatory reach.[5]

Significant Issues

One water-quality issue does merit consideration as a risk over the medium- to long-term future. For roughly the past decade, scientific studies have been conducted on a very broad

group of “Contaminants of Emerging Concern” (CECs) in both drinking water and environmental waters.

The primary distinguishing feature of CECs is their very low levels of concentration when detected, typically on the order of “micrograms per liter” of water. These concentrations are roughly 1,000 times less than traditional contaminants measured in “milligrams per liter.” The recognition of CECs is largely due to improved laboratory tests and instruments able to detect at these low levels. CECs include a wide range of substances: pharmaceuticals, antibiotics, industrial chemicals, food additives, and others; and CECs are hypothesized to have a wide range of effects on human and animal health, including disruption of endocrine systems and inducement of antibiotic resistance. Scientific studies are underway to assess the real effects of CECs on human and environmental health as well as the introduction, transport, and fate of these substances in the environment.[6]

It is known, however, that existing water- and wastewater-treatment technologies are often ineffective at removal of CECs with better removal fractions often accompanied by higher costs (e.g., reverse osmosis and ozonation).[7] Intensive research is underway to determine appropriate technologies and combinations of the same for CEC removal.[8]

EPA is currently engaged in the scientific study process of CECs, largely through its “Endocrine Disruptor Screening Program” (EDSP).[9] In the authors’ opinion, regulatory action in Texas under SDWA or CWA authority is very unlikely in the next 10 years due to:

- Existing uncertainty over human- and environmental-health effects of CECs
- Existing uncertainty over effective technologies for CEC removal
- Generally gradual nature of regulatory implementation by TCEQ.

The next 10 years will likely see significant gains in knowledge affecting the first two bullets above. SAWS should monitor this field of knowledge on a regular basis to anticipate and prepare for any regulatory changes that may eventually occur.

Edwards Aquifer Authority (EAA)

Created by the State of Texas in 1993, the Edwards Aquifer Authority has regulatory jurisdiction to manage, conserve, and protect the Edwards Aquifer and to prevent waste or pollution of the aquifer's water in all of Bexar, Medina and Uvalde counties and portions of Atascosa, Caldwell, Comal, Guadalupe, and Hays counties.[1] The EAA authorizes up to a total of 572,000 acre feet of groundwater withdrawals each year used for municipal, industrial, and irrigation purposes. Among EAA responsibilities are:

- Groundwater permits issued by the EAA allow non-exempt well owners to withdraw Edwards Aquifer groundwater for municipal, industrial, and irrigation purposes.
- EAA regulated the storage of certain substances and hazardous materials on the recharge zone and the contributing zone of the Edwards Aquifer. Facilities in these environmentally sensitive areas are required to register with the Authority if they store an aggregate quantity exceeding 1,000 gallons or 10,000 pounds of regulated substances in containers 55-gallons or less in size.
- EAA regulates above-ground and underground storage tanks.
- EAA prohibits coal-tar-based pavement sealant products in Comal and Hays counties.
- The Authority serves as the administrator and signee of the Habitat Conservation Plan for incidental takes related to well permitting and other actions of the Authority.[2]

Representation on the Edwards Aquifer Authority Board is based on a regional compromise that provided seven representatives for San Antonio and eight for the rest of the region.[3] This political compromise means that San Antonio with 70 percent of the population in the region has less than 50 percent of the elected positions on the EAA board of directors. It means San Antonio's board members must recruit at least one other board member to support issues on which they are united and seek a favorable decision.

The EAA funds its regulatory and educational efforts by charging Edward Aquifer pumpers based on the water they lease or own.

Agricultural pumpers pay $2/acre foot for water they actually use. Municipal and industrial pumpers pay $37/acre foot plus another $47/acre foot for the Edwards Aquifer Habitat Conservation Program Implementation costs.[4]

On December 10, 2014, Mark Hamilton, AMS, ED, of the Edwards staff offered an analysis that credited the existence of the EAA with reducing pumping in the region by 2-4 million acre feet. The reduced pumping since 1996 has resulted in 1.8 million acre feet more spring flow and 600,000 acre feet more water in the aquifer, which translated to 17 extra feet of J-17 monitoring well level.[5]

There is no reason to question those claims, and also there have been positive accomplishments in creating an effective water market and contributing to the negotiation of the

Habitat Conservation Plan, all of which are important factors in protecting the endangered species and stabilizing the availability of water for San Antonio's use from the Edwards Aquifer.

Through the years, SAWS and the EAA have cooperated on issues such as abandoned-well capping, pump metering, supplementing water supplies for communities with shortages, the Pucek catfish farm water, the creation of the Habitat Conservation Program and many other issues.

The question of regulation of development over the EARZ has been an ongoing issue. It is a complex subject, but the EAA and some environmental entities favor EAA regulation as it exists in the non-urban areas. SAWS, TCEQ, developers and the state legislature have supported SAWS rules and enforcement in their Certificate of Convenience and Necessity (CCN).[6]

In 2013, the League of United Latin American Citizens (LULAC) filed a lawsuit seeking equal representation on the EAA Board based on population. SAWS has joined in the lawsuit.

Significant Issues

The issues in the LULAC lawsuit are not as simple as they seem. The areas in the Edwards Aquifer Area around San Antonio have a long history of using Edwards Aquifer water, and having major influence in the policies governing that use. They recognize the City of San Antonio has 70 percent of the region's population but don't necessarily believe water policy should be governed by urban populations. They cite a history of San Antonio water use and actions that have not been in the best interest of the resource or the environment.

It is ironic that development of the Edwards Aquifer Habitat Conservation Plan occurred in a structure created to represent diverse interests rather than to fulfill the idea of one person, one vote. The City of San Antonio only had one vote out of 26 in that process. If agreement can be reached, the advantage of such a structure (especially if it requires consensus) is that the population and economic segments that would do battle with decisions imposed by a majority, have bought into the decision. Without that ownership, we can expect a long period of dispute and more lawsuits if SAWS/LULAC should win the lawsuit.

The LULAC lawsuit and particularly SAWS' support of the lawsuit has annoyed Edwards Aquifer Authority staff and elected officials from the other counties (Uvalde, Medina, Comal, Guadalupe and Hayes) in the district. Some see this action as another attempt by SAWS to bully its neighbors. The situation could change as a result of this lawsuit[7]:

- LULAC and SAWS could win the lawsuit, with the result that 13 of the 15 board positions would be elected by Bexar County voters.
- The state legislature may intervene and divide EAA responsibilities between TCEQ (Permitting) and Texas Parks and Wildlife (Habitat Conservation Plan)
- The EAA may win with minor modifications and the situation will essentially stay the same.

If LULAC/SAWS do win the lawsuit, perhaps the parties and the legislature can produce a compromise on the model of the EAHCP that increases Bexar County's representation but also retains strong input from the other parts of the Edwards Aquifer area.

The authors recommend the City of San Antonio seek a compromise with the rest of the Edwards Aquifer stakeholders prior to an all-or-nothing settlement of the court case. Ideal would be a compromise that keeps the Edwards Aquifer Authority team in action but with more representation from Bexar County.

If LULAC/SAWS win the case on the basis of one person, one vote, there will be unhappiness on the part of the Western and Eastern Edwards Region counties, but since the new structure would be mandated by the courts and legislature, the basic structure would remain.[8]

As is usually the case in such court actions, there can be expected to be a three- to four-year delay for appeals and negotiations. The delay will lend uncertainty to the regulatory situation in the Edwards Aquifer area.[9]

Local Groundwater Districts

In addition to the Edwards Aquifer Authority, there are a number of local groundwater districts that have considerable influence over water-supply projects important to the City of San Antonio.

- **Evergreen Underground Water Conservation District** – The EUWCD is responsible for the Carrizo-Wilcox and minor aquifers in Atascosa, Wilson, Karnes, and Frio counties. Most water use is for agricultural irrigation. The EUWCD is a factor in the Twin Oaks ASR, brackish groundwater desalination and local Carrizo projects. The district is the most influential district within GMA 13, where decisions on Desired Future Conditions (DFC) are made for part of the Carrizo-Wilcox Aquifers. EUWCD is also an important factor in Eagle Ford hydraulic fracturing issues.[1]

- **Trinity Glen Rose Groundwater Conservation District** – The TGRGCD is responsible for Trinity Aquifer resources in north central Bexar County and for the Trinity Aquifer water used by Fair Oaks Ranch in Kendall, Comal and Bexar counties. The TGRGCD is a factor in the Trinity Aquifer water-supply project. It is a member of GMA 9, the groundwater management area that develops DFCs for the Trinity Aquifer.[2]

- **Gonzales County Underground Water Conservation District –** The GCUWCD is responsible for the Carrizo-Wilcox and minor aquifers in most of Gonzales County (576,000 acres) and a portion of Caldwell County (77,440 acres). The GCUWCD is a factor in the Schertz/Seguin Carrizo (Gonzales County), and the Wells Ranch projects. The District is also a member of the Region 13 GMA that sets DFCs for the Carrizo-Wilcox Aquifer.[3]

- **Post Oak Savannah Groundwater Conservation District –** The POSGCD covers the Carrizo-Wilcox Aquifer in Milan and Burleson counties. It is part of GMA 12, which includes the Brazos, Fredericksburg and Bastrop area of the Carrizo-Wilcox Aquifer. The POSGCD is the major groundwater district in the Vista Ridge project.[4]

- **Guadalupe County Groundwater Conservation District** – The GCGCD is the local regulatory agency responsible for permits to use Carrizo-Wilcox water in Guadalupe County. The GCGCD is a factor in the Schertz/Seguin Carrizo project, and the Wells Ranch water projects. The District is a member of GMA 13.[5]

Significant Issues

Local groundwater districts have local boards elected by residents in the geographic areas they represent. It is not surprising the boards often have a local outlook rather than a regional outlook. They are not usually sympathetic to the water needs of their larger neighbors, such as San Antonio. Rules usually discourage the export of water from their districts.

The election of local boards also leads to frequent policy changes that make it risky to invest the large amounts of funds needed to finance water projects.

It seems in the interest of good water policy for the City of San Antonio to support legislation that removes as much local control as possible. It would also serve the same interest more specifically to support legislation that limits GCD freedom to change policies for existing water permit holders, limits the ability of GCDs to discriminate against permitting for water projects out of the district and puts brackish-water supplies in the regulatory hands of state agencies to encourage their development.

Water Policy Issues: Water Costs

Water Project Costs

One of the major water-project-comparison and risk-analysis factors is the cost of the water produced by the water project being considered. The SAWS 2012 Water Plan states, “The annualized cost methodology was used as the basis for developing the cost per acre foot.[1] This methodology is currently recommended by TWDB for the regional water-planning process and calculates the current year annual capital and operations and maintenance costs throughout the debt-payoff period.

Project cost estimates were prepared based on the recommended standards of the Texas Water Development Board (TWDB) and modified to reflect current financial market conditions.” The plan also reports that SAWS assumes a three percent inflation rate through 2030, but it also states, “To allow for comparability, inflation is not assumed in the per acre-foot costs.”

Figure 7A below is taken from the SAWS 2012 Water Management Plan reports costs per acre foot for water-supply projects in the plan.

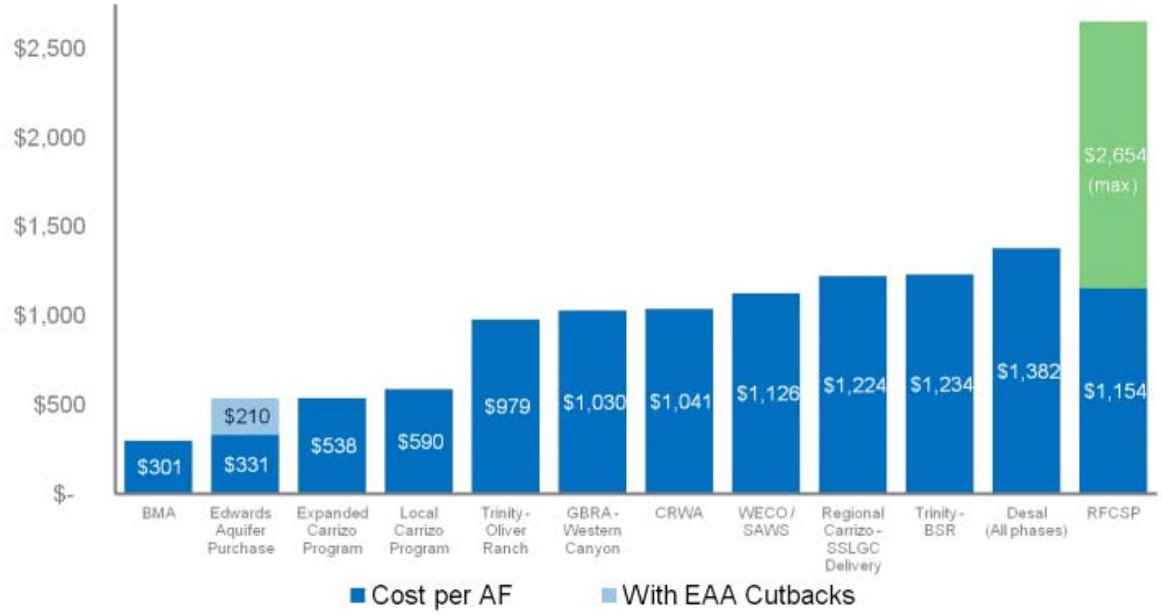
Significant Issues

The authors of this analysis were not enlisted to do a detailed review of the way SAWS estimates water costs but it may be useful for the City of San Antonio to have access to an appendix that relates more information on project-cost estimates, especially the consideration of inflation, which is important.

It is simple to compare project costs if they are at current or 2030 value, but the plan will have more long-term value if an appendix relates the logic for the application of inflation and a table showing current and inflated water costs when the project is scheduled for implementation.

The addition of the appendix will also be useful to link the costs in one plan to the changes in the next version of the SAWS Water Management Plan.

Figure 7A.
Annual Cost per Acre Foot by Project



The financial status of conservation incentives is discussed in the* ***Planned Projects* *section and currently SAWS has the ability to issue incentives up to $400 per acre-foot.*

Texas Water Rate Structures, Residential

Here is a brief comparison of water-rate structures for four cities – San Antonio, Austin, Houston, and Dallas. No economic efficiency or proper pricing of the water resource can and/or should be deemed from this comparison. No such analysis is conducted.

Pricing of water and related services is a combination of political, financial, and other realities. The four cities are consistent in that the rate structure varies by meter size and type of user (e.g. residential vs. other users). Because of the number and complexity of water-rate structures, only residential rates for a 5/8-inch meter size are presented here (see Table 4A and Figure 8A).

It should be noted Houston's website does not provide volumetric charges, rather just examples.[1] Volumetric charges are approximated from the examples for 2013 and 2014. Austin also charges a rate of $0.19/1,000 gallons as a water-revenue-stability reserve fund surcharge.[2] This value is included in the volumetric charges for Austin.[3] San Antonio also has different rates based on the season and location inside and outside the city, but standard inside-the-city rates are used here.[4] In addition to the Water Delivery charge, San Antonio also charges a Water Supply Fee and an Edwards Aquifer pass-through charge as part of the water bill.

All four cities employ a fixed monthly charge plus an increasing-block-rate structure based on water use (see Table 4A, Figures 8A and 9A on pages 150-151). The blocks vary by city. The sewer-rate structure is an increasing block rate for San Antonio (only two blocks with a small first block), Austin, and Houston. Dallas' volumetric rate for sewer is a uniform rate.[5] Sewer rates are based on winter water use in San Antonio and Dallas. It was not clear from the utilities' website for Austin and Houston if winter usage is used.[6]

For simplicity, the figures below are based on whether the winter usage applies to the amount in the graph. The first figure provides only the block-rate structure for water charges, whereas the second figure includes both water and sewer charges

Several aspects are apparent, San Antonio's (1) fixed monthly charge for water is larger than the other cities; (2) its fixed charge for sewer is in the middle of the four cities; i3) its volumetric water rates for both water and water plus sewer are less than the other cities for most blocks, but higher than Houston and Dallas for the highest block; and (4) its block-rate structure is closer to a uniform rate than the other cities.

Significant Issues

San Antonio has the most successful water-conservation program of the four major cities compared in this issue paper. Based on the rate comparisons for a basic residential meter, the city also seems to have the least expensive water and the least difference between blocks in its block-rate structure. Residential water users are not penalized by a steep rate increase for high water use. At the behest of its Rate Advisory Committee, SAWS has proposed a new rate structure which it will soon present to the SAWS Board and the San Antonio City Council for their consideration.

SAWS officials expressed the belief to the authors of this paper that the new rates and structure would further address several of the issues raised in this paper. The new rate structure would increase rates for all but the lowest-water-use households (27 percent fall in this category) and higher water usage blocks would be responsible for the steeper increases in rates. For more information on the rate proposal, a “pro” and “con” article, “The Price of Water,” by W. Carroll Jackson and Meredith McGuire was published in the San Antonio Express-News (Section F, Opinion) on Sunday June 21, 2015.

The contention is that the changes to the water rates for residential ratepayers will protect families through a “lifeline” water rate, and will have more water-conservation impact than the current rate structure.

Table 4A.

Residential Fixed Monthly Service Charge for Four Texas Cities, 5/8 Meter Size[6]

City	Water	Sewer
San Antonio	$7.57	$12.69
Austin	$7.10	$10.30
Houston	$5.00	$10.62
Dallas	$4.85	$4.45

Rates effective:
San Antonio – January 1, 2015
Austin – Water, January 1, 2015; Sewer, November 1, 2014
Houston – April 1, 2015
Dallas – October 1, 2014

San Antonio's fixed sewer charge also covers the first 1,496 gallons of wastewater usage; a volumetric charge is assessed on usage above 1,496 gallons.

Austin also charges a monthly tiered minimum charge based on total billed volume of water as follows:
0-2,000 gallons $1.05;
2,001-6,000 gallons $3,00;
6,001-11,000 gallons $7.60;
11,001-20,000 gallons $23.75;
and 20,001+ gallons $23.75.

Figure 8A. Residential Volumetric Water Rates for Four Cities in Texas [7]

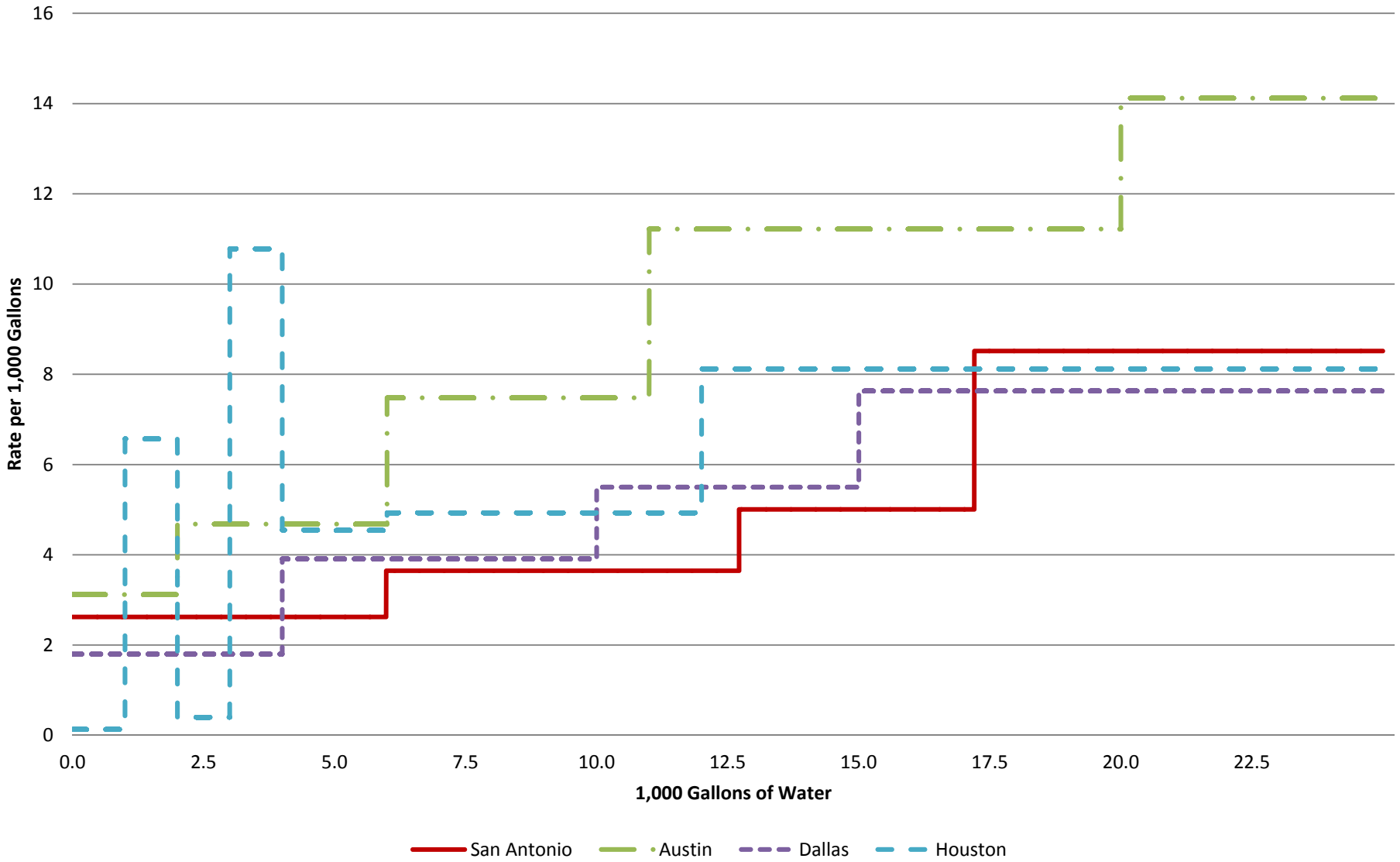
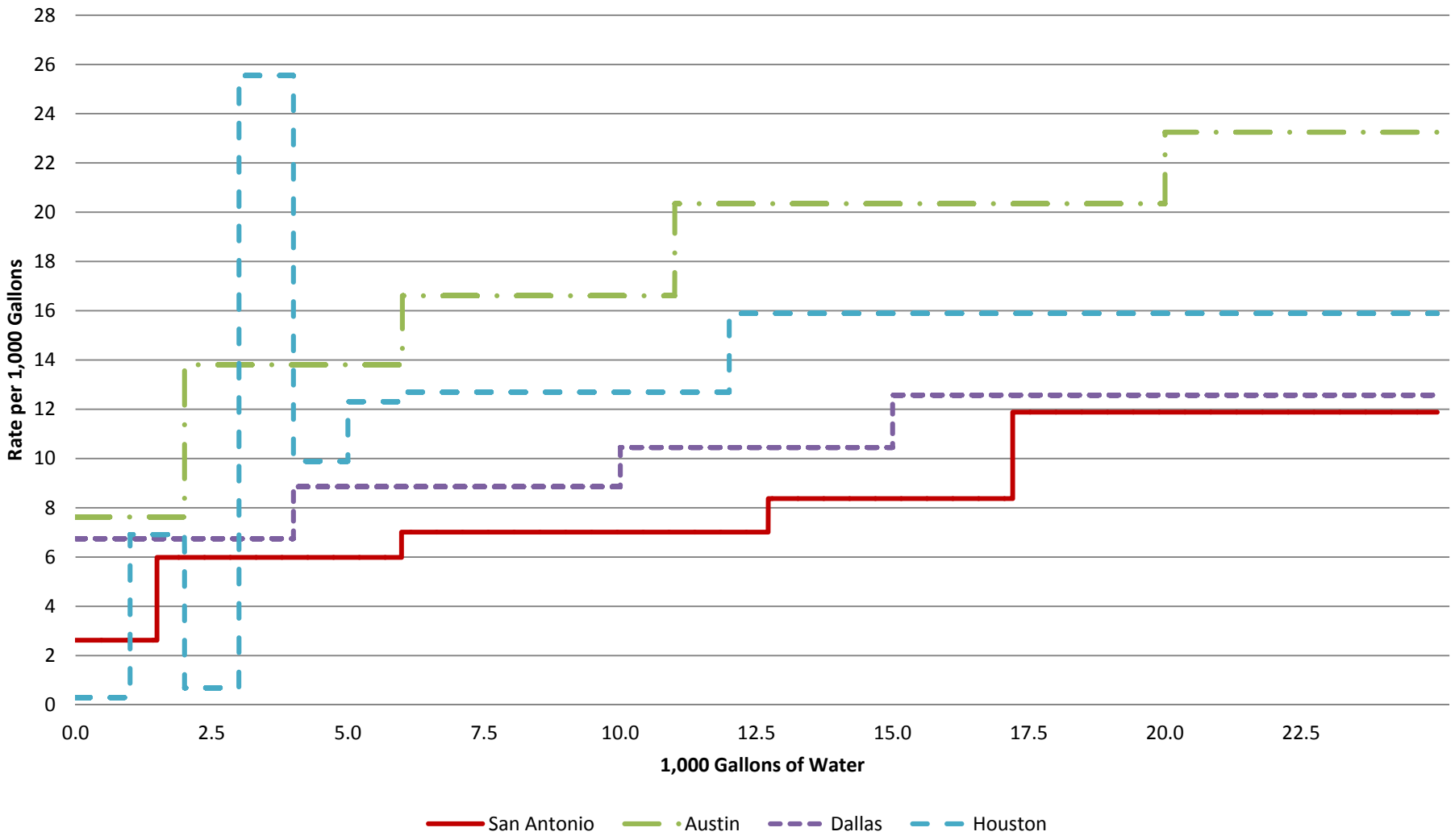


Figure 9A. Residential Volumetric Water & Sewer Rates for Four Cities in Texas [8]



Texas Water Rate Structures, Commercial and Industrial

Residential water rates may influence discretionary water use, such as landscape irrigation. It seems unlikely, however, that the rates themselves described above for the various cities would impact industrial development. As long as rates are roughly comparable, the cost to water residential lawns probably is not a factor in attracting industrial development to a community. Commercial and industrial rates, however, may be a factor, especially for a high-water-use industry.

Below is a brief comparison of water-rate structures for four cities: San Antonio, Austin, Houston, and Dallas. No economic efficiency or proper pricing of the water resource can and/or should be deemed from this comparison. No such analysis is conducted.

Commercial, business, and industrial pricing of water is even more complicated in the four cities than residential-rate structures. Depending on the city, rates depend on the meter size, type of user, and large- versus smaller-volume uses, and sometimes the particular customer. Below is a quick synopsis for comparison purposes.

Readers should consult each city for exact rates. The figure below illustrates the rates for one meter size and commercial customers. As seen in the figure, Houston and Austin charge a uniform volumetric rate that meets economic efficiency criteria (see section on residential water rates, page 147). San Antonio's structure is an increasing-block rate based on average annual use. San Antonio may secure economic efficiency gains by considering moving to a uniform rate. San Antonio rates are lower than the other cities, consistent with its residential rates.

In 2005, SAWS put commercial and industrial firms on an increasing-block-rate structure that resembles the residential increasing-block-rate structure. The commercial/industrial rates are different, however, in that they also include a water-use budget feature.[1]

A key feature of this water-use budget is to identify 100 percent of annual average consumption. Entities in this water-rate category pay $3.5251 per 1,000 gallons. The rates increase if the entity exceeds its base rate. At 100-125 percent of base water use, the rate is $3.7641/1,000 gallons for everything over the 100 percent amount. The 125-175 percent rate is $4.3491/1,000 gallons and, for water use over 175 percent of the base amount, the rate is $5.2981/1,000 gallons. The base amount is relatively easy to change from year to year, especially if the increased water use expectation reflects increased production and/or employment.[2]

San Antonio's water-rate structure includes a fixed charge based on meter size and then a monthly volume charge using an increasing-block-rate structure based on 100 percent of annual average consumption. Sewer rates in San Antonio include a minimum charge of $12.69 for the first 1,496 gallons consumed and a uniform rate of $3.365/1,000 gals.[3]

Austin's rate structure includes:[4]

1. Commercial rates consisting of a fixed charge based on meter size and uniform volumetric charges of $5.98 and $6.58/1,000 gallons for the two periods, off-peak and peak

2. Specified large-volume customers have fixed charges and lower uniform rates that depend on the user and vary from $5.02 to $5.98/1,000 gallons off peak and $5.52 to $6.58/gallons at peak.

A fixed minimum charge on the volumetric portion of the bill also is mandated, along with a water-revenue-stability charge of $0.19/gal. Austin sewer charges consist of a fixed charge of $10.30 per customer and then a uniform rate per 1,000 gallons based on the user. Uniform rates vary between $7.32 and $8.82 with most commercial customers paying either $8.79 or $8.82 per 1,000 gallons.[5]

Dallas has two rate structures for general services. Both include a fixed charge based on meter size. The first is a three-tiered increasing-block-rate structure of:[6]

1. $3.05/1,000 gals for the first 10,000 gallons

2. Above 10,000 gallons, a rate of $3.45

3. Above 10,000 gallons and 1.4 times annual average monthly use, $5.00/gal.

Dallas also has an optional general-services rate of $2,025.00 for the first one million gallons (minimum charge) and $2.75 per 1,000 gallons above one million gallons. Dallas sewer rates include a monthly fixed charge based on meter size and then a uniform rate of $3.70/1,000 gallons for general services under the tiered system and $3.38/1,000 gallons under the optional general-services rate with the one million gallon minimum charge.[7]

Houston charges a fixed rate based on meter size and then a uniform water rate of $4.10/1,000 gallons for commercial and industrial users. Sewer charges include a monthly fixed sewer charge based on meter size and a volume charge. For commercial users, the sewer volumetric charge is a uniform $5.80/1,000 gallons, whereas industrial users without a surcharge face an increasing-block-rate structure of $3.57/1,000 gallons up to 2,000 gallons and over 2,000 gallons, the rate is $6.35/1,000 gallons.[8]

The four cities also have various rate structures for customers with different needs, such as lawn irrigation, temporary services, recycled water, untreated water, interruptible and non-interruptible services. Sewer surcharges may also apply for the various customers, for example, based on biochemical oxygen demand (BOD) in wastewater.

Significant Issues

San Antonio's commercial and industrial rates and residential water rates are less expensive in most ways when compared to Austin, Houston and Dallas, but the rates are probably not different enough to provide a general competitive advantage to any of the cities. A city's

willingness to negotiate special rates to high-water-use industries or treatment of special needs may differentiate the cities.

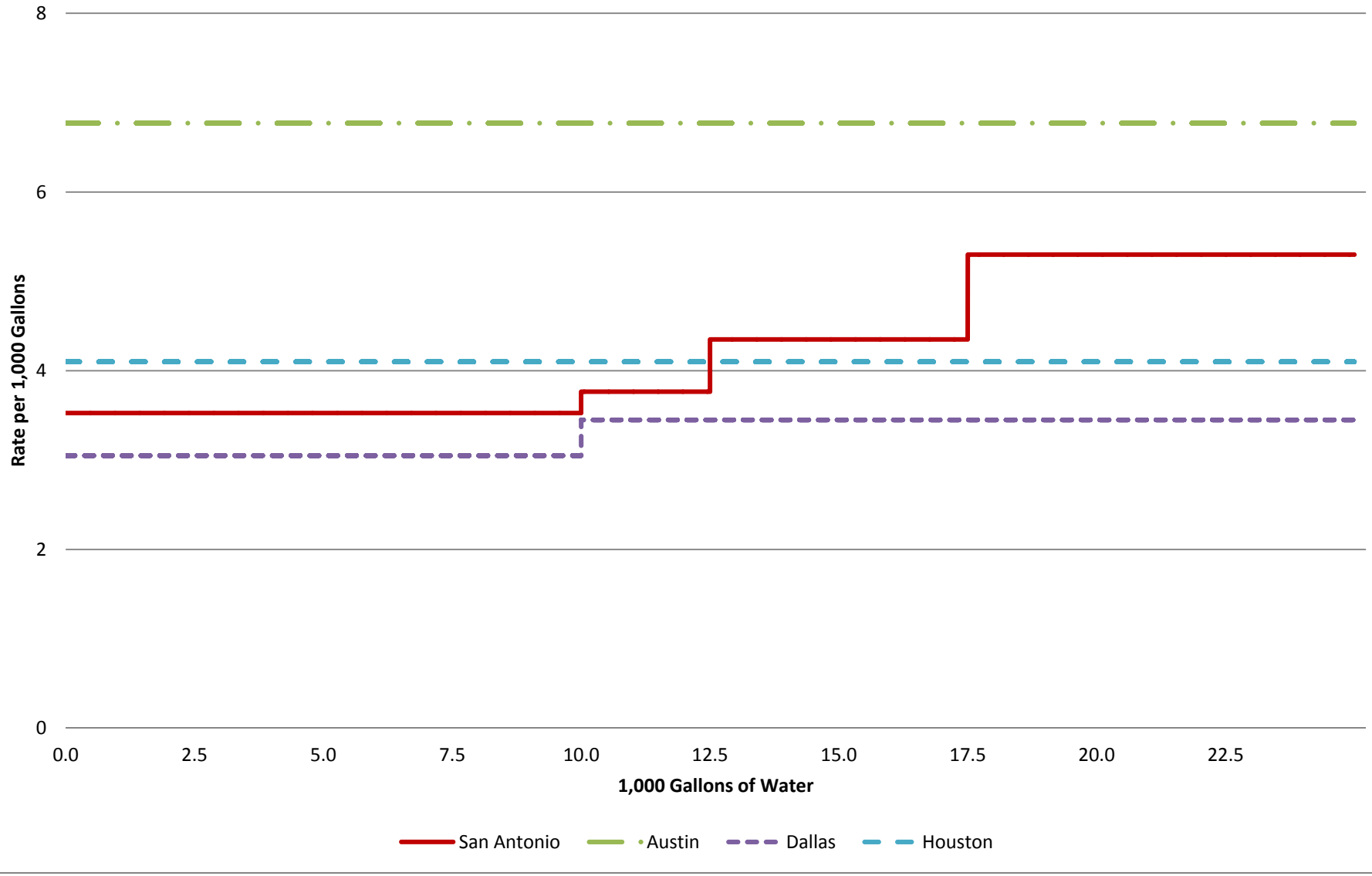
Table 5A.
Commercial Fixed Monthly Service Charge (dollars)
for Four Texas Cities, 5/8 Meter [9]

City	Water	Sewer
San Antonio	$10.53	$12.69
Austin	$14.77	$10.30
Houston	$5.19	$9.13
Dallas	$4.85	$4.45

Rates effective:
San Antonio – January 1, 2015
Austin – Water, January 1, 2015; Sewer, November 1, 2014
Houston – April 1, 2015
Dallas – October 1, 2014.

San Antonio's fixed sewer charge of $12.69 also covers the first 1,496 gallons of wastewater usage and then a volumetric charge is assessed on usage above 1,496 gallons.

Figure 10A. Commercial Volumetric Water Rates [9]



Impact Fees

Development impact fees are known by various labels depending on the community, are usually one-time charges with the goal of raising revenue for new-infrastructure construction. San Antonio's definition is that "an impact fee is a one-time charge imposed on new development to help recover capital costs associated with providing the infrastructure and other required improvements to provide service to that new development".[1]

There is no doubt new developments come with costly infrastructure requirements to maintain and increase the level of services, such as water and sewer systems, roads, schools, libraries, public safety, parks and other recreational outlets. These costs must be paid.

Total infrastructure services necessary for a given new development are, in general, not altered by impact fees, but these fees affect who pays for the infrastructure and the distribution of costs.

Impact fees arose because existing property taxes are not sufficient to cover the full costs of the new infrastructure, political resistance to raising taxes, decreasing federal subsidies, and the need to cover new infrastructure costs. Issues are distribution of costs, the impact of fees on new development, other more minor issues, and current impact fees.

Distribution of costs

Two general methods to raise the capital necessary for infrastructure are raising property taxes and impact fees. Increasing current property taxes charges the cost of the new infrastructure to all residents and not just the residents residing in the new development. Costs are spread out among many taxpayers, lowering any one resident's costs.

It has been argued that all residents benefit from economic development; therefore, they should help pay the costs. Impact fees charge the costs directly to new residents. Although impact fees may not charge the full costs of the infrastructure, the idea is impact fees are a more efficient way to pay for new infrastructure since those who benefit pay the costs. Impact fees are generally considered to promote economic efficiency as they charge the marginal costs to the new residents.

Within the use of impact fees, another distribution issue arises – the share of impact fee paid by the homebuyer and by the developer. Developers cannot simply add the fee to the price because of the elasticities of demand and supply (a relative term measuring responsiveness to changes in price). The less responsive (more inelastic demand) buyers are to price, the larger the share of the fee paid by the buyers. On the other hand, the more responsive buyers are to price changes (more elastic demand), the relatively larger share developers pay.

Impact of Fees on New Development

Demand for development is a derived demand based on the demand for new housing. Simple economic theory suggests increasing the price of a new house would decrease the quantity demand for new homes. This simple model is based on homogeneous product that

can be bought in continuous (infinitesimal changes in amount) quantities. Houses are heterogeneous and not bought and sold in continuous amounts, so the effect of impact fees on housing prices is much more complex, involving raw-land and housing markets. The fee may reduce raw-land prices, but developed land may recover some of this fee because of the improved infrastructure. Buyers may purchase smaller homes or smaller lots because of increased home prices.

How impact fees will impact a local housing market is a complex empirical issue beyond the scope of this report. Important factors include the amount of the fee, elasticities of supply and demand, which are dependent on factors such as economic and population growth, and the utility home buyers receive from buying new housing. As expected, because local conditions play an important role, the empirical evidence is mixed on how water and sewer fees affect new construction. Other impact fees generally are shown to reduce construction levels of single-family homes. Multi-family home construction may increase.

Other Potential Effects of Impact Fees

Impact fees may also have the following additional effects:

1. Increase the supply of buildable land as revenues are available for infrastructure development
2. Provide a policy mechanism to manage growth
3. Help the city avoid the leapfrogging effect of development
4. Change the attractiveness (positive and negative) of the area to businesses and residents.

Current Impact Fees – San Antonio

Current impact fees charged by San Antonio are shown in the table (effective June 1, 2015). San Antonio realtors estimate the median price of a single-family home to be $184,200, which is below the $201,400 median price of single-family homes in metropolitan areas in the U.S. [2]

Using the sum of largest impact fees in each category ($7,604) and the median home price, impact fees represent about 4.43% of the median price of a home. This calculation represents the largest possible increase for the median home and assumes the price of a median home is representative of new home prices. The approximate four percent is an upper bound, or ceiling, because most buyers will not pay the largest fees in each category, because new home median prices are usually larger than the median price of all homes, and because homebuyers and builders share the costs. A lower bound of 3.18 percent is found by summing the smallest fee values ($5,858). The weighted average impact fee of $7,205 per EDU is 3.91% of the median home price.

Significant Issues

The concept of impact fees is simple but the reality is not. In San Antonio, the goal is to have new developments pay 100 percent of their water and wastewater infrastructure costs. A recent headline stated impact fees covered 46.6 percent of the projected capital spending on water supply projects over the next 10 years.[3] The current impact fee, however is only part of the funds used to pay those costs. Estimates are made by SAWS of what development will occur in a particular area of SAWS CCN. The cost of that infrastructure and when the funds may be required are also estimated. Cash flow issues are involved and total costs can end up being paid from current, past and future impact fee accounts.[4]

Impact fees can also be used to direct growth and counteract urban sprawl in a community. In San Antonio impact fee waivers are available for City of San Antonio developments that build projects in the inner city and other targeted development areas.[5]

San Antonio reviews and revises its impact fees on a regular basis. The last review was made in 2014.

Table 6A.

Current Impact Fees*[6]
(Effective June 1, 2015)

Water Supply Impact Fee	$2,796
Water Delivery	
Flow	$1,182
System Development	
Low Elevation	$ 619
Middle Elevation	$ 799
High Elevation	$ 883
Wastewater	
Treatment	
Medio	$1,429
Dos Rios/Leon Creek	$ 786
Collection	
Medio	$ 838
Upper Medina	$1,565
Lower Medina	$ 475
Upper Collection	$2,520
Middle Collection	$1,469
Lower Collection	$ 719
Impact fees are shown as per equivalent dwelling unit (EDU)	
*Impact fees charged are based up the date of plat recordation. Properties requesting an increase in water or wastewater service beyond designated in the original plat will be subject to current impact fees.	

San Antonio Tables and Graphs

Notes and Citations, City of San Antonio

Water Source: Edwards Aquifer Groundwater (Page 61)

1. San Antonio Water System website – Edwards Aquifer Pumping Rights Acquisition. Available at www.saws.org/Your_Water/WaterResources/projects/edwards.cfm.
2. Adam Conner and René Gonzales, "San Antonio Water System's Supply and Demand Planning" SAWS Water Planners PowerPoint presented at the Southwest Texas APA Summer Mini-Conference, August 29, 2014. The dual member amounts provided by Patrick Shriver in phone conversation, 2/20/2015.
3. San Antonio Water System 2012 Water Plan, page 3, from copy printed from SAWS website at www.saws.org.
4. "About the Edwards Aquifer," Aquifer Level and Statistics, SAWS website, www.saws.org.
5. Diane Pavlicek, T.A. Small and P.L. Rettman, 1987 Hydrologic data from a study of the freshwater/saline zone interface in the Edwards Aquifer, San Antonio region, Texas: U.S. Geological Survey Open File Report 87-389, 108 p.
6. Robert L. Gulley, "Heads Above Water," page 3, Texas A&M University Press, College Station, 2015, The Inside Story of the Edwards Aquifer Recovery Implementation Program.
7. Greg Eckhardt, "The Hydrology of the Edwards Aquifer," The Edwards Aquifer website, http://www.edwardsaquifer.net.html. This portion of the website does not have page numbers but the information is provided early in the section.
8. Patrick Shriver, SAWS Project Coordinator, phone conversation with Calvin Finch in December, 2014.
9. Texas Commission on Environmental Quality website. Fifth Circuit Court of Appeals rules in favor of TCEQ in whooping-crane lawsuit. June 30, 2014.
10. Javier Hernandez, Edwards Aquifer Authority staff provided the breakdown of water-use totals in an email, Calvin Finch calculated percentages. December, 2014.
11. San Antonio Center website – Edwards Aquifer 'Pumping Rights Acquisition'

Water Source: Recycled Water (Page 65)

1. Darren Thompson, SAWS Water Resources Director, email response provided the 125,000 acre feet figure in a response to a request from Calvin Finch for the information12/19/14. Thompson also reported there were about 140,000 acre feet of wastewater produced each year.
2. Patrick Shriver, SAWS Water Resources Coordinator, phone conversation on 2/20/15 with Calvin Finch. The $319 figure is being used but is probably actually low.
3. Questions and responses provided by Darren Thompson on 12/18/14 in response to request for data on the Recycled Water Program. Electronic Communications.
4. Irrigational and Industrial Recycled Water, SAWS website at www.saws.org.
5. Darren Thompson, 12/19/14.
6. Darren Thompson, 12/19/14.
7. Darren Thompson provided the numbers in electronic communication with Calvin Finch, who made the calculations based on his knowledge of GPCD calculations.
8. Based on Calvin Finch's involvement as Conservation Director and Water Resources Director at SAWS in the decade of the 2000s.
9. Robert Puente, SAWS CEO, information provided in discussion with Texas A&M San Antonio President Maria Ferrier during meeting to seek SAWS rebate assistance for recycled connection by Texas A&M. Calvin Finch was present for the discussion.
10. Neena Satija, "San Antonio Seeks Ownership of its Wastewater," *Texas Tribune*, August 20, 2012.
11. Ibid.

12. Ibid.
13. Neena Satija, "State to San Antonio: No You Can't Own Your Wastewater," *Texas Tribune* 7/11/14.
14. Taylor Thompson, "Water Savings to be Part of Cut in Emissions," *San Antonio Express-News,* 11/29/14.
15. Darren Thompson electronic correspondence, 12/19/14.
16. Darren Thompson provided Table 10 to Calvin Finch in the exchange of information on 12/19/14. The table does a good job of explaining SAWS Recycled Water Program by the numbers.

Water Source: Vista Ridge (Page 69)

1. Neena Satija. "Private Sector an Oasis for Thirsty San Antonio," *Texas Tribune,* 11/12/14.
2. Ibid.
3. Greg Jefferson, "More light on the 3.4 billion SAWS pipeline deal," *San Antonio Express-News,* 11/23/14. The article discusses the Abengoa stressed financial status.
4. Michelle Gangnes, "Con-rural Texas could be next endangered species," *San Antonio Express-News,* 10/26/14.
5. Ibid. See note #1. Nina Satija, *Texas Tribune,* 11/12/14
6. Ibid. See note #1. Nina Satija, *Texas Tribune,* 11/12/14
7. Ibid. See note #1. Nina Satija, *Texas Tribune,* 11/12/14
8. Ibid. See note #1. Nina Satija, *Texas Tribune,* 11/12/14
9. Joe Krier, "Pro-San Antonio needs the water to grow business," *San Antonio Express News,* 10/26/14.
10. Vista Ridge Pipeline-Frequently Asked Questions available on the SAWS website-www.saws.org.
11. Opinion offered by Calvin Finch based on his interpretation of the discussion on the topic of, "Will the conservation effort continue now that Vista Ridge is in place?"
12. Michele Gangnes, 10/26/14
13. Opinion offered by Calvin Finch based on his work in water planning and familiarity with the Region Land/Region K water plans.
14. Scott Huddleston, "SAWS vows to 'respect' water from Central Texas town," *San Antonio Express-News,* 12/30/2014.
15. SAWS 2012 Water Plan, Page 21, copy printed from SAWS website, www.saws.org.
16. Karen Guz, SAWS Water Conservation Director, Conservation, 2/20/15.
17. Greg Jefferson, "More light on the $3.4 billion SAWS pipeline deal," *San Antonio Express-News,* 11/23/2014.
18. Nina Satija, *Texas Tribune,* 11/12/14
19. Doug Evanson, SAWS Chief Financial Officer, Phone Interview, April 6, 2015.
20. Ibid.
21. Ibid.
22. Ibid.
23. Ibid.

Water Source: Brackish Water Desalination (Page 73)

1. San Antonio Water System 2012 Water Management Plan, Page 6.
2. Ibid. Page 42.
3. Ibid. Page 31.
4. MySanAntonio.com, "SAWS embarks on plant to get salt out of water," at www.mysanantonio.com. 12/16/14.

5. Desalination Plant, San Antonio, United States of America, from Water and Technology website www.water-technology.net. 2/23/15.
6. From Calvin Finch based on information collected when he was SAWS Water Resources Director.
7. SAWS website, "Brackish Groundwater Desalination," www.saws.org.
8. From Calvin Finch based on experiences as SAWS Water Resources Director pursuing the development of the brackish groundwater desalination project.
9. Ibid.
10. Ibid. Information gathered and calculations made by Calvin Finch.
11. SAWS website, "Desalination Project Status" www.saws.org.

Water Source: Aquifer Storage and Recovery (Page 76)

1. Charles Ahrens in report given to the Edwards Aquifer Habitat Conservation Program Implementing Group January 15, 2015. Mr. Ahrens is the SAWS VP for Water Resources and Conservation.
2. Patrick Shriver, electronic communication on 2/24/15 after a phone conversation on 2/21/15. Calculation for the Edwards Aquifer Habitat Conservation Program.
3. SAWS website, "Twin Oaks-Aquifer Storage and Recovery." Available at www.saws.org.
4. Gregg Eckhardt, "Aquifer Storage and Recovery" from the Edwards Aquifer Website, page 1.
5. Phillip Cook, SAWS Engineer, "Twin Oaks ASR Operations" PowerPoint presentation to the Edwards Aquifer Habitat Conservation Project Science Committee on 4/13/09, Slides 10 and 11.
6. Scott Huddleston, "Hope for end to drought buoyed," *San Antonio Express-News,* 2/2/15.
7. Information offered by Calvin Finch based on his role as SAWS Water Conservation District and SAWS representative in the negotiations to develop the Edwards Aquifer Habitat Conservation Plan.
8. Ibid.
9. Ibid.
10. SAWS website, Aquifer Storage and Recovery, 2009 Water Management Plan Adjustments at www.saws.org discusses the changing estimate of capacity. Calvin Finch projects impact of changing that estimate several times through the years.
11. Calvin Finch opinion based on role as SAWS Conservation Director.

Water Source: Carrizo Water – Bexar County (Page 79)

1. San Antonio Water System 2012 Water Management Plan, "Expanded Carrizo Production", Page 31. Available on the SAWS website at www.saws.org.
2. Ibid. "Cost per Acre-Foot", page 42.
3. Gregg Eckhardt, "Twin Oaks Aquifer Storage and Recovery", "San Antonio Project Development". Edwards Aquifer Website.
4. SAWS website, "Twin Oaks-Aquifer Storage and Recovery" at www.saws.org. Information about no new agreement offered by Calvin Finch, based on his knowledge the project.
5. Greg Eckhardt "Twin Oaks Storage and Recovery," Edwards Aquifer website. Calculation of acre feet completed by Calvin Finch.
6. SAWS website, "Pipeline Will Deliver Water Management Flexibility," 2/2/15 at www.saws.org.
7. See note 4 covering agreement with EUWCD.
8. SAWS 2012 Water Management Plan, page 31.
9. San Antonio Water System 2012 Water Management Plan, "The Water Resources Integration Pipeline (WRIP)", page 40.
10. SAWS 2012 Water Management Plan, page 31.

Water Source: Medina Lake – BMA (Page 82)

1. Texas Water Development Board website, "Medina Lake" access at www.twdb.texas.gov.
2. San Antonio Water System 2012 Water Management Plan, page 42.
3. Amended and Restated Water Supply Agreement, Bexar-Medina-Atascosa Counties Water Control and Improvement District 1 (BMA) to Bexar Metropolitan Water District, January 1, 2008.
4. Zeke MacCormack, "With Medina Lake empty, irrigation system gets make over," *San Antonio Express-News,* April 6, 2014. Page 4. The SAWS website, "Medina Lake," also states the likelihood of zero firm yield in drought. The website is www.saws.org.
5. Gregg Eckhardt, "Medina Lake and Canal System, Infrastructure Issues," The Edwards Aquifer Website. From Calvin Finch-some repairs have been completed but according to the source, there are still questions on the dam's infrastructure.
6. Texas Water Development Board website, "Medina Lake"
7. Water Supply Agreement, January 1, 2008
8. Zeke McCormack, "Residents on edge as Medina Lake evaporates," *San Antonio Express-News,* January 6, 2013 from the *San Antonio Express-News* website, www.mysanantonio.com.
9. Nolan Hicks, "In Medina County, the drought begins to claim water wells," *San Antonio Express-News,* August 29, 2013.
10. Ibid.
11. Richard Oliver, "Running Dry: A four-part Series," *San Antonio Express-News* obtained from the Express News website – www.expressnews.com on 12/12/2014.
12. Carolyn B. Edwards, "Gates closed at Medina Dam," *Bandera County Courier,* December 18, 2014.
13. Zeke MacCormack, *San Antonio Express-News,* April 7, 2014

Water Source: Carrizo Aquifer – Gonzales (Page 84)

1. SAWS website, "SAWS and Schertz-Seguin Finalize Largest Non-Edwards Regional Water Project" 2/1/11 at www.saws.org.
2. San Antonio Water System 2012 Water Management Plan, page 42, available at www.saws.org.
3. Scott Huddleston, "Regional Carrizo, helping with drought," *San Antonio Express-News,* June 8, 2014.
4. SAWS Website, "Carrizo Aquifer" at www.saws.org.
5. Darren Thompson, SAWS Water Resources Director in personal communications with Calvin Finch on 12/19/14.
6. SAWS website, "SAWS and Schertz/Seguin Finalize Largest non-Edwards…"
7. SAWS website, "Carrizo Aquifer".
8. Scott Huddleston, *San Antonio Express-News,* June 8, 2014.
9. Conclusion offered by Calvin Finch, based on discussions he participated in with Gonzales Underground Water Conservation District in 2007-2010 as SAWS Water Resources Director.

Water Source: Water Conservation (Page 86)

1. San Antonio Water System 2012 Water Management Plan, Page 5. Available on the SAWS Website at www.saws.org.
2. Figures offered by Calvin Finch based on the water conservation reports for the years he was Water Conservation Director at SAWS and PowerPoint presentations given by Karen Guz and Brandon Leister in 2008 and 2006.
3. Brandon Leister, "Meeting Conservation Goals," November 27, 2006 PowerPoint in possession of Calvin Finch.

4. Programming listed by Calvin Finch based on his experience as SAWS Water Conservation Director 2000-2005. Also reinforced by PowerPoint presentation by Karen Guz, "Conservation Planning," September 5, 2014, and Brandon Leister, "Meeting Conservation Goals," November 27, 2006.
5. Ibid. See note 2. San Antonio Water System 2012 Water Management Pan, page 5, www.saws.org.
6. Ibid.
7. Ibid.
8. Chris Brown, "The Business Case for Water Conservation in Texas," June 2007 for the Lower Colorado River Authority, Page 3.
9. Calculation by Calvin Finch based on knowledge he has of high-efficiency toilet distribution as a conservation activity.
10. U.S. Energy Policy Act (EPA Act) cited in Amy Vickers' "Water Use and Conservation" Table 2.1, page 18. *Water Plow Press* 2001.
11. San Antonio Water System 2012 Water Management Pan, page 5, www.saws.org.
12. Ibid.
13. Ibid.
14. See note 3. Figures offered by Calvin Finch from slide sets by SAWS staff.
15. Calculated by Calvin Finch based on information from SAWS 2012 Water Management Plan and other sources noted.
16. Charles Ahrens, SAWS VP for Water Resources and Water Conservation provided the data in an email to COSA Planning Director John Dugan, who passed the information to Calvin Finch by email.

Water Source: Western Canyon (Page 91)

1. San Antonio Water System 2012 Water Management Plan, page 26. Source is a hard copy printed from SAWS website at www.saws.org.
2. Ibid. page 42.
3. SAWS website, "Canyon Lake", www.saws.org.
4. Ibid.
5. Ibid. See note 3.
6. Ibid. See note 3.
7. Ibid. See note 3.
8. SAWS 2012 Water Management Plan, page 26.
9. Robert Gulley, "Heads Above Water", Texas A&M University Press, College Station, 2015, The Inside Story of the Edwards Aquifer Recovery Implementation Program. The opinion in the paragraph comes from Calvin Finch after considering the history of San Antonio water-supply issues described in "Heads Above Water."

Water Source: Trinity Oliver Ranch (Page 93)

1. San Antonio Water System 2012 Water Management Plan, page 25, hard copy printed from the SAWS website www.saws.org.
2. Trinity Aquifer Project, SAWS website, www.saws.org/Your_Water/WaterResources/projects/trinity_aquifer.cfm.
3. Gregg Eckhardt, "The Trinity Aquifer," The Edwards Aquifer Website, page 1, www.edwardsaquifer.net/trinity.html.
4. San Antonio Water System 2012 Water Management Plan, page 25.
5. Ibid. see note 2. SAWS website, "Trinity Aquifer Project."
6. SAWS 2012 Water Management Plan, page 25.

7. Colin McDonald, "SAWS ready to shut off pricey Bexar Met deal," My SA website. July 9, 2012.

Water Source: Lake Dunlap/Wells Ranch (Page 95)

1. SAWS Website "Lake Dunlap/Wells Ranch," www.saws.org.
2. San Antonio Water System 2012 Water Management Plan, page 42. The plan is available at the SAWS website, www.saws.org.
3. Ibid, "Canyon Regional Water Authority (CRWA)," page 27.
4. Ibid.
5. Conclusion offered by Calvin Finch based on his experience as SAWS Water Resource Director during the period of the Bexar Metropolitan integration.
6. Canyon Regional Water Authority Website at http://www.crwa.com/resources.html.
7. Ibid.
8. The issue of GBRA contract extension expectations came up several times in CRWA Board Meetings in 2010 and 2011 attended by Calvin Finch. The major dispute resulted in a Texas Supreme Court Case in 2008, "Canyon Regional Water Authority v. Guadalupe-Blanco River Authority, No. 06-0873, Decided May 16, 2008. The Texas Supreme Court decided in CRWA's favor but the relationship is still stressed.

Water Planning: Population Estimates (Page 97)

1. Metropolitan Planning Organization. Potential Population and Employment Scenarios for use in the Metropolitan Transportation Plan Update. Memorandum, November 25, 2012.
2. Adam Conner, SAWS Planner II, electronic communications, December 02, 2014.
3. San Antonio Water System 2012 Water Management Plan, page 18, available on the SAWS website, www.saws.org.
4. 2016 Regional Water Plan (Region L), County Population Projection for 2020-2070, page 14, available from the Texas Water Development website.
5. See note 3. San Antonio Water System 2012 Water Management Plan, page 18
6. Calculated by Calvin Finch using MPO, SAWS 2012 Water Management Plan and Region L Data.
7. Ibid.
8. See note 3. San Antonio Water System 2012 Water Management Plan, page 18
9. See note 6. Calculated by Calvin Finch.
10. Data from SAWS 2012 Water Management Plan, page 21 used to calculate difference in water requirements by Calvin Finch.

Water Planning: GPCD, Demand Management (Page 100)

1. San Antonio Water System 2012 Water Management Plan, page 21. Available at the SAWS website, www.saws.org.
2. Ibid.
3. Ibid.
4. Ibid.
5. Ibid.

Water Planning: Public Input and Communication (Page 103)

1. Gregg Eckhardt, "Alternatives to the Edwards Aquifer", The Edwards Aquifer Website, available at the website www.edwardsaquifer.net/alternatives.html.
2. Karen Guz, San Antonio: "A Conservation Success Story," PowerPoint Slide 25 available on the Internet if San Antonio Landscape Ordinance is Googled.
3. Ibid. Slide 26.
4. SAWS Website "Community Involvement," available at www.saws.org

Water Planning: Climate Change (Page 106)

1. Chi-Chung Chen, Dhazn Gillig, and Bruce A. McCarl, Effects of Climatic Change on a Water Dependent Regional Economy: A Study of the Texas Edwards Aquifer, National Assessment of Climate Change, Agricultural Focus Group supported by U.S. Global Climate Change Office, 2000.
2. Ibid. Page 4.
3. Ibid. Page 4.

Water Planning: Water Shortage, 2060-2070 (Page 107)

1. San Antonio Water System 2012 Water Management Plan, Conceptual Projects for the Long Term (2040-2070)," page 36 available at SAWS Website www.saws.org.
2. Ibid.
3. Ibid. Page 37.
4. Ibid. Page 37.
5. See the section on Population in this paper. Calvin Finch is interpreting the possibility of shortages in 2040 in the MPO population estimates are correct and a drought of record occurs.
6. SAWS 2012 Water Management Plan. Figure 8 is duplicated from page 37 of the Plan.

Water Management: Drought Management (Page 109)

1. The paragraph offers a number of conclusions by Calvin Finch based on his experience as SAWS Water Conservation Director and on the Texas Water Conservation Task Force. The opinions have been presented in numerous presentations to local and state audiences.
2. Karen Guz, "Drought Management" PowerPoint presented to the Recovery Implementation Program meeting in January 2010. Slide 7.
3. Ibid.
4. Brian Perkins of HDR in PowerPoint on Region L Drought Management, provided, March 2, 2015

Water Management: Lost/Non-Revenue Water (Page 111)

1. John Sutton, SAWS audit worksheet and water-loss threshold and application for financial assistance, discussion and electronic correspondence, March 17, 2015.
2. Assumption by Calvin Finch based on discussion with Patrick Shriver, Karen Guz and others at SAWS during the fall of 2014.
3. Calculated by Calvin Finch by applying the 15 percent to an assumed SAWS pumping rate of 200,000 acre feet/year.
4. Kelly Brumbelow, Edwards Aquifer Lost Water Conference at the Edwards Aquifer Authority, October 30, 2014.
5. Patrick Shriver, SAWS Program Coordinator, Water Resources electronic communication, November 19, 2014.

6. Ibid.
7. Calculations by Calvin Finch based on a projected cost of water of $1,000/acre foot, less than the cost of water from the three projects listed.
8. Patrick Shriver, November 19, 2014.

Water Management: Edwards Aquifer Habitat Conservation Plan (Page 114)

1. Robert Gulley, "Heads Above Water, The Inside Story of the Edwards Aquifer Recovery Implementation Program." Published in 2015 by Texas A&M Press. Preface.
2. The two main goals are the interpretation of the main goals of the Recovery Implementation Program (RIP) goals by Calvin Finch, who represented SAWS in the negotiations.
3. The management activities are summarized by Calvin Finch, based on his role as the SAWS representative on the RIP Steering Committee.
4. The positive impacts and challenges are offered by Calvin Finch, based on his participation in the RIP process and the effort to receive support from the RIP stakeholders, including the San Antonio Water System.

Water Management: Integration of Bexar Metropolitan Water District (Page 117)

1. Colin McDonald, "Bexar Met and SAWS go toe to toe," *San Antonio Express-News,* May 25, 2011, available at www.sara-tx.org/newsclippings.
2. Darren Thompson, SAWS Water Resources Manager, "Integration of Bexar Met," PowerPoint presented to Trinity Glen Rose GCD, January 12, 2012, slide 7.
3. Joint Committee On Oversight of Bexar Metropolitan Water District, Report to the 81st Texas Legislature, January 9, 2009.
4. Information and conclusions provided by Calvin Finch based on his role as a SAWS administrator during the lead up to the Bexar Met Integration.
5. Colin McDonald, "SAWS ready to shut off pricey Bexar-Met deal," *San Antonio Express-News*, July 9, 2012 at www.mysanantonio.com/news/environment.
6. Patrick Shriver, SAWS Coordinator, Edwards Aquifer, phone conversation, March 3, 2015.
7. SAWS Water Management Plan, page 28.
8. "Evaluation of Bexar Metropolitan Water District," Response to Senate Bill 341, Texas Commission on Environmental Quality, August 2012.
9. Colin McDonald, "Bexar Met district goes down the drain," *San Antonio Express-News,* January 27, 2012, www.mysanantonio.com/news/environment.
10. Darren Thompson, SAWS Water Resources Manager, "Integration of Bexar Met," PowerPoint given to Trinity Glen Rose GCD, January 12, 2012, slide 5.
11. Ibid.
12. SAWS website, "Bexar Met Integration" found in "Welcome to saws.org" at www.saws.org.
13. San Antonio Water System website, "Dear Valued Bexar Met Customers," at http://www.saws.org/welcome/.
14. SAWS website, "SAWS Trustees Save Ratepayer Money with Revisions to Controversial Bexar Met Water Contract" at www.saws.org.
15. SAWS 2012 Water Management Plan, pages 27 and 28.
16. Ibid. See note 1.

Water Management: San Antonio as a Water Neighbor (Page 119)

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2. Ibid.

3. Michele Gangnes, "Is the pipeline deal good for everyone involved? Con Rural Texas could be next endangered species," *San Antonio Express-News*, October 26, 2014.
4. Robert Gulley, "Heads Above Water," pages 123-131.
5. SAWS website, "Trinity Aquifer Project" available at www.saws.org/Your_Water/WaterResources/projectstrinity_aquifer.cfm.

Water Quality: Edwards Aquifer Conservation Easements (Page 121)

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2. Leslie Lee, "Protect our land, Protect our water," Summer 2014, txH_20, Texas A&M, Texas Water Resources Institute.
3. Robert Rivard, see note 1.
4. Ibid.
5. City of San Antonio website, "Conservation Easement FAWs at www.sanantonio.gov/EdwardsAquifer/ConservationEasementsFAQ
6. Kate Galbraith, "In San Antonio, a Focus on Land Conservation," *Texas Tribune,* March 18, 2011.
7. Justin Horne, "Council approves aquifer protection program," KSAT 12 TV, January 29, 2015. http://www.ksat.com/content/pns/ksat/weather-currents.html
8. Recommendation by Calvin Finch based on the discussions in this section.

Water Quality: EARZ and Contributing-Zone Protections (Page 124)

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Water Policy Analyses for San Antonio and Fair Oaks Ranch

Part B: City of Fair Oaks Ranch

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Appendix B: City of Fair Oaks Ranch

Executive Summary

Part B: City of Fair Oaks Ranch

The Cities of San Antonio and Fair Oaks Ranch Water Policy Analyses are efforts designed to review and assess many of the factors important in implementing effective water policies for the two cities.

The City of Fair Oaks Ranch portion of this report briefly describes and assigns risk ratings to three water-supply sources. It also discusses eleven water issues important to Fair Oaks Ranch water security and assigns grades to the water-management and planning performance in terms of water security when addressing some of the issues.

The water-issue descriptions include identification of significant issues and recommendations concerning them. A number of the issues addressed in the San Antonio portion of this report also have significance for Fair Oaks Ranch water security, particularly the water quality and state regulatory agency sections.

There are a number of the significant issues and recommendations that merit special attention.

Water Planning

- **Population Estimates** – To read the 2012 Water and Wastewater Report from AECOM, an international professional technical services firm, the Fair Oaks Ranch water-supply situation appears to be well in hand. City of Fair Oaks Ranch water needs in 2040, when build-out is reached and the population reaches 10,301 people, will amount to 2,389 acre feet of water per year even if the 207 gallons per capita per day (GPCD) is not improved. To meet its water needs, the City of Fair Oaks Ranch has a contracted commitment of 2,393 acre feet of water, 543 acre feet from the Trinity Aquifer and 1,850 from the Canyon Lake project operated by the Guadalupe-Blanco River Authority (GBRA). On paper, all is well.

  As is usually the case, however, when it comes to water supplies, the situation is never as simple as it seems. A recent alternate population projection exists that estimates the final population at build-out will be 16,411 people. Combining that number with the potential impact of drought-of-record conditions, climate change and the vulnerability of water supplies from the Trinity Aquifer, the Fair Oaks Ranch water situation is not as secure as the 2012 AECOM Water and Wastewater Report implies.

  Commissioning this water policy analysis indicates that the City of Fair Oaks Ranch recognizes it is time to reassess its water plan.

Water Management

- **Water Conservation** – At an average GPCD of 200, over the last 10 years, Fair Oaks Ranch is not performing at an efficient water-use rate. The city recognizes that fact and has established the ambitious water-conservation goal of reaching 160 GPCD by 2040.

The city needs to translate the goal to a more specific plan of programming to reduce water use by two gallons/person/day per year. The water-conservation section of this analysis offers a number of specific activities to link with the new AMR system, strong development rules, and an aware population in developing that plan.

- **Drought Management** – The Fair Oaks Ranch surcharge program to reduce water use in drought situations works well to reduce water use but would be less effective in other types of water emergencies, where supply is drastically reduced. Fair Oaks Ranch needs to use its new AMR system to assess why its drought management rules and enforcement have not been effective so it can be modified to serve the city in other types of water emergencies.

- **Lost/Non-Revenue Water** – The City of Fair Oaks Ranch has given the question of lost water considerable attention. Its average monthly rate of 7.8% lost/non-revenue water is further differentiated between required non-revenue water such as line flushing and an estimated calculation for leaks. The attention makes it possible for the City of Fair Oaks to closely manage this important source of water supply. The low rate of lost/non-revenue water achieved by the City of Fair Oaks Ranch will make it easier for city leaders to ask area residents to launch an equally effective water conservation effort.

Water Quality

- **Relationships with Regional Neighbors** – The Trinity Aquifer is identified as the most challenged water-supply source in the state because of the heavy population growth and its geology. A key to maintaining its reliability as a supply is to work closely with Boerne, Kendall County, and Comal County areas that also depend on the Trinity Aquifer as a water source. Together, they can better ensure development is conducted in a manner to protect water quality. It is important for Fair Oaks Ranch to set high goals and initiate contact to accomplish them.

- **City of San Antonio** – Fair Oaks Ranch and the City of San Antonio work cooperatively in a number of ways, including the Canyon Lake Project, ETJ issues, and projects such as this water-policy analysis. The interdependence of Trinity Aquifer and Edwards Aquifer recharge means that both cities will benefit from a close and ambitious relationship on recharge-zone and contributing-zone water-quality protection. Fair Oaks Ranch officials can take the initiative in this area of mutual benefit.

- **Protection of Fair Oaks Ranch Water Supplies** – Protection of the challenged water supplies from the Trinity Aquifer and Canyon Lake is a major theme of the Fair Oaks Ranch and San Antonio Water Policy Analyses. Considerable discussion on EARZ protection, a contributing zone initiative, the potential for contamination and low-impact development is provided under those titles in the Part A City of San Antonio section. The topic of the Texas Commission on Environmental Quality/U.S. Environmental Protection Agency is also pertinent to the Fair Oaks situation and is included in Appendix B.

Water Supply Projects

- **Trinity Aquifer and Canyon Lake Water Supplies** – The City of Fair Oaks Ranch merits a high grade in securing water-supply quantities to meet its needs at build-out and beyond. The fact that the main water supply projects are identified as relatively high-risk sources means the city should work to protect the sources from contamination and other challenges to quality, as addressed in the water-quality portions of the paper. It is also important Fair Oaks Ranch have a strong effort to ensure the positive situation on water quantity is maintained.

  One of the recommended actions to ensure the favorable supply situation is maintained is to work with the San Antonio Water System to establish an interconnection between the two water systems.

- **Regulatory Agencies** – The Trinity Glen Rose Water Groundwater Conservation District through a vote of the citizens of Fair Oaks Ranch has regulatory authority over Trinity Aquifer water resources within the City of Fair Oaks Ranch boundaries. The district also represents Fair Oaks Ranch's Trinity Aquifer interests in many important situations, including dealings with Cow Creek Groundwater Conservation District and City of San Antonio. It is important for Fair Oaks Ranch to review the Trinity Glen Rose administrative situation toward a determination whether it is in the city's interest to strengthen the conservation district's administrative capabilities.

  The production of a new water plan for Fair Oaks Ranch may require that the city obtain more water supplies. If that turns out to be the case, the resources available through the Texas Department of Water Development (TWDB), such as SWIFT funds may be useful.

Water Supply Projects, City of Fair Oaks Ranch

1. Trinity Aquifer Water
2. Canyon Lake Water
3. Fair Oaks Ranch Recycled Water Program

Risk Analysis

Each of the water-supply project descriptions is preceded by a risk analysis list and scorecard. The basic risk factors include variability and/or unpredictability. The more of either of those characteristics, the higher the risk score. A risk score may be multiples of (-) as an indicator of little risk, (0) as a middle category of risk and multiples of (+) to indicate more risk. Risk ratings involve identified conditions and opinion of the authors.

Risk Factors

Total Water – Total water is not a risk factor but is an important characteristic of the water project. The amount of water provided by the project (sometimes under various conditions) is included on the risk-factor sheet for every project.

Cost of Water – Cost in itself, even a high cost, is not deemed a risk factor as long as it is a stable cost. Water costs that are uncertain or subject to change due to inflation or other factors will rate a (+) risk point.

Ownership of Water – Some of the water-supply projects include both owned and leased water. The authors assign more risk to leased water. Owned water is rated as a (-) risk factor. Leased water adds risk to the project's reliability so merits a (+) risk point. Projects that include a nearly equal mix of owned or leased water may receive a (0) risk score.

Length of the Contract – Water supplies that are contracted for periods shorter than the 45 years through 2060 merit a risk point (+) because they will have to be renegotiated or replaced.

Distance from San Antonio or Fair Oaks Ranch – A long pipeline to transport water from its source to San Antonio or Fair Oaks Ranch is deemed a risk. A water source that originates under the boundaries of the subject city reduces risk by a point (-). A water source that involves a pipeline less than 30 miles does not receive a risk point (0). Pipelines between 30 miles and 100 miles are determined to be at risk for one point (+) and over 100 miles are assigned two risk points (++).

Endangered Species – Water projects or a project's pipelines in the vicinity of endangered or threatened species are considered at risk and receive a point (+). If there are no endangered species or the issue has been addressed with the completion of an Incidental

Take Permit, the project may merit a negative risk point (-) rather than the addition of a point.

Treatment Required – Supply projects requiring significant treatment are deemed more vulnerable to accidents and/or purposeful actions and are rated as more risky (+). Water sources that do not need treatment face less risk (0).

Contamination Threat – Water sources are subject to more or less risk of contamination based on their nature. Surface water sources are deemed more vulnerable and receive a (+). Groundwater sources that recharge quickly are deemed more threatened and receive a (+). Groundwater sources slow to recharge are deemed to be less vulnerable and receive a (-). A water supply project that includes several sources of varying vulnerability may receive a risk rating of (0).

Sensitivity to Drought – Some water resources projects are not affected by the drought situation in the region. They receive a minus risk credit (-). Projects that move into drought restriction situations in times of drought are assigned a risk point (+). Projects that provide no or very little water in a severe drought situation may be assigned 2 risk points (++).

Regulatory Agencies – The number and characteristics of the regulatory agencies involved with a particular water supply are an important risk factor. If there are no local regulatory entities involved or a local agency with Fair Oaks Ranch representation, the project merits a minus risk point (-). If the regulatory agency is a state agency, the situation is assigned no risk points (0). A local regulatory agency without any representation from San Antonio is deemed a risk and receives a point (+).

Other Issues – Among the issues that may result in a risk point being added include the precarious financial state of a water supplier.

Overall Risk Rating – Risk analysis is subjective. The few factors to be considered have to be selected from among many issues that could be included for consideration. Weighing of each factor could be different for every community and the evaluating “experts” have to assign ratings based on their experiences. The authors of this paper have related an overall risk rating to the number of negative and positive risk points assigned. A supply project with more minus risk (-) points than a (+) risk points is rated as a “low-risk” water supply project. Projects with an equal number of pluses and minuses, or one more plus, are designated as “medium-risk” projects. Projects with two or more plusses (+) than minuses (-) are rated “high-risk” projects.

Risk Table

Name of Project:		
Total Water:		
Cost of Water:	Unstable	(+)
Ownership State of Water:	Owned	(-)
	Combination	(0)
	Leased or Contract	(+)
Length of Contract:	Shorter than 45 Years	(+)
Distance of Source from San Antonio or Fair Oaks Ranch:	On Site	(-)
	Less than 30 Miles	(0)
	30-100 Miles	(+)
	Over 100 Miles	(++)
Endangered or Threatened Species Issue:	No	(-)
	Yes	(+)
	HCP	(0)
Treatment Required:	No	(-)
	Yes	(+)
Contamination Threat:	Difficult Recharge	(-)
	Easy Recharge	(+)
	Surface Source	(+)
Drought Restrictions: (Drought Sensitivity)	No	(-)
	Yes	(+)
	No, or Very Little Water in Drought	(++)
Regulatory Agencies Involved:	None or One Local with Representation	(-)
	One or More, No Representative	(+)
	State Agency	(0)

Other Issues:	No	(-)
	Consider	(0)
	Yes	(+)
Total Score:	Minus Risk	
	Plus Risk	
Rating:	Low Risk (More minuses than pluses)	
	Medium Risk (Same number or one more plus)	
	High Risk (Two or more pluses than minuses)	

Risk Rating, Projects Listed in Order of Water Production

Part B. City of Fair Oaks Ranch

	Low Risk	High Risk	Risk Rating
Trinity Aquifer Water	6	3	Low
Canyon Lake Water	1	5	High
Fair Oaks Ranch Recycled Water	4	1	Low

Part B: City of Fair Oaks Ranch

Summary Report

Introduction

The City of Fair Oaks Ranch portion of the Cities of San Antonio and Fair Oaks Ranch Water Policies Analyses are made up of three water-project and eleven water-policy-issue sections. Each of the projects has been assigned a risk rating and each water-policy issue has been assigned a grade by the authors.

The authors are experts in various pertinent water areas and objective assessors of the city's water supplies and policies. The risk rating, grades and brief write-ups are designed to be a catalyst and fuel for the city's efforts to develop the water-planning and policies sections of the city's development plans.

The report is presented as sections of several paragraphs, including a general statement and recommendation for each of the topics covered. Water-policy issues are covered first, and water projects second. For more details on the topic or the authors' thoughts related to the topic, readers should review the full text in Appendix B.

Significant Issues and Recommendations

Water Issues

Water Planning

Population Estimates – The City of Fair Oaks Ranch has identified and implemented a water-supply plan relying on water from the Trinity Aquifer and Canyon Lake. The water projects are relatively high-risk, but the water involved will meet the needs of Fair Oaks Ranch now and in the future as Fair Oaks Ranch reaches the build-out point in 2040. If the 16,411 population estimate is the more accurate estimate, that means that water supply would be 50 percent short of demand rather than adequate to meet demand due to population. It changes the situation from one of on-paper sufficiency to a need to locate more water resources.

Recommendation – If 10,301 people is the build out total, the issue becomes one of protecting the water sources in place and reducing risk by working closely with neighbors to regulate use of the Trinity; working with Fair Oaks Ranch citizens to achieve the city's water-conservation goals; seeking agreements with SAWS that allow a mutually beneficial interconnection; and staying influential in the machinations of pricing and water allocation for the Canyon Lake project.

If the 16,411-person estimate is the likely build-out population, more water supplies are required.

Action Steps

1. Determine the most accurate population estimate for Fair Oaks Ranch build-out.
2. If the number is the 10,301 provided by the 2011 AECOM Water and Wastewater Report, then the nature of the Fair Oaks Ranch water plan becomes one of blending protection of the Trinity Aquifer and Canyon Lake Project with water conservation and a SAWS interconnection. Prepare that plan.
3. If the 16,411 people plan is the more realistic estimate, a new water plan must be created. The same issues described in Step 1 are important, but a new source, or sources of water, for 500-1,500 acre feet more water needs to be identified. Options include an expanded Canyon Lake water supply; purchase of water from the SAWS system, if there are surplus supplies; and increased water conservation.

Drought-of-record Conditions – Drought-of-record conditions play a major part in determining how much water supply a community like Fair Oaks Ranch requires to meet its needs. Other factors include population, GPCD and climate change. Although the AECOM 2011 Water and Wastewater Plan describes the water supply situation as adequate to handle the population at build-out, that may be an overly optimistic outlook. As Table 1B(i) illustrates, there are several scenarios where Fair Oaks Ranch will have a water deficit well before 2040, especially if drought-of-record conditions are repeated.

Table 1B(i) lists the many water-supply and demand-reduction options available to Fair Oaks Ranch. Others are mentioned throughout the analysis.

Action Steps

1. City officials prepare a new water plan based on a water-balance type of analysis, as provided in Table 1B(i). The analysis considers the water-supply-and-demand conditions due to population, GPCD, drought-of-record conditions and climate change.

2. The deficit indicates how much more water supply needs to be obtained. Table 1B(i) does not take into account the time factor, but it should be considered in the more comprehensive plan required for Fair Oaks Ranch. Figure 1A(i) in Part A on page 53 includes the impact of timing in planning for needed water supplies. Fair Oaks Ranch should complete a similar water-supply/time-interaction graph.

Table 1B (i)		
Drought of Record, Climate Change and Other Factors and Their Impact on Fair Oaks Ranch Water Balance		
Population Estimate	10,301	16,411
Water Requirement at 207 GPCD in Acre Feet (GPCD from AECOM paper)	2,390 acre feet	3808 acre feet
Requirement at 160 GPCD	1,847 acre feet	2,932 acre feet
Climate Change		
1.5% Increase in Demand in 2030	1,871 acre feet	2,970 acre feet
Drought of Record Reduces Trinity Aquifer Supply by 77%	2,289 acre feet	3,388 acre feet
Total Water Available at this Point	1,973 acre feet	1975 acre feet
Deficit	314 acre feet	1,413 acre feet
Ideas for Addressing Deficit		
Graywater Initiative – 8% of Landscape Watering	96 acre feet	152 acre feet
Drought Restrictions – 20% Reduction	478 acre feet	762 acre feet
Remaining Deficit	+ 260 acre feet	499 acre feet

Climate Change – The extent of the impact of climate change has been debated. Until recently, even the existence of climate change has been questioned. Whatever the policymakers' beliefs, however, the issue must be addressed in terms of water supplies and water demand.

A paper from 2000 cited in this analysis discusses demand increases of 1.5 percent and 3.5 percent in 2030 and 2090 respectively. The authors also estimated that pumping from the Edwards Aquifer will have to be reduced by nine percent in 2030 and 20 percent in 2090 to account for a reduction in Edwards Aquifer recharge in order to protect the endangered species. Edwards Aquifer pumping to protect spring flow does not have direct application to Fair Oaks Ranch and the Trinity Aquifer recharge, but it does raise questions that need to be considered.

Recommendation – Climate change needs to be considered in the next Fair Oaks Ranch water-management plan. The phenomenon has the potential to increase the likelihood of increasing demand and reducing supply in the period of this analysis, 2015-2060. Recharge volume for the Trinity Aquifer, and recharge levels and higher evaporation rates' effect on the Canyon Lake reservoir require special attention.

Action Steps

1. Take advantage of work done by neighboring water-related agencies such as SAWS, the Edwards Aquifer Authority, or Region L Water Planning Group to update the local climate-change impacts on demand, recharge, evaporation rate and rainfall for use in Fair Oaks Ranch water planning.

2. Determining the impact of the availability of Trinity Aquifer water because of a possible reduction in recharge flows is important. Both evaporation-rate increases and rainfall total will also affect the Canyon Lake reservoir. Work with the Trinity Glen Rose GCD to seek reasonable estimates as to how much supply will be affected.

Water Management

Water Conservation – The City of Fair Oaks Ranch has an average GPCD of 200 over the last 10 years, and a goal of 160 gallons per capita per day. The nature of the community, with its large lots and large lawns, supports a tendency for high water use, but there are other characteristics of the city that make reaching the 160 GPCD goal seem likely. Citizens of Fair Oaks Ranch are involved, the city has a new automated meter reading (AMR) system in place and strong rules for more efficient landscapes in the future exist.

Further, the citizens of Fair Oaks Ranch have been responsive to some of the limited education offerings available so far. The goal of reducing water demand by 577 acre feet (Figure 1BB) annually is desirable as insurance if the final population at build-out reaches 10,301 citizens as predicted in the 2011 AECOM Water and Wastewater document. If the alternate estimate of 16,411 people is more accurate, the 577 acre feet would help provide the additional 1,500 acre feet of water supply required.

Fair Oaks Ranch would be especially well positioned to gain access to low-interest-rate SWIFT funds from TWDB if the ambitious water-conservation program is identified as a priority. The water-use level is high, but prospects of success are also high. The advantages would include access to design and development funds at a low interest rate that would be paid back when the water savings were actually achieved.

Recommendation – Formalize the Fair Oaks Ranch quest to reach the 160 GPCD goal by producing a water-conservation plan that includes a budget and describes the programming to be implemented every year to achieve a water-use reduction of two GPCD per year. This report offers a list of specific programming that may be considered. A key recommendation is the creation of a community conservation committee of interested citizens to provide public input and help develop the long-term plan.

Action Steps

1. Organize a Community Conservation Committee (or an advisory group of another name) with the stakeholder representation suggested in the text to provide leadership in organizing the water-conservation program and serve as a communications link to the rest of the community.

2. Prepare a plan that lists the activities to be implemented to achieve the two GPCD reduction each year from 2015 through 2040. The GPCD impact expected of each activity should be described to allow for program monitoring. Water-conservation BMPs on the TWDB website describe the amount of water they are expected to save and the cost to save that water.

3. Implement the water-conservation program and a monitoring process so activities can be adjusted if the results are not as expected.

Drought Management – The City of Fair Oaks Ranch has a very complex drought-management system built on water restrictions and surcharges. The restrictions and surcharges are triggered by a combination of pumping totals for the city, GBRA drought declarations, and observation-well levels.

Fair Oaks Ranch officials have reported less-than-acceptable results with the restriction tools, but are more satisfied with response to the surcharges. Surcharges work better for reducing water use during drought emergencies than during infrastructure or contamination emergencies. The restriction portion of the drought management effort needs to be made more functional.

Recommendation – One of the priorities for a community conservation committee is to review the Fair Oaks Ranch drought-management plan and experience. The plan is very complex. It has features that have been successful in reducing short-term water use in other cities.

The issue is one of developing citizen support for a simplified plan and enforcement mechanisms.

Action Steps

1. A priority for the committee is to review the rules and enforcement mechanisms of the restriction portion of the drought-management rules toward the end of simplifying them and making them more effective as protection for emergencies involving infrastructure failure or a contamination event.

2. Organize and implement an education program to familiarize the citizens of Fair Oaks Ranch with the simplified drought-restriction rules. The education effort will be a natural progression after the input collection and communication exchange to develop the new rules.

Lost/Non-revenue Water – The City of Fair Oaks Ranch has given the question of lost water considerable attention. Its average monthly rate of 7.8 percent lost/non-revenue water is further differentiated between required non-revenue water, such as line flushing and an estimated calculation for leaks. The attention makes it possible for the City of Fair Oaks Ranch to closely manage this important water-supply source. The low rate of lost/non-revenue water achieved by the City of Fair Oaks Ranch will make it easier for city leaders to ask area residents to secure citizen buy-in and launch an equally effective water-conservation effort.

Recommendation – Continue to manage the lost/non-revenue water as effectively as it is currently and has been in the recent past. It is not always easy to use a lost-water rate as an education and confidence-building tool, even where it is as low as the rate in Fair Oaks Ranch. However, the effort should be worth it to encourage more water conservation, and raise confidence levels in the city's water-management effort.

Action Steps

1. Continue to manage the lost/non-revenue water levels in the effective manner displayed today and in years past.

2. Expand the effort to educate Fair Oaks Ranch residents and policymakers about the success in managing this important water source. The confidence gained in the effort will be useful for addressing other demanding water issues as they occur. There is similar value to be gained by educating neighboring communities about the success and techniques that Fair Oaks Ranch uses in managing lost/non-revenue water.

Relationships with Neighboring Communities – Fair Oaks Ranch is a relatively small community that has done a good job of projecting its future water needs and obtaining the resources required. Its task now is to protect the water sources that have been identified to meet its needs.

Key relationships in that quest are with the City of San Antonio and with Boerne, Comal County and the rest of Kendall County. These four areas have major influence over the integrity of Trinity Aquifer and even Canyon Lake water.

Recommendation – The City of Fair Oaks Ranch work through any reluctance that the San Antonio Water System has to share an interconnection as part of an agreement that covers development rules in Fair Oaks Ranch and the SAWS ETJ to better protect both the Trinity and Edwards Aquifer recharge zones. The agreement should include consideration of the City of San Antonio's annexation plans for areas near Fair Oaks Ranch and how they will affect the City of Fair Oaks Ranch.

Equally important, Fair Oaks Ranch officials must assume a strong policy to interact with Boerne, Kendall County, Comal County, Cow Creek GCD and other entities involved in the growth of population over the Trinity Aquifer, both for water-quality and water-quantity concerns. It is essential the entities mentioned work under some formalized

structure to coordinate mutually beneficial policies to protect all parties relying on the Trinity Aquifer.

Action Steps

1. Initiate communication with the City of San Antonio to reach agreement on the completion of a water interconnection to provide both entities back-up water insurance.

2. Express willingness to work with San Antonio on better protecting Trinity and Edwards Aquifer recharge water through a two-city or regional examination of EARZ-development rules, contributing-zone rules, and cooperation on meeting ETJ infrastructure needs, either as part of an interconnection or apart from it.

3. Confer with the Trinity Glen Rose GCD leadership to extend an invitation to the City of Boerne, Kendall County, Comal County, and the Cow Creek GCD to form a work group to establish a forum to discuss issues important to protecting the Trinity Aquifer and other water sources affected by the separate and joint actions of the parties involved. It would be desirable to seek formal agreements on how to jointly address the issues.

Regulatory Agencies

Trinity Glen Rose Groundwater Conservation District – The City of Fair Oaks Ranch has an excellent relationship with TGRGCD. The groundwater district is important for its role in helping protect the Fair Oaks Ranch water sources, particularly the Trinity Aquifer.

Recommendations – Fair Oaks Ranch should consider actions that strengthen the TGRGCD's ability to represent Fair Oaks Ranch's water-supply interests with Cow Creek GCD, SAWS, Boerne and other Trinity-Aquifer stakeholders. It seems reasonable Fair Oaks Ranch officials (with citizen input) weigh the advantages that would result for the city if Fair Oaks Ranch and other grandfathered beneficiaries of the 50 percent-or-less rule (See Trinity Aquifer section below), if TGRGCD fees were paid.

Action Steps

1. Review the capabilities of the TGRGCD in terms of its ability to represent Fair Oaks Ranch's water interests and contribute to the city's water security.

2. Begin discussion and improve the situation if it is determined that an increase in funding or status would make them more effective.

Water Costs

Rates and Impact Fees – Residential customers pay water rates based on an increasing-block rate. The rates represented in the blocks increase from approximately

$3.50 per 1,000 gallons at 10,000 gallons of water to approximately $23.75 per 1,000 gallons for use over 100,000 gallons of use.

Commercial rates are charged through an expanded-block rate without much difference between the rates/block (see Figure 3B).

There is a connection service charge in addition to the volumetric charge. The service charge when the set wastewater fee is included reaches $96.67/month.

Impact fees are charged for new construction and connections at a rate that appears competitive. There was a major increase in impact fees in 2015 after a review by staff and City Council. For further discussion on impact fees in general, visit the Impact Fees section of Part A on page 156.

Recommendation – Fair Oaks Ranch should look at its rate structure in terms of system expenses and water-use goals. Of particular interest is the justification for the low block rates for commercial customers. Unless there are good reasons for the differences, the commercial rates should be increased to match residential rates.

Action Steps

1. Review the water rate structure to assure that revenues cover water and wastewater expenses plus provide funding for desirable programming such as water conservation activities and participation in regional water quality protection efforts.

2. Secondly, review the rate structure to insure that the increasing rate blocks elevate quickly enough in terms of volume to reduce excessive water use for landscapes. Change the commercial rate structure to provide steeper increases of volumetric rates to more nearly match the residential rates and to encourage water conservation.

Water Resources

Trinity Aquifer – The Trinity Aquifer project is rated as a challenged water source, based on its geology and the pressure from growth in the area.

Recommendation – The authors recommend Fair Oaks Ranch work even more closely with the Trinity Glen Rose Aquifer Groundwater Conservation District to play a strong role in managing use of the aquifer and protecting water quality. It is essential to develop closer relationships with Boerne, Comal County and Kendall County in the same regard.

Action Steps

1. Convene a discussion with Boerne, Comal County, Kendall County, Cow Creek WCD and Trinity Glen Rose GCD to develop a process of regular communications and path to take action to better protect the water quality and recharge quantity of the Trinity Aquifer.

2. Encourage the initiation of discussion to organize a regional Edwards Aquifer contributing zone initiative. Work with the parties listed in action step one to integrate protection for the Trinity Aquifer recharge system in that effort.

Canyon Lake Water – The water-supply project is important to the City of Fair Oaks Ranch, but the water is relatively expensive and the price will continue to increase.

Recommendation – Fair Oaks Ranch needs to continue to be involved and on top of every decision point offered in the complex price mechanisms that characterize the Canyon Lake water project. The efforts recommended in water conservation, a SAWS interconnection and Trinity-Aquifer protections will all contribute to making Fair Oaks Ranch less dependent on this high-risk project.

Action Steps

1. Continue the active involvement in GBRA Canyon Lake policymaking processes toward the end of protecting the price, quantity and quality of the water supply.

2. Encourage GBRA to analyze the impact that climate change will have on the Canyon Lake water supply resources. Impact of climate change on refilling of the reservoir and evaporation from the reservoir need to be quantified.

3. Use Fair Oaks Ranch's influence with both GBRA and San Antonio to keep their cooperation concerning Canyon Lake water resources at their current level. The history of San Antonio-GBRA conflict is well known. San Antonio's involvement as a default purchaser of extra Canyon Lake water and the influence that the city contributes in the legislature make it important to Fair Oaks Ranch's interests that San Antonio stays involved as a partner.

Fair Oaks Ranch Recycled Water – The relatively small (224 acre feet/average year) water-supply project is significant as it utilizes the entire Fair Oaks Ranch treated-wastewater production to replace potable water to irrigate the Fair Oaks Ranch Golf Course.

Recommendation – The reuse program is important as both a water-supply and water-quality project and should be more aggressively promoted as part of the City of Fair Oaks Ranch water policy.

Action Step

The effort to better inform the public about this admirable recycled-water program could begin with a more detailed account on the Fair Oaks website of how it works.

Water Planning and Management Grades

A	Exemplary, recognized as a leading example, and accomplishing the goals for the effort
B	Effective, generally accomplishes goal for effort, but not be exemplary, lacking in one area
C	Seems to be accepted by local ratepayers without any special recognition outside. Meets goals but not exemplary
D	Does not meet goals and effort to correct not adequate
F	Failure to meet goals without much effort to address or correct

Water Planning

Population Estimates – A

Commissioning this analysis indicates the City of Fair Oaks Ranch recognizes it is time to review the population estimates for the city and relate them to a new water plan. The AECOM Water and Wastewater Report of 2011 characterized a balance between water supplies and demand that requires a reassessment.

Climate Change – A

This section of the analysis is included at the request of Mayor Landman. She and the public utilities staff recognize the potential for climate change to have an impact on Fair Oaks Ranch water demand and water supplies. It is the first step in a small community's efforts to ensure they have a grasp on a factor that may affect their water security. The grade is high because of the initiative and the expectation that the next steps will match the lost/non-revenue water example.

Water Management

Water Conservation – D

It is exciting to think of the potential that Fair Oaks Ranch has for water conservation. If an ambitious effort is organized, the GPCD can be reduced from 200 to 160 by 2040.

Drought Management – C

According to Fair Oaks Ranch officials, the city has a mixed record on drought management. The weekly irrigation restriction and enforcement was not successful but the water surcharge was.

Lost/Non-revenue Water – A

The City of Fair Oaks Ranch has taken the initiative in determining how much total lost/non-revenue water exists in their system. At an average of 7.8 percent per month, the lost/non-revenue water rate is at a commendable level. The rate becomes even more impressive when the 7.8 percent is further defined between actual lost water from leaks, and non-revenue sources, such as line flushing and fire protection. Attention to the lost/non-revenue water is important in maintaining water supply and confidence of ratepayers.

Water Quality

Relationship with Neighboring Communities – C

Fair Oaks Ranch cooperates on ETJ and other issues with San Antonio, but needs to pursue the idea of an interconnection. There is considerable room for increasing the relationship with Boerne and Comal and Kendall Counties to protect the Trinity Aquifer resource.

Regulatory Agencies

Trinity Glen Rose Groundwater Conservation District – B

The cooperation between the city and Trinity Glen Rose Groundwater Conservation District is close. The two entities could expand their cooperation to protect the Trinity Aquifer water supply even further.

Texas Commission on Environmental Quality and US Environmental Protection Agency – B

Fair Oaks Ranch is proud of its relationship with TCEQ. It works closely with the agency on its recycled water program and can use the close relationship in the advancement of the regional water-quality-protection effort.

Water Costs

Residential and Commercial Rates and Impact Fees – C

The authors assign a C grade because they see the opportunity for Fair Oaks Ranch's water-rate structure to better reflect Fair Oaks Ranch goals for financial returns, water conservation and fairness. Fair Oaks' decisive action on adjusting impact fees illustrates a willingness to make changes to achieve goals.

Appendix B: City of Fair Oaks Ranch

Water Supply Projects

1. Trinity Aquifer Groundwater		Rating
Amount of Water:	543 acre feet [1]	
Cost of Water:	$30/acre feet if the Trinity water makes up over 50 percent of the City's supply. There is no cost if the use is less than 50 percent of total supply. The $30/acre foot is the cost of the raw water paid to the Trinity Glen Rose Groundwater Conservation District. The Legislative TGRGCD Board has granted permission to increase the fee to $40/acre foot at some point in the future.[2]	
Cost Stability:	Prices are stable.	(0)
Ownership State of Water:	Wells are owned by the city [3]	(-)
Length of Contract	N/A	
Distance of Source from Fair Oaks Ranch:	The Trinity Aquifer well sites are in and around the Fair Oaks Ranch City Limits	(-)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Only requires chlorination	(-)

Contamination Threat:	Sources state that 4-5 % of the rainfall that falls recharges the aquifer. Recharge is described as slow, therefore, although there is localized risk; large-scale contamination threat is low.[4]	(-)
Drought Restrictions: (Drought Sensitivity)	Yes. The Trinity Aquifer is often described as an inconsistent water source as been identified. The Trinity Aquifer as the most stressed water source in the area. [5]	(++)
Regulatory Agencies Involved:	Trinity Glen Rose Groundwater Conservation District. Fair Oaks Ranch has a representative on the TGRGCD Board [6]	(-)
Other Issues:	Fair Oaks Ranch Trinity Aquifer water supplies are related to water use in Boerne, Comal and Kendall County where growth is rapid. The Cow Creek GCD has some density growth controls for groundwater. [7]	(+)
Rating:	6	(-)
	3	(+)
Total:	-3	Low Risk

Trinity Aquifer Water Supply

At the present time, water from the Trinity Aquifer accounts for just under 50 percent of the total City of Fair Oaks Ranch water supply. By 2040, the 543 acre feet available will be 23 percent of total supply. The decade of 2040 is a key date because, according to the Water and Wastewater Planning Study-2011, the city will be built out. Unless changes occur, the supply adequate for 2040 will be adequate for 2060 and beyond.[8]

George Wissman, General Manager, Trinity-Glen Rose Groundwater Conservation District, reports there are several reasons to expect the Trinity Aquifer Water source to be a reliable source for the City of Fair Oaks Ranch.[9]

1. The projected water use for the Bexar County portion of the Trinity/Glen Rose aquifer is only 50 percent of the MAG (Managed Available Groundwater).[10]

2. The remaining land over the Trinity Aquifer in Bexar County is all within the San Antonio Water System CCN. The expectation is that there will not be a large number of additional wells drilled into the Trinity Aquifer. Water for new homes in the area will be part of the SAWS municipal system.[11]

Despite the fact that the Trinity Aquifer water supply is considered low-risk by the risk-rating factors of this analysis, the Trinity Aquifer, as a supply, requires careful consideration. Its rank as a high-risk source by Eckhardt and other sources is based on experience with the aquifer through the drought periods leading up to 2015.[12]

Homeowners in developments such as Cross Mountain Ranch and other parts of Kendall County that rely on Trinity Aquifer water have been in the news with some residents requiring water deliveries by truck because of their falling well levels.[13]

It may be true the degree of reliability depends on which Trinity Glen Rose pool is being pumped, but it is not reassuring that SAWS relegates Trinity Aquifer supplies to a reduced-supply status during drought in the SAWS 2012 Water Plan.[14]

It is also of concern that the rural and underground areas over the Trinity Aquifer north and adjacent to Fair Oaks Ranch in Kendall and Comal counties rely almost entirely on Trinity water. Boerne has a surface-water treatment plant and uses Canyon Lake water in addition to the Trinity Aquifer water.[15] Boerne and the surrounding rural areas are still growing very quickly despite water fears reflected in the more demanding well-drilling permit requirements promulgated by the Cow Creek Groundwater Conservation District.[16]

Significant Issues

It is important Fair Oaks Ranch recognize the general concerns about the Trinity Aquifer as a water source and develop a strategy to help ensure reasonable aquifer use. The authors recommend the city become more involved in their Kendall and Comal County neighbors' use of Trinity Aquifer water. This might mean closer ties with Boerne and more involvement in Groundwater Management Area 9 issues.

2. Canyon Lake Surface Water		Rating
Amount of Water:	1,850 acre feet[1]	
Cost of Water/Cost Stability:	$2.90/1000 gallon or $943.92/acre foot in 2015, price adjusted based on inflation and operating costs through complex formula.[2] It can be changed at GBRAs discretion with 60 days notice.	(+)
Ownership State of Water:	Bought yearly from GBRA through a contract, more water may be available. Contract extensions available through 2077 if the cost conditions are acceptable.[3]	(+)
Length of Contract:	Decision points at 2037 and every few years	(+)
Distance of Source from Fair Oaks Ranch:	A short pipeline, less than 25 miles[4]	(0)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Treated by GBRA	(+)
Contamination Threat:	Lake in Comal County	(+)
Drought Restrictions: (Drought Sensitivity)	Yes, but very liberal.[5]	(0)
Regulatory Agencies Involved:	Surface water permitted by TCEQ (state agency) to GBRA and Certificate of Convenience and Necessity to Fair Oak Ranch from TCEQ [6]	(0)

Other Issues:	N/A	
Rating:	1	(-)
	5	(+)
Total:	+4	High Risk

Canyon Lake Water

The City of Fair Oaks Ranch obtains its water supply in 2015 from a groundwater source (Trinity Aquifer) and a surface-water source, Canyon Lake. The Guadalupe-Blanco River Authority (GBRA) delivers water by through a contract last amended in 2012 and extending at least to 2077 if the conditions are acceptable.[7]

The current version provides for an annual commitment of 942 acre feet of treated potable water to be delivered to Fair Oaks Ranch and up to 1,850 acre feet available with notice on or before December 31 of the previous year.[8]

The Canyon Lake agreement is desirable in that it has an upper volume (1,850 acre feet) that is 78.5 percent of its estimated needs once the community is built out to its ultimate size. The city also has the option to use only a portion of the total available Canyon Lake allotment because SAWS has agreed to use the balance of the difference between the amount needed and the maximum amount available.[9]

One issue with Canyon Lake water is that the cost of the water is re-calculated as GBRA determines necessary, with a 60-day notice to Fair Oaks Ranch. In 2015, it is at $943.92 acre feet.[10]

Significant Issues

1. The price of Canyon Lake water is established by a complex set of calculations and is not inexpensive. The involvement of SAWS in purchasing the difference between the water Fair Oaks Ranch needs in the current year and its full entitlement is an advantage.

2. The situation reinforces the need for Fair Oaks Ranch to maintain its close relationship to SAWS and the City of San Antonio. It is also important for the sake of maximizing the utility of this water resource that Fair Oaks Ranch Utilities continue playing an active role on the GBRA Project Management Committee.

3. Fair Oaks Ranch Recycled Water Program		Rating
Amount of Water:	Up to 560 acre feet/year (500,000 GPD) [1] Averages 224 acre feet/year	
Cost of Water:	$0	
Cost Stability:	Prices are stable	(0)
Ownership State of Water:	Owned by Fair Oaks Ranch	(-)
Length of Contract	N/A	
Distance of Source from Fair Oaks Ranch:	Within city	(-)
Endangered or Threatened Species Issue:	None	(-)
Treatment Required:	Yes	(+)
Contamination Threat:	Used for the golf course, none	(0)
Drought Restrictions (Drought Sensitivity):	No	(-)
Regulatory Agencies:	TCEQ, state agency	(0)
Other Issues:	None	
Rating:	4 1	(-) (+)
Total:	-3	Low Risk

Fair Oaks Ranch Recycled Water Program

The Fair Oaks Ranch recycled-water program is not large in terms of total water (up to 560 acre feet/year) but it is a reliable source that reduces potable water needs to irrigate the Fair Oaks Ranch Golf Course.[2]

The water source is in the form of a permit from TCEQ that allows Fair Oaks Ranch to apply up to 500,000 GPD of treated effluent to the land in the Fair Oaks Ranch area.[3] The permit requires all the water be applied as irrigation (no discharge permit) and that none be released into the Cibolo Creek, which is an important Edwards Aquifer recharge feature.[4]

The Fair Oaks Ranch golf course option is desirable because the 280-acre facility is capable of using the entire amount of available water. Treated wastewater produced in the winter can be stored in the golf course storage ponds for use at other times of the year. Cost of the water is described as $0 in the risk-rating sheet because it would have to be treated whether it was reused or not.

The 560 acre feet amount reflects the entire potential and amount allowed in the permit. Fair Oaks Ranch generally has less wastewater to treat than the 500,000 GPD.[5]

The amount of available reuse water means the City of Fair Oaks Ranch also requires a contract to provide 52 acre feet of Trinity Aquifer water/year to be mixed with the reuse water, as needed.[6]

Significant Issues

The Fair Oaks Ranch recycled-water program is as much a water-quality issue as it is a water-supply project.

The 224 acre feet used by the golf course in an average year does replace potable water. Using the water to irrigate the golf course also eliminates the need for the wastewater to be placed in the Cibolo Creek, which is an Edwards Aquifer recharge feature. There are probably legitimate arguments questioning whether the water is a contamination threat in the Cibolo, but TCEQ and probably many others believe it is. The best of both worlds is to use it for irrigation.

Water Policy Issues: Water Planning

Fair Oaks Ranch Population Estimates

The City of Fair Oaks Ranch has had an average GPCD of 200 over the last 10 years.[1] The highest GPCD was 235 in 2011 (dry year) and the lowest was 148 (very wet year).[2] Population was estimated to be 6,382 people in 2009, with a projection to reach 10,301 people in 2040 in the water and wastewater-planning study completed in 2011.[3] Other sources estimate the population may reach 16,411 people.[4]

Based on a dry-year GPCD of 207 and a total population of 10,301, the water needs of the community will be 778,292,055 gallons or 2,389 acre feet.[5] The 2011 AECOM Water and Wastewater Study projects the City of Fair Oaks Ranch and its ETJ will be completely built out by 2040, and the expectation is water demand will stay constant through 2060. If, however, the 16,411-person estimate calculated by the Mayor and City Council members is accurate, the overall water demand would increase by 60 percent. A major part of the increase required by this population estimate may be provided by the San Antonio Water System as much of the growth is expected in its ETJ.[6]

The water sources for the City of Fair Oaks Ranch include groundwater from the Trinity Aquifer and surface water from the Canyon Lake reservoir. There is also a Fair Oaks Ranch Recycled-Water Program.

The Kendall County and the City of Fair Oaks Ranch Water and Wastewater Planning Study reports that, based on available supplies, projected growth to 10,301 people and complete build-out of the ETJ, there will be no shortage of water through 2040 and beyond.[7]

The Region L (SCTRWP) water plan reflects that the City of Fair Oaks per-capita water use will be reduced from 207 to 204 by 2040. Total water needs in 2040 would then be 2,354 acre feet. In 2011 the City of Fair Oaks Ranch used 890 acre feet of water from Canyon Lake. In 2040, 1,850 acre feet is available from Canyon Lake. Since 543 acre feet is available from Trinity groundwater wells, the Water and Wastewater Planning Study-2011 projects a 39-acre feet surplus in 2040 and beyond.

If the 16,411 population projection is more accurate, there will be a water-supply shortage well before build-out is complete unless GPCD or other factors in the water-demand calculation are reduced or supplies are increased.

Significant Issues

The City of Fair Oaks Ranch needs to resolve the uncertainty over its projected population at build-out. If the 2011 Water and Wastewater planning study is accurate, the City of Fair Oaks Ranch appears to be relatively well situated to meet its water needs for the future. It is a city that expects to be built out by 2040, at which time the city has adequate supplies available from a combination of Canyon Lake and Trinity Aquifer sources, even if per-capita water use remains at the high level of 200-207. If the 16,411 figure is more accurate, GPCD must be reduced and/or new water supplies identified to meet needs in the future.

Drought-of-record Conditions

When calculating water needs, water purveyors in Texas generally use firm yield during drought-of-record conditions to determine what portion of their water supply will be available.

Drought of record refers to the weather conditions that existed in the period of 1950 through 1957 in Central Texas. These were eight years of extreme drought, with the worst year in 1956. Temperatures were high, rainfall was low, and recharge to aquifers and lakes was low.

Conditions in 1956 did not quite match the high temperatures and low rainfall experienced in the record-setting year, 2011. The cumulative impact of eight years of drought, however, is more severe than one year, even if it set records.

Recharge data for the Edwards Aquifer showed the average recharge in the period 1950-1956 was 24 percent of average recharge for the overall period of 1934-2011.[1] Predictions are that if conditions again approach the intensity of the drought of record, water levels in the Trinity Aquifer may fall as much as 100 feet and a large part of the aquifer would be depleted by 2030.[2]

It is true that despite the severity of the drought in the 1950s, wells pumping from the Trinity fared pretty well. Most wells continued to produce water. Things have changed, however, since the 1950s. The main difference is that over much of the Trinity Aquifer, population has increased by more than 800 percent.[3] In recent years, wells drilled into the upper layers of the Trinity at developments such as Cross Mountain Ranch have gone dry. Even Jacobs Well, an artesian well near Wimberly, quit flowing during a dry spell in 2008. It had flowed all through the drought of record.[4]

It is not easy to determine how much water supplies from the Trinity Aquifer and Canyon Lake will be reduced during drought-of-record conditions. Until better data exist, it is reasonable to accept the estimates made for the reliability of the Trinity Aquifer sources during drought. The San Antonio Water System has contracts for 8,800 acre feet of water from Trinity sources, but in its 2012 Water Management Plan, only rates firm yield at 2,000 acre feet, just 23 percent of total yield.[5]

Significant Issues

The net effect is that water purveyors, such as Fair Oaks Ranch Public Utilities Department, that rely on the Trinity Aquifer and, even Canyon Lake, need to make provision to address potentially severe water-supply reductions during drought-of-record conditions.

Table 1B(i) on page 186 in the Significant Issues section illustrates how conditions, such as drought of record, climate change, high GPCD levels and increased population estimates, may affect water supply and demand.

Climate Change

Local communities and water planning groups in Texas have been slow to consider climate change as a factor in preparing water-need estimates. The phenomenon is not mentioned in the SAWS 2012 Water Management Plan, the Region L Water Plan for 2011 or the State Water Plan. Part of the reluctance to consider the effects of climate change when planning for water needs may be a rejection of the idea as a part of a lack of confidence in the science, but it has also been hard to obtain data that could be translated into local change in water demand, evaporation rate, and rainfall.

At this stage in the process, however, water purveyors need to consider the data that exist and fine-tune the local impact of climate change as the availability of and confidence in the data increase.

A starting point for determining the effect climate change will have on the Fair Oaks Ranch water situation could be the paper by Chi-Ching Chen et al., “Effects of Climate Change on a Water Dependent Regional Economy: A Study of the Texas Edwards Aquifer.” It was produced in 2000 so doesn’t have the most recent data, but it does offer useful estimates.[1]

The authors estimated the forecast climate change of higher temperatures, less rainfall and more erratic rainfall will contribute an increase in municipal demand by 1.5 percent in 2030 and increase to 3.5 percent by 2090.[2] They also predicted recharge to the Edwards Aquifer would decrease so much that pumping from the Aquifer would have to be reduced by nine percent in 2030 and 20 percent in 2090 to maintain spring flow at high enough level to protect the endangered spcies.[3]

Significant Issues

The data is important to Fair Oaks Ranch water planning in that it predicts demand will increase and recharge will be reduced. Stated a different way, the conclusions of the paper predict Fair Oaks Ranch water needs for household and landscape use will increase by 1.5 percent by 2030 and that the water available to recharge the Trinity Aquifer will be reduced by some amount, perhaps approaching 9 percent by 2030. Nine percent is less than the 77 percent SAWS calculation, but illustrates clearly a new estimate must be developed.

Based on the Fair Oaks Ranch water situation, the effects of climate change will not translate to water shortages in the mid-term because of demand increases. The most important effect will be to make the Trinity Aquifer, already a challenged water source, even more challenged.

Water Policy Issues: Water Management

Water Conservation

In Article 12.06 in the Fair Oaks Ranch Code of Ordinances, the city proposes to achieve 160 gallons/capita/day by 2040. Its current GPCD averages 200. It has reached 235 in a dry year.[1] The high water use is largely the result of landscape watering, with a reported 2.5 to 3.0 ratio of summer water use to winter water use.[2] The high summer peak use characterizes a community with large residential lawns and limited industrial or commercial water use.

San Antonio, Fair Oaks Ranch's neighbor to the east and south, has a 1.5 ratio of summer water use to winter water use, reflecting its more diverse mix of multi-family housing, smaller landscapes, and business water use.[3]

If the landscape-watering season is nine months, that would mean approximately 50 percent of Fair Oaks Ranch water use is landscape irrigation.[4]

At first glance, water-conservation programming does not need to be a high priority for Fair Oaks Ranch. On paper, the city has adequate water supplies to meet future water needs. Build-out will be accomplished by 2040 and, at that time and beyond, the contracted water supplies are projected to meet population needs.

The authors would argue, however, there is a good reason to work to achieve the 160 gallons/capita/day goal reflected in the City of Fair Oaks Water conservation plan.

Reasons to work to make the 160 GPCD goal a priority:

1. Trinity water supplies are always a risky proposition and the Canyon Lake water has several decision points starting in 2037, when costs and conditions may make the water source more difficult to use.[5]

2. A per-capita water use level of 200-207 is not generally viewed as a level that reflects efficient water use. It is desirable for a community to have water-use performance that is more environmentally appropriate.[6]

3. Fair Oaks Ranch has a number of characteristics that bode well for the potential of a water-conservation program to work in the community.

4. If the population estimate of 16,411 is more accurate at build-out than that provided by the AECOM 2011 Water and Wastewater Planning Study, more water supplies will be required to meet demand.

Conditions lending themselves to water-conservation success:

1. The citizens of Fair Oaks Ranch are environmentally aware and involved in the issues of their community and region. They respond to challenges and insist on making their own decisions. They (FOR citizens) would work with officials in a manner that would allow them to have the freedom they desire to manage their landscapes consistent with

environmentally and horticulturally appropriate practices. The goal should be to convert the preponderance of well watered, very large lawn areas to more natural Hill County landscapes with smaller areas of irrigation.[7]

2. Fair Oaks Ranch is approximately 60 percent built out according to the 2011 Water and Wastewater Planning Study. Development rules for the 40 percent of new homes expected to be built by 2040 include a limit for sodded and irrigated landscape only to exceed the house footprint by 55 feet in all directions.

   For a 2,500-square feet home, that would amount to approximately one half acre of irrigated landscape (194 x 140 feet = 27,300 square feet less 2,500 square feet). If the current average irrigated landscape is one acre then average new home for the next 40 percent of the households will use 50 percent less water.

   Using these speculative estimates, the new development requirements could reduce GPCD to 182 by 2040 (assuming the average irrigated lot is now one acre and 40 percent of the eventual households will be the home footprint plus 55 feet on all sides).[8]

3. Fair Oaks Ranch has an automated meter-reading (AMR) system in place, so there is huge potential for early leak detection, irrigation-pattern analysis, water budgeting, drought-restriction enforcement and other water-conservation related activities.[9]

4. The Trinity Glen Rose Groundwater Conservation District and Texas A&M AgriLife Extension report offering some water-use education, rainwater catchment, and water-use-audit programming, but it seems there is still a largely untapped opportunity for water-conservation education in the city.[10]

5. Fair Oaks has an increasing-block system of water rates, with significant monetary penalties for high water use but even at its most extreme, during periods of drought restrictions, the rates are not very high. Rate increases could influence water use.[11]

Significant Issues

Fair Oaks Ranch should take advantage of its water-conservation assets and organize a formalized program to achieve the 160 GPCD goal by 2040. The reduction of the GPCD from 207 to 160 at the projected population of 10,301 in 2040 reduces water need by ≈ 577 acre feet (2,390 acre feet vs.1,812 acre feet) of water, equal to 23 percent of total water needs and about the amount of water that will be extracted from the Trinity Aquifer. Figure 1B and Figure 2B on pages 208 and 209 reflect estimates of these numbers.[12]

In addition to using the advantages listed in the earlier portion of this paper that appear to be assets to organizing a successful water-conservation program, the effort should work to do the job at an investment of about $500/acre foot. If the goal is to reduce per-capita water use by two gallons per year, the overall budget for water-conservation could begin at $7,500 ($14.58/acre foot) in 2015 and reach $11,550 ($23.10/acre foot) for the year 2040.

The $500/acre foot does not provide a generous budget for water-conservation activities, but it is the approximate cost experienced by the City of San Antonio in its water-conservation program.

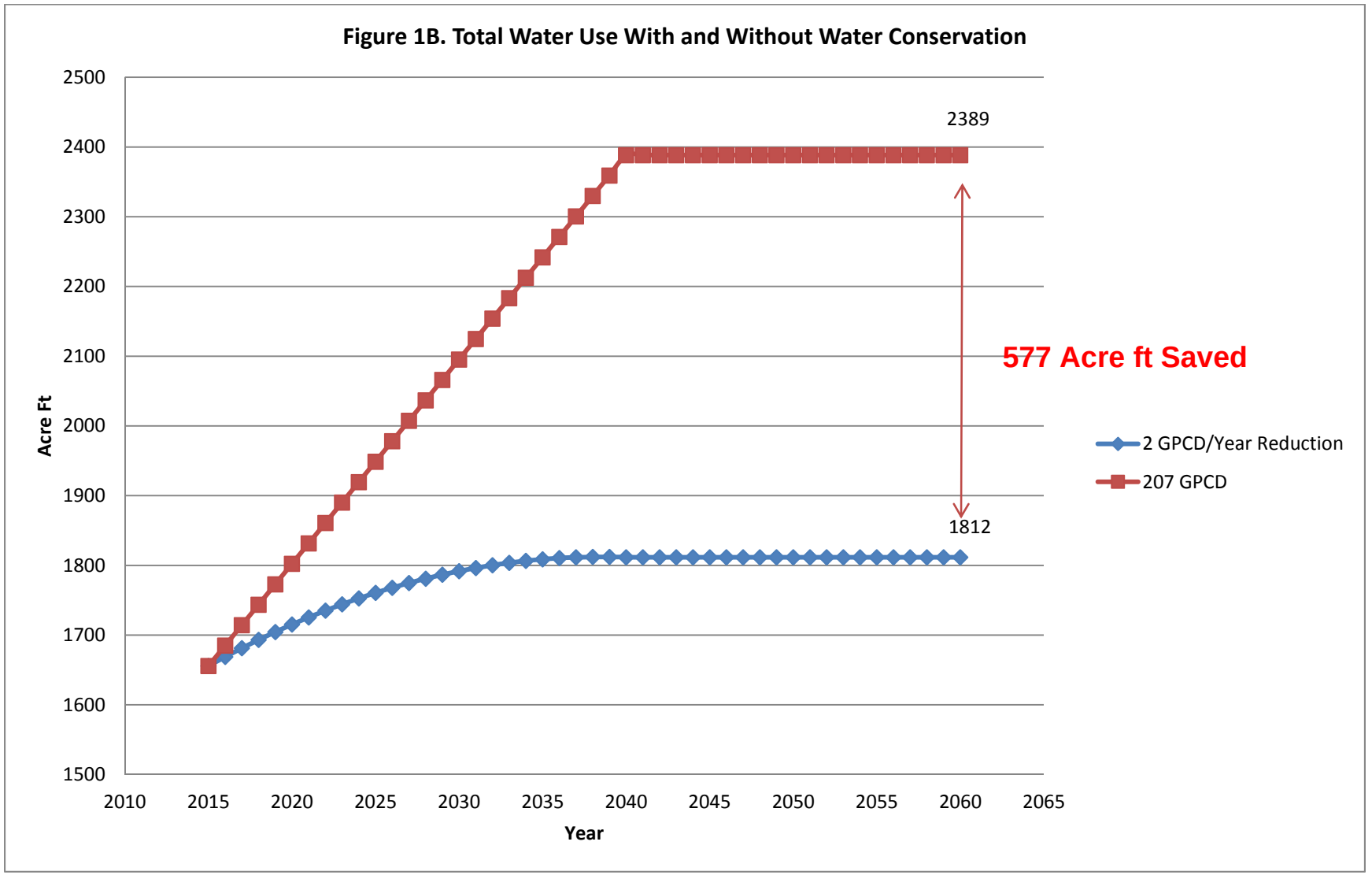


Figure 1B. Total Water Use With and Without Water Conservation
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
Acre Ft
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
Year
2389
1812
577 Acre ft Saved
2 GPCD/Year Reduction
207 GPCD

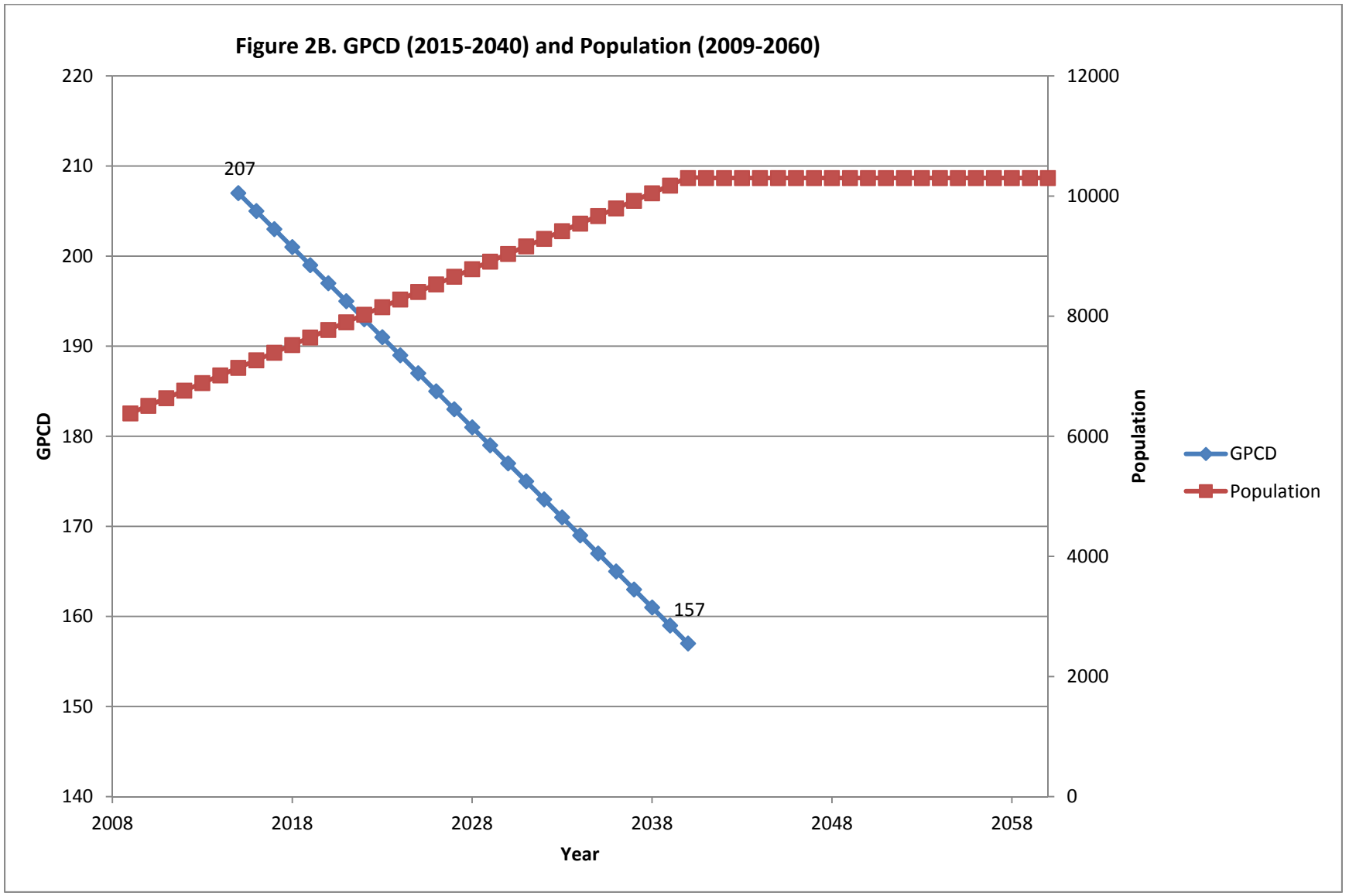


Figure 2B. GPCD (2015-2040) and Population (2009-2060)
220
210
200
190
180
170
160
150
140
GPCD
12000
10000
8000
6000
4000
2000
0
Population
207
157
2008
2018
2028
2038
2048
2058
Year
GPCD
Population

Key features of a Fair Oaks Ranch conservation program could include:[13]

1. The water-use regulations already require leak repairs and limiting sprinkler irrigation to periods of the day when evaporation and winds are lowest.

2. Consideration of a community conservation committee (such a committee could have a name individualized to Fair Oaks) made up of citizens with the goal of advising City Council and city staff on conservation activities, and perhaps more importantly, to communicate with citizens to mobilize community support for conservation initiatives.

3. Organization of an education program utilizing resources available in and around the city is important. The City of Fair Oaks already uses conservation programs presented by Texas AgriLife Extension Service personnel and water-use audits offered by Trinity Glen Rose personnel. The effort would contribute more towards achieving the two GPCD/year reduction in water use if the CCC described in Paragraph 2 identified a list of priority classes for the Fair Oaks situation. Among suggested classes are:

    a. “Turfgrass Water Requirements and Drought Capabilities” – The water needs of lawn grasses are often over-estimated. Research in the region has shown that all lawn grasses on soil depth of approximately 12 inches survived 60 days of no rain or irrigation.

    b. “The Characteristics and Advantages of Hill County Landscape” – Most area residents love the look of the Hill Country. This education offering would list the characteristics that make it attractive, including the plants, geographic features, and its tolerance for drought.

    c. “Twelve Months of Low Water Use Color” – This class would identify and describe a list of plants with colorful berries or blooms so that a landscape can have 12 months of color without irrigation.

    d. “Advances in High Efficiency Irrigation Technology that can be Used to Reduce Water Use” – There is a relatively long list of irrigation technology and management techniques that keep landscapes healthy with reduced water.

    e. “Using Graywater, Condensate and Rainwater Catchment to Reduce Potable Water Use on the Landscape” – Everyone is aware of rainwater catchment but graywater and even condensate are probably more effective sources of water for a typical household in the Fair Oaks Ranch climate.

4. Consideration of a graywater-use initiative in Fair Oaks Ranch. Graywater is the water recycled from the shower, clothes washing machine, and bathroom sinks. The average household produces 100 gallons per day of graywater that can be used to replace a portion of the potable water currently used on the lawn. If 50 percent of the

households utilized 50 gallons/household per day, it would save approximately 84 acre feet of water in 2015 and 100 acre feet per year by 2040.[14]

5. Use the AMR system to identify and alert area residents in real time to unusual water use patterns due to leaks. The AMR system also lends itself to the establishment of a recognition program that results when city residents reduce water use on the landscape or in other ways.

6. The City of Fair Oaks Ranch already has an excellent water-bill insert. Its impact could be enhanced if it offered a brief horticulture article with information that would contribute to reduced landscape-water use and/or offered some sorts of prize or response if the household responded to the water-conservation help or advice. The opportunity for response could target youth on some bills and other individuals on others.

The City of Fair Oaks Ranch has all the tools within reach for a strong water-conservation program to achieve the two GPCD/year reduction reflected in its water-conservation plan. Implementation of an effort with features such as those described would provide considerable insurance to back up risky Trinity Aquifer and Canyon Lake water sources.

Drought Management

On paper, Fair Oaks Ranch is in good shape with its water supply in relationship to water demand. Even at GPCD of 207, Fair Oaks Ranch has enough water to meet its needs in 2040 and beyond when it reaches its fully built-out status under the regime predicted in the 2011 AECOM Report.[1]

Unfortunately, droughts occur on a regular basis in the area and a water emergency due to infrastructure failure, contamination, acts of God and even terrorism are always possible. It is best for a well-governed community to have a drought/emergency-management plan in place.

Fair Oaks Ranch has an unique and relatively complex drought-management system. The main enforcement tool is an escalating surcharge system.[2] The city has, however, also imposed a once-per-week sprinkler-irrigation limitation and other water-saving activities.[3]

Once-per-week watering is allowed with sprinklers on a day of the week based on address: addresses ending with 1 and 2 on Monday, and addresses ending with 3 and 4 irrigate on Tuesday. Wednesday is reserved for addresses ending in 5 or 6. Thursday is reserved for addresses ending in 7 or 8. Addresses ending in 9 or 0 water on Friday.

Unfortunately, Fair Oaks Ranch officials report the once/week requirement and enforcement combination has not appeared to reduce overall water use, as expected.[4]

Officials are more positive about the three-stage drought-management scheme that relies on rate surcharges.[5]

There are three stages:

Stage 1

Drought-management restrictions are imposed when two of the following three conditions have been met:

1. The static level in the observation well reaches 1,045 feet above Mean Sea Level (MSL) for 15 consecutive days.
2. The system's average daily consumption of Trinity Aquifer groundwater exceeds 1.2 million/gallons for the same 15 days.
3. GBRA institutes Stage 1 water-reduction requirements.

The goal of imposing Stage 1 drought restrictions is to reduce Trinity Aquifer water use to levels below 1.2 million gallons for 30 days.

Supply management measures include:

- Surcharge on all water used over 25,000 gallons.
- Commercial car washes using non-recycled technology are banned.

- Reduce water-main flushing to a minimum level required to maintain quality standards.

Stage 2

Declared when two of the three conditions below have been met:

1. Static water level in the observation well reaches 1,030 feet above MSL for eight consecutive days.
2. Trinity aquifer water use level reaches 700,000 gallons per day for the same eight consecutive days.
3. GBRA implements Stage 2.

The goal is to reduce total water use and reduce Trinity Aquifer groundwater use to below 700,000 gallons/day for 30 consecutive days.

Supply management measures include:

1. Implementation of a surcharge on all water over 18,000 gallons per billing period.
2. Water use from fire hydrants limited to firefighting and other health-safety activities.
3. Ornamental-fountain use banned.
4. No sale of bulk water.

Stage 3

Restrictions imposed when one of the following three conditions are met:

1. The static water level reaches 1,015 feet above MSL.
2. Any time that the city's Trinity wells are falling at a rate to prevent pumping of 1.2 million gallons per day for seven consecutive days.
3. GBRA declares Stage 3.

Supply management measures include:

1. All non-essential water uses as defined in the definitions except hand watering of household shrubs is prohibited
2. Golf-course irrigation limited to recycled water from Fair Oaks Ranch utility treatment plant.
3. Moratorium on new landscaping or construction of new swimming pools
4. No application of new or expanded water-service connections will be approved

5. Water-flow restrictors may be installed on customer meters

6. The surcharge imposed in Stage 2 will be retained.

It is a misdemeanor to violate these provisions. Conviction will result in a fine.

In addition to the severity of the surcharge, the key to the effectiveness of drought-management restrictions in an emergency is ratepayer cooperation and the strength of the enforcement.[6]

In Stage 1, the surcharge is $5/1000 gallons for water use 25,000 to 40,000 gallons with increases to $12.50/1000 gallons for water use over 100,000 gallons. In Stage 2, the surcharge increase kicks in at 18,000 gallons. The surcharge is $30/1000 gallons for use over 100,000 gallons. In Stage 3, the surcharge stays the same as the charge for Stage 2.[7]

The surcharges do not seem severe enough to reduce water use to levels enough to accomplish the goals described for each stage, but city officials report the surcharges were, in fact, effective.[8] At the same meeting, officials did report that the imposition and enforcement of the once/week watering was not effective in reducing water use.[9]

Significant Issues

It is important Fair Oaks Ranch have an effective drought- and emergency-management scheme. If Fair Oaks Ranch is subjected to a severe drought or infrastructure emergency, the actions to reduce water use must work.

1. An in-depth review of the drought-management scheme by the new Community Conservation Committee (See the Water Conservation Section on page 205) is an important step.

2. It is important to simplify the rules so everyone understands them, buys into them, and understands they will be enforced.

3. Review the surcharge amounts to ensure they are high enough to make it likely that water use will be reduced rather than just increasing revenues.

4. Review the mechanism of enforcement. The City of San Antonio uses certified police officers working part-time to enforce drought restrictions. In a small community such as Fair Oaks Ranch, using regular police officers could be effective if it is also made clear a water-use misdemeanor is a serious violation.

5. The availability of the automated meter-reading system offers a strong enforcement tool in real time. It would be useful to review the response of ratepayers to the once/week sprinkler-irrigation limitation. City officials reported the restriction and its enforcement did not achieve the desired reduction in water use. Data collected through the AMR system should be able to show individual compliance and particularly the weekend reduction that should be easily detectible.

Lost/Non-revenue Water

As the search for new water resources intensifies, the idea of lost/non-revenue water is attracting more attention.

Every water purveyor has an amount of water that is lost or used for non-revenue producing activities. This amount is expressed as a percentage where the difference between the water pumped and purchased, and the water sold is divided into the water pumped and purchased.

There is a debate about how much lost water is acceptable and how much is excessive. Large, complex water systems want the characteristics of the system considered when lost water is calculated. A water purveyor with long stretches of distribution pipes, multiple wells or entry points, many connections and other complications would naturally have a higher lost-water rate than a simpler, modern system for a recently planned community.

The Texas Water Development Board requires all water purveyors with 3,505 connections to complete a water-audit report.[1] The report is also required for any water entity utilizing state funding (see the TWDB text). Water purveyors with a lost-water rate higher than the rate allowed for a water system of the complexity of the system completing the audit must use some of the funds being requested to reduce the lost-water level.

It is not easy to simplify the lost-water issue, but it is generally accepted that a lost-water rate of 10 percent or less is excellent and a rate of 15 percent or more merits action to correct the problems causing the water loss. A community losing a large portion of its water supply to a lost-water source needs to address the issue.

The first step in grasping the lost/non-revenue water is to calculate a gross figure by comparing water pumped (Trinity Aquifer) and received (Canyon Lake) to water that is actually paid for by system ratepayers.

The next step is to determine where the non-revenue water is going. Is it leaky distribution lines, inaccurate pumping data, firefighting water, stolen water, unmetered water, inaccurate consumer metering, line flushing, inaccurate bookkeeping, forgiven water bills or various other categories? Only when the lost-water contributing factors and amounts are identified can it be determined how much it will cost to reverse all or part of the losses.

In some cases, all or a portion of the lost water will be tolerated because it is not sound business management to spend the money required to correct the situation that causes it. In all cases, however, the amount and source of the non-revenue water should be identified and quantified so that the problem can be corrected if it does make business sense.

Significant Issues

Fair Oaks Ranch with 2,698 connections is not required to prepare a full-scale lost/non-revenue-water determination for consideration by TWDB, but the city is conscious of the issue and makes regular calculations to help identify any issues related to lost water before it becomes a major problem.[2]

The city produces a non-revenue-water percentage every month by recording water used in dead-end flushes, random flushes, and water purchased for construction projects. To this total, City of Fair Oaks Ranch adds an estimate for the volume of water lost through broken water-main leaks. The average total is 7.8 percent per month.[3]

Water Policy Issues: Water Quality

Relationships with Neighboring Communities

Discussions include the City of San Antonio and neighboring communities.

City of San Antonio

The relationship between Fair Oaks Ranch and its large neighbor to the east and south, San Antonio, seems more than cordial. Both cities work closely with the Trinity Glen Rose Groundwater Conservation District on Trinity Aquifer issues.

Significant Issues

The water-policy study represented in this paper is jointly sponsored by the two cities and is linked to cooperation concerning an ETJ issue. The arrangement that has SAWS buying surplus Western Canyon water until Fair Oaks Ranch and other area communities need it, is also an example of cooperation between the two entities.[1] Based on the history of cooperation, it is hard for the authors to understand why Fair Oaks Ranch has not lobbied harder to create a wholesale interconnection between Fair Oaks Ranch water lines and those of the City of San Antonio.

There is some evidence SAWS is not as excited about the value of the interconnection as Fair Oaks Ranch should be. Discussion of costs have revealed a reluctance on SAWS' part to make the connection affordable, but the importance to Fair Oaks Ranch to have access to City of San Antonio supplies in case of an emergency, makes it worthwhile for Fair Oaks Ranch to use all its influence to make the interconnection a reality.[2]

The City of San Antonio relies on the Edwards Aquifer for the majority of its supply, also has Carrizo water, and is soon to have treated brackish groundwater. COSA's water supplies are very different from the Fair Oaks Ranch supply. The interconnect would provide Fair Oaks Ranch a diversified source for backup in case of problems in one or both of its current supplies.

The promise of access to Fair Oaks Ranch Canyon Lake and Trinity Aquifer water supplies may not be as important to San Antonio as the connection is to Fair Oaks Ranch, but there are other issues important to the City of San Antonio that could be addressed as part of the cooperative interconnect agreement. A significant portion of the rain that falls over the Trinity Aquifer recharge area eventually recharges the Edwards Aquifer.[3] The two cities will find value in reaching agreement on land use to govern development and even conservation easements within the cities' boundaries and in the region.

Boerne, Comal and Kendall Counties

The Water and Wastewater 2011 planning document produced AECOM, an international professional technical services firm, treats the Fair Oaks Ranch Trinity Aquifer water supply as if it were an uniquely Fair Oaks Ranch source, unaffected and unrelated to any other communities' water use. It is, of course, not in that category at all.

The Trinity Aquifer is under pressure as a water source throughout its range.[4] Population growth and Trinity-water pumping in Kendall and Comal Counties is especially important to the reliability of Fair Oaks Ranch supply.[5] As was noted in the Trinity Aquifer supply section of this analysis, the Trinity Aquifer "is the most stressed water source in the area."[6]

In recognition of the interdependence of communities and other pumpers that rely on the Trinity Aquifer as a water source, nine groundwater districts in 2001 formed the Hill Country Alliance of Groundwater Districts. The expectation of some of the parties was that the group would eventually evolve into an Edwards Aquifer Authority type of entity.

The Hill Country Alliance did receive a grant of $450,000 to support nine monitoring wells but beyond that, joint action seems lacking. In 2008, it is reported that the last vestiges of cooperative action occurred after a revolt arose against the Cow Creek GCD permitting rules. [7]

SAWS reduces use of its Trinity sources during drought, which allows other pumpers to better rely on the challenged resources.[8] Boerne, the rest of Kendall County and Comal County are growing at a fast rate. Boerne has several supply sources but the unorganized areas rely almost entirely on the Trinity Aquifer. They cannot be expected to assume the same type of pumping plan the City of San Antonio uses.

Significant Issues

It is important that area Trinity Aquifer pumpers revisit the idea of close cooperation to protect the Trinity Aquifer.

Fair Oaks Ranch should strengthen relationships with Boerne, the rest of Kendall County and the Comal County areas that rely on the Trinity Aquifer with the goal of working together to jointly protect this important water source. The discussion may be sponsored, or under the auspices of the Cow Creek WCD and the Trinity Glen Rose Groundwater Conservation District, but such a discussion is essential so the parties can work more closely together to manage their Trinity Aquifer resources. Another entity may be involved if the bills currently being considered in the legislature (HB 2407 and SB 963) to create a Comal Trinity GCD are passed.[9]

Water Policy Issues: Regulatory Agencies

Trinity Glen Rose Groundwater Conservation District

The **Trinity Glen Rose Groundwater Conservation District** (TGRGCD) was created by the legislature in 2001 and was confirmed by area voters in 2002.[1] Its purpose is to develop and implement regulatory, conservation, and recharge programs that preserve and protect the underground water resources located in the district.[2]

In the legislation, TGRGCD was charged with responsibility for Trinity Aquifer resources in northern Bexar, north of Highway 1604 to the Medina, Bandera and Kendall County lines.[3]

Based on an election in 2004, the citizens of Fair Oaks Ranch decided that TGRGCD is responsible for the territory within the entire boundaries of the City of Fair Oak Ranch, even that portion in Kendall County and Comal County.[4] See Figure 3B on page 220.

TGRGCD legislation was written to benefit existing Trinity pumpers in the jurisdiction both by way of well spacing and other requirements, such as water costs. Existing pumpers were grandfathered and Fair Oaks Ranch and other municipal pumpers whose Trinity water use is less than 50 percent of their total water use, do not need to pay the aquifer fee for water used.[5]

TGRGCD is a small district with limited income and staff. Among the services it offers to Fair Oaks Ranch residents are residential water use surveys (audits). It is reported that the surveys are not in high demand.[6]

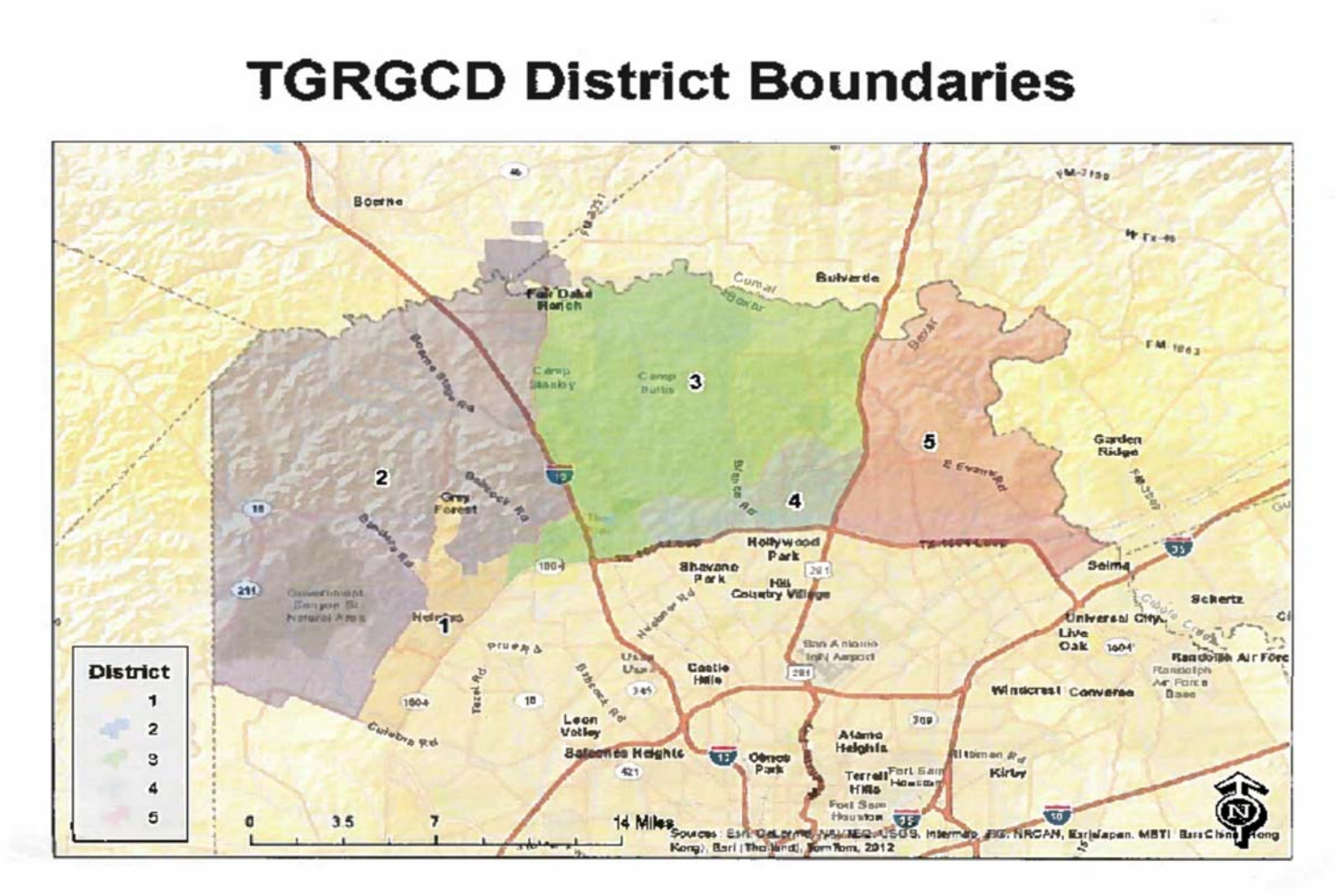
TGRGCD staff also reports they maintain close relationships with the Cow Creek Groundwater Conservation District, District 9 Water Management Area and the Region L Water Planning District.[7] TGRGCD also has close relationships with Fair Oaks Ranch and SAWS.[8]

Significant Issues

Fair Oaks Ranch benefits now and could benefit further by a close working relationship with TGRGCD. Because of the importance of Trinity Aquifer water to the Fair Oaks Ranch supply, it is essential the city's interests be represented in the Trinity pumping areas in Bexar County where TGRGCD is responsible. TGRGCD can also help protect Fair Oaks Ranch's interests in the Cow Creek GCD area and in the respective water-planning and management regions.

Toward the end of protecting Fair Oak Ranch's interests, the city needs to maintain an active presence on the TGRGCD Board. Fair Oaks Ranch may also want to consider the TGRGCD funding situation. Would Fair Oaks Ranch benefit by the more powerful TGRGCD organization that would result if Fair Oaks Ranch, SAWS and other municipalities benefitting from the "under 50 percent rule" were paying for use of Trinity water?[9] A better funded TGRGCD may better represent Fair Oaks Ranch's interests in the various entities and fields described in this paper.

Figure 3B. TGRGCD District Boundaries



Texas Water Development Board

The Texas Water Development Board (TWDB) is the state's primary water planning and financing agency. TWDB has three main responsibilities.[1]

1. Collect and disseminate water-related data
2. Plan for the development of the state's water resources
3. Administer cost-effective financing programs.

The TWDB mission is "to provide leadership, planning, financial assistance, information and education for the conservation and responsible development of water for Texas."[2] The TWDB is a state agency with responsibilities important to the City of Fair Oaks Ranch water program. Among those responsibilities are:[3]

- TWDB is responsible for the production of a state water plan and support for regional planning efforts used to construct the state plan.
- Local water projects must be included in the regional plan in order to be considered for any of the funding sources available from the TWDB.
- TWDB specifies how water purveyors must calculate lost and non-revenue water and collects the information. Lost water over a specified amount must be addressed with TWDB or local funds before the funds can be used for other projects.
- TWDB specifies each water purveyor must have a water-conservation plan that passes muster with the TWDB before any funding can be considered.
- There is a long list of funding sources available through TWDB. Among the most important are the Texas Water Development Fund, the Water Research Grant Program, and State Water Implementation Fund for Texas (SWIFT), which is the newest funding opportunity from TWDB.

SWIFT Funds for Water Supply Projects

House Bill 4, passed by the Texas Legislature in 2011 and approved by voters as Proposition 6 in 2013, made provision for a $2 billion State Water Implementation Fund for Texas (SWIFT). This money will be available for low-interest, flexible-term loans for water-resource projects. At least 20 percent of the funding is reserved for water conservation or reuse projects and another 10 percent is reserved for rural projects.[5]

The legislation did not provide a specific definition of a water-conservation project. A popular definition of water conservation is to "make new water resources available through practices and technology that allow activities that use water to be completed at current levels with less water." This definition is in keeping with a statement in the legislation about SWIFT funds being used for "water-conservation or reuse projects designed to reduce the

need … to develop additional water resources." [6] A definition of "rural" is referenced in the legislation.

Rural political subdivision means:

1. A non-profit water supply or sewer service corporation, district, or municipality with a service area of 10,000 or less in population or that otherwise qualifies for financing from a federal agency
2. A county in which no urban area exceeds 50,000 in population." [7]
3. To be considered for SWIFT funding, water-resource projects must be sponsored by a local government or public water purveyor and must already be in the current state water plan, which is made up of regional plans.

"Loan, Not a Grant"

SWIFT funds are available to water purveyors and local governments as a loan, not a grant; the money must be repaid. The assistance is desirable in many situations, however, because the interest rates will be low and the terms flexible. If SWIFT funds make it possible to fund a project and only pay the loan back when the water is available for sale to and paid for by ratepayers, that is a major advantage.

The Texas Water Development Board (TWDB) created rules for prioritization of the water-resource projects for funding. The legislation says TWDB should base those rules on input from the regional water-planning groups. The groups are currently prioritizing the projects in their regional plans by looking at them in terms of:

1. The decade in which the project will be needed
2. The feasibility of the project, including the availability of water rights for purposes of the project and the hydrological and scientific practicability of the project
3. The viability of the project, including whether the project is a comprehensive solution with a measureable outcome
4. The sustainability of the project, taking into consideration the life of the project;
5. The cost-effectiveness of the project, taking into consideration the expected unit cost of the water to be supplied by the project.[8]

The TWDB will further consider projects in terms of whether they:

1. Serve a large population
2. Provide assistance to a diverse urban and rural population
3. Provide regionalization

4. Meet a high percentage of the water supply needs of the water users to be served by the project.[9]

In addition, the TWDB must also consider at least the following criteria:

1. Local contribution to finance the project
2. Financial capability of the applicant to repay the provided funding
3. Ability of the TWDB and applicant to leverage state funding with local and federal funding
4. An emergency need for the project:
    a. Less than a 180-day supply is available
    b. Federal funding has been used or sought.
5. Readiness of applicant to proceed with the project:
    a. All preliminary planning and design work has been completed
    b. Applicant has acquired the required water rights
    c. Funding from other sources has been secured
    d. Applicant is able to begin implementation.
6. Applicant has filed a water audit with the TWDB
7. Prioritization given by the regional water planning group.[10]

Significant Issues

As the primary state agency involved in water planning and water-resource funding, the TWDB is very important to water security. Toward the end of being better able to take advantage of the services provided by TWDB, water-planning officials need to stay tuned and even seek to influence TWDB policies whenever possible.

Supporting appointment of commissioners sensitive to area issues is a worthy endeavor. It is also critical that funding for SWIFT, the Texas Water Development Fund water research and other TWDB funding programs be adequate to do the job.

Policies that affect how the funding is made available to water purveyors is also important. Policies that reward a strong conservation program as a prerequisite for receiving TWDB funds encourage successful conservation programs.

Texas Commission on Environmental Quality (TCEQ) and United States Environmental Protection Agency (EPA)

The Texas Commission on Environmental Quality is the state agency charged with environmental regulation and enforcement. While this mission includes a wide range of responsibilities, the two areas of jurisdiction most relevant are:

1. Regulation of water-utility operations, including water quality as delivered to consumers
2. Regulation of environmental water quality, including quality of treated wastewater discharged to receiving water bodies.

In performing these regulatory functions, the Texas Commission on Environmental Quality frequently acts as a state-level delegate for the federal government U.S. Environmental Protection Agency (EPA), although the relationship between these agencies is complex and has included some conflict in the past. Critical federal laws relevant to the two regulatory jurisdictions named above are, respectively, (1) the "Safe Drinking Water Act" (SDWA), originally passed in 1974 and amended multiple times since, and (2) the "Clean Water Act" (CWA) originally passed in 1972 and since also amended on multiple occasions.

Fair Oaks Ranch present water supply operations are in compliance with SDWA requirements.[1]

State and federal law and regulation relevant to CWA and SDWA issues have been relatively constant for several years. While some might argue with this statement due to various items of enforcement and reporting at the state and federal level[2], these items have generally been progressive implementations of existing law and regulation, not additions of wholly new concern. A typical example of the gradual nature of these processes is the groundwater rule first proposed by EPA in 2000, finally promulgated by EPA in 2006, and adopted for implementation by TCEQ in 2012.[3]

TCEQ, in its own current strategic plan, echoes the "Philosophy of Texas State Government" to include "government should be limited in size and mission…" (p. 3). That document's review of "Current Activities & Opportunities" relevant to the Clean Water Act (CWA) and Safe Drinking Water Act (SDWA) topics (pp. 177-184) emphasizes gradual implementation and efficiency improvements in regulatory activities, as well as technical assistance to water utilities for compliance. The agency does not express interest in expanding regulatory reach.[4]

Significant Issues

One water-quality issue does merit consideration as a risk over the medium- to long-term future. For roughly the past decade, scientific studies have been conducted on a very broad group of "Contaminants of Emerging Concern" (CECs) in both drinking water and environmental waters.

The primary distinguishing feature of CECs is their very low levels of concentration when detected, typically on the order of "micrograms per liter" of water. These concentrations are

roughly 1,000 times less than traditional contaminants measured in “milligrams per liter.” The recognition of CECs is largely due to improved laboratory tests and instruments able to detect at these low levels. CECs include a wide range of substances: pharmaceuticals, antibiotics, industrial chemicals, food additives, and others; and CECs are hypothesized to have a wide range of effects on human and animal health, including disruption of endocrine systems and inducement of antibiotic resistance. Scientific studies are underway to assess the real effects of CECs on human and environmental health as well as the introduction, transport, and fate of these substances in the environment.[5]

It is known, however, that existing water- and wastewater-treatment technologies are often ineffective at removal of CECs with better removal fractions often accompanied by higher costs (e.g., reverse osmosis and ozonation).[6] Intensive research is underway to determine appropriate technologies and combinations of the same for CEC removal.[7]

EPA is currently engaged in the scientific study process of CECs, largely through its “Endocrine Disruptor Screening Program” (EDSP).[8] In the authors’ opinion, regulatory action in Texas under SDWA or CWA authority is very unlikely in the next 10 years due to:

- Existing uncertainty over human- and environmental-health effects of CECs
- Existing uncertainty over effective technologies for CEC removal
- Generally gradual nature of regulatory implementation by TCEQ.

The next 10 years will likely see significant gains in knowledge affecting the first two bullets above. Fair Oaks Ranch should monitor this field of knowledge on a regular basis to anticipate and prepare for any regulatory changes that may eventually occur.

Water Policy Issues: Water Costs

Residential and Commercial Water Costs and Impact Fees

The most noticeable characteristic of the water rates in Fair Oaks Ranch is the striking difference between residential and commercial rates. Both water-fee categories include a service fee based on meter size.[1] Figure 4B below illustrates the difference between residential and commercial fees.

Wastewater fees are set on a monthly basis (Table 1B on page 228). The reasonable set fee as opposed to a volumetric fee for wastewater treatment may reflect administrative ease and the efficiency of the recycled-water program. It is reported that the relatively level commercial fees were set to accommodate the Fair Oaks Ranch Country Club. The relatively flat water rates across various volumes were justified because many Fair Oaks Ranch residents were members of the Country Club. If Fair Oaks Ranch wanted to convert to a volumetric charge, the new AMR system would make that relatively easy.[3]

Current impact fees charged by Fair Oaks Ranch are presented in Table 2B on page 228. One estimate of the median price of a single family home in Fair Oaks Ranch is $396,489.[4] Using the impact fee of $6,950 and the median home price, the percentage increase in the price of a home is 1.75 percent.[5]

Significant Issues

The expanded block rate for residential water uses increases significantly as water use increases in Figure 4B on page 227. The block rates on the graph may be deceiving, however, because the higher rates, ≈$24/1000 gallons, for example, only kick in for water use over 100,000 gallons in a month. The rate for relatively high use of 20,000 gallons is less than $5/1,000 gallons.

If Fair Oaks Ranch wants the block rates to reduce water use, the rate will have to increase for lesser amounts of water.

The city may, in fact, be achieving that goal with its drought-management surcharge imposed to reduce water use during a drought emergency.[6]

As Figure 4B clearly illustrates, the rate structure is sympathetic to commercial ratepayers. There may be an economic development policy decision reflected in the low and steady rates for commercial customers. The City of Fair Oaks Ranch should reconsider the policy. The rates between residential and commercial ratepayers should be equal for the sake of fairness when Fair Oaks Ranch launches its water-conservation program. The impact fees are reasonable, and as long as they cover all infrastructure costs, meet the needs of the community

Figure 4B. Residential and Commercial Volumetric Water for Fair Oaks Ranch[7]

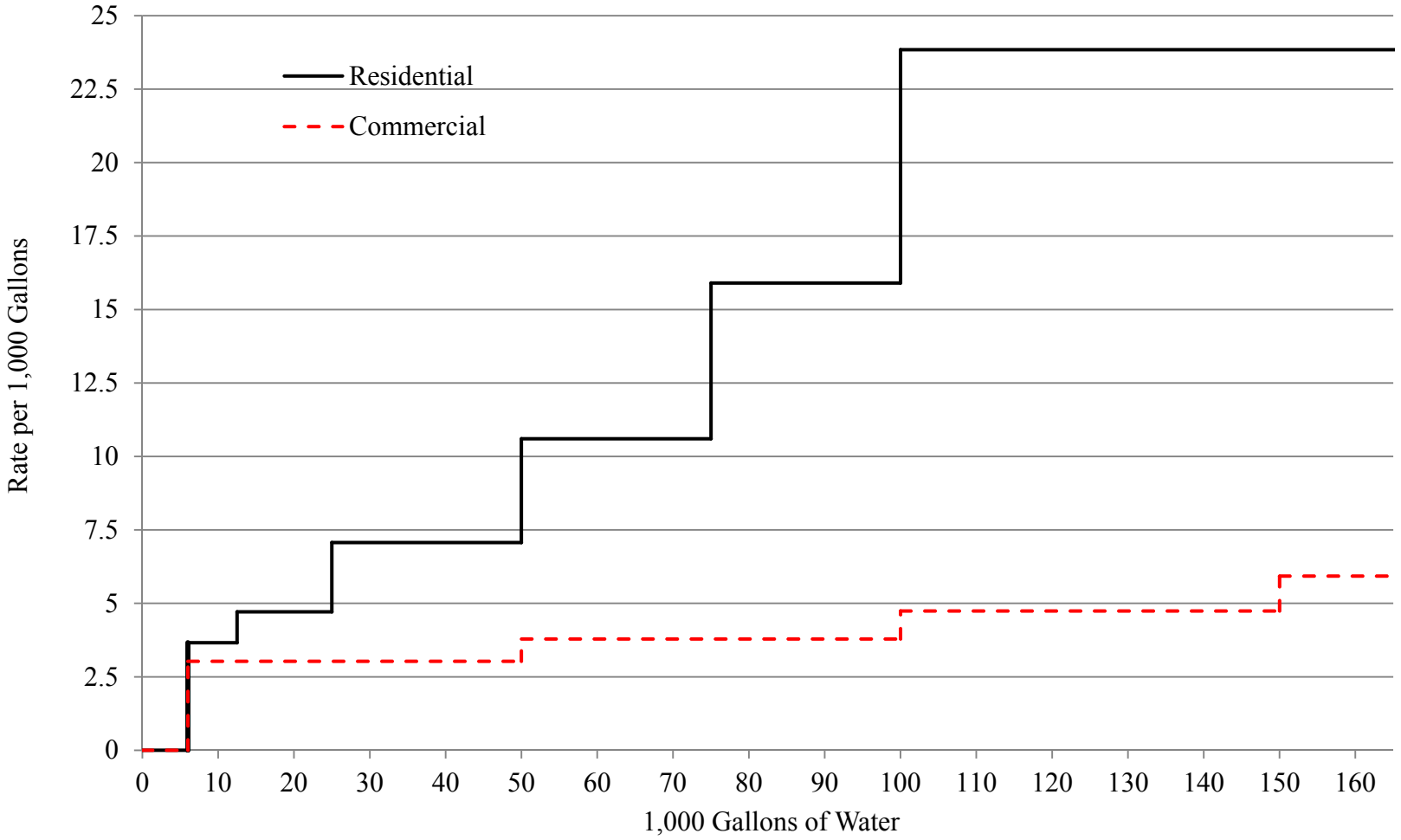


Table 1B.

Fixed Monthly Service Charges (dollars) for Fair Oaks Ranch, 3/4 Meter

Category	Fee ($)
Water Fees	
Meter Rental Fee	25.20
Surface Water	13.04
Texas Commission on Environmental Quality	0.17
Trinity Glen Rose Ground Water Conservation District	0.00
Debt Service	9.27
Capital Reserve	3.36
Total Water Fees	51.04
Wastewater Fees	
Service Availability	35.85
Texas Commission on Environmental Quality	0.07
Debt Service	7.65
Capital Reserve	2.06
Total Wastewater Fees	45.63
Total Water + Wastewater Fees	96.67

Source: http://www.fairoaksranchtx.org/index.aspx?NID=228 http://www.fairoaksranchtx.org/DocumentCenter/Home/View/456 [8]

Table 2B.

Fair Oaks Ranch Impact Fees per Service Unit per Living Unit Equivalent

Category	Fee ($)
Water Facilities	5,400
Wastewater	1,550
Total	6,950

Source: http://www.fairoaksranchtx.org/ArchiveCenter/ViewFile/Item/625 [9]

Fair Oaks Ranch Tables and Graphs

Notes and Citations: City of Fair Oaks Ranch

Water Source: Trinity Aquifer Water (Page 195)

1. Reem Zoun and David Parkhill. Kendall County and the City of Fair Oaks Ranch Water and Waste Water Planning Study. Feb 2011, AECOM for Guadalupe-Blanco River Authority Page 3-12.
2. George Wissman Interview, January 7, 2015. Wissman is the General Manager of the Trinity Glen Rose Groundwater Conservation Distinct (TGRGCD).
3. Ron Emmons, City of Fair Oaks Ranch Public Works Director, Q&A Meeting with City of Fair Oaks Ranch and Trinity Glen Rose Groundwater District officials at the City of FOR offices on 12-18-14.
4. Gregg Eckhardt, "The Trinity Aquifer", The Edwards Aquifer Website, http://www.edwardsaquifer.net.html.
5. Ibid.
6. See note #2. George Wissman Interview, January 7, 2015.
7. Ron Emmons, City of Fair Oaks Ranch Public Works Director, electronic communication, March 11, 2015.
8. Reem Zoun and David Parkhill City of Fair Oaks Ranch Water and Wastewater Planning Study, Feb 2011.
9. See note #2. George Wissman Interview, January 7, 2015.
10. Ibid.
11. See note #2. George Wissman Interview, January 7, 2015.
12. See note #4. "The Trinity Aquifer," The Edwards Aquifer Website.
13. Colin McDonald "Thirsty for Water in Kendall County" *San Antonio Express-News,* C. McDonald. Express-news.net, July 1, 2011, and conversation with George Wissman on 1/7/15.
14. San Antonio Water System 2012 Water Management Plan. www.saws.org
15. Ron Emmons, electronic communications, March 11, 2015.
16. George Wissman Interview, January 7, 2015.

Water Source: Canyon Lake Water (Page 198)

1. Third Amendment to Agreement Between City of Fair Oaks Ranch, Texas and Guadalupe-Blanco River Authority, January 1, 2012. Provided to Calvin Finch by Christina Picioccio at the 12/18/14 Meeting at the FOR offices.
2. Guadalupe-Blanco River Authority Invoice date 2/1/15 was provided to Calvin Finch by Christina Picioccio of the FOR Utilities on 2/17/15. The information on the invoice was used to calculate the water rate. Corrected by Ron Emmons 3/11/15.
3. Agreement Between City of Fair Oaks Ranch Texas and Guadalupe-Blanco River Authority, Regional Water Supply Project for Portions of Comal, Kendall, and Bexar Counties, 9/16/1999. Hard copy provided to Calvin Finch by Christina Picioccio of the FOR Utilities 2/17/15. Page 19.
4. Dave Pasley, SAWS Supports Sprawl: Western Canyon Pipeline, March 28,2006 at http://sawssupportssprawl.blogspot.com. Page 2.
5. In the opinion of author Calvin Finch based on experiences in drought of 2011 and before.
6. Certificate of Convenience and Necessity, Certificate No 11246 Texas Natural Resource Conservation Commission.
7. See note #3. Agreement between FOR and GBRA.
8. See note #1. Third Amendment Agreement between FOR and GBRA.
9. See note #4, Page 3. Dave Pasley Article.
10. See note #2. Corrected by Ron Emmons.

Water Source: Recycled Water (Page 200)

1. Ron Emmons, Fair Oaks Ranch Public Works Director, email communication, Reuse Water, March 11, 2015.
2. Ibid.
3. Ibid.
4. Ibid.
5. Ibid.
6. Ibid.

Population Estimates (Page 202)

1. Ron Emmons, Fair Oaks Ranch Public Works Director, email communication, March 11, 2015. Based on calculations completed by the Mayor and three City Council members.
2. Ibid.
3. See Note 1, Ron Emmons, March 11, 2015.
4. Reem Zoun and David Parkhill. Kendall County and the City of Fair Oaks Ranch Water and Wastewater Planning Study, February 2011. Prepared for Guadalupe Blanco River Authority in association with Texas Water Development Board by AECOM Page 1-1 for 2009 population and pages 2-4 (Table 2.2) for 2040 population estimate.
5. Calculated by multiplying GPCD in Kendall County and Fair Oaks Ranch Water and Wastewater Planning Study (page 3-1) by population at 2040 when build-out is reached (Page 3-11).
6. Information provided by Mayor Landman, June 4, 2015, email communication to Calvin Finch.
7. AECOM report. Page 3-11.

Drought-of-record Conditions (Page 203)

1. Robert Gulley, "Heads Above Water," Texas A&M Press, Page 3, 2015
2. Robert Mace, Ali H. Chowdhury, Roberto Amayas, Shao-Chih (Ted) Way, Groundwater Availability of the Trinity Aquifer, Hill Country Area, Texas: Numerical Simulation through 2050, Report 353, Texas Water Development Board
3. Colin McDonald, "Thirsting for Water in Kendall County," San Antonio Express-news, July 1, 2011 https://mysanantonio.com
4. Gregg Eckhardt, "The Trinity Aquifer," The Edwards Aquifer website https://www.edwardsaquifer.net/trinity.html
5. San Antonio Water System 2012 Water Management Plan, Page 25 www.saws.org

Climate Change (Page 204)

1. Chi-Chung Chen, Dhazn Gillig, and Bruce A. McCarl, Effects of Climatic Change on a Water Dependent Regional Economy: A Study of the Texas Edwards Aquifer, National Assessment of Climate Change, Agricultural Focus Group supported by U.S. Global Climate Change Office, 2000.
2. Ibid. Page 4.
3. Ibid. Page 4.

Water Conservation (Page 205)

1. Article 13.06 Water Conservation Plan from the Fair Oaks Ranch Code of Ordinances, Page 1. This document was provided to Calvin Finch at the 12/18/2014 meeting with Mayor Cheryl

Landman, Public Works Director Ron Emmons, and others from the City of Fair Oaks Ranch and the Trinity Glen Rose Groundwater District.
2. Ron Emmons provided the winter/summer watering ratio at the 12/18/2014 meeting described above.
3. Information provided by Calvin Finch based on his experiences with the San Antonio Water System.
4. Calculated by Calvin Finch.
5. Ron Emmons in phone conservation noted that one important decision point was at 2037. The review of the contract between GBRA and Fair Oaks Ranch for Canyon Lake Water related many decision points. January 12, 2015.
6. Opinion offered by Calvin Finch.
7. Opinion offered by Calvin Finch based on his experiences with various citizens and groups within City of Fair Oaks Ranch on water conservation since 1989.
8. Calculations by Calvin Finch based on the development rules offered in the Article 13.06 Water Conservation Plan, Section 13.06.004.
9. Ron Emmons related the existence of the newly completed automated Meter Reading system in the December 18, 2014 discussions first noted under #2 in the Trinity Water Source section.
10. Opinion of Calvin Finch after Discussions with Ron Emmons, George Wissman, and Mayor Landman at the various discussions held between him and the individuals mentioned (12/18/14, 1/7/15, 1/12/15).
11. Numbers calculated and graphed by Uyen Truong.
12. Opinion of James Mjelde based on his experience with water rates and their impact in changing water use.
13. Reem Zoun and David Parkhill. Kendall County and the City of Fair Oaks Ranch Water and Wastewater Planning Study, February 2011. Prepared for Guadalupe Blanco River Authority in association with Texas Water Development Board by AECOM Page 1-1 for 2009 population and Page 2-4 (Table 2.2) for 2040 population estimate.
14. Opinions offered by Calvin Finch and other authors based on their experiences with the water conservation programming in San Antonio, the Edwards Aquifer Region and the State of Texas.
15. Graywater estimates based on data received by Calvin Finch in his research and promotion of graywater as a water resource.

Drought Management (Page 212)

1. Reem Zoun and David Parkhill. Kendall County and the City of Fair Oaks Ranch Water and Wastewater Planning Study, February 2011. Prepared for Guadalupe-Blanco River Authority in association with Texas Water Development Board by AECOM Page 1-1 for 2009 population and Page 2-4 (Table 2.2) for 2040 population estimate.
2. Article A 9.000 Water charges from the FOR code of Ordinances provided to the authors by the attendees of the 1/7/2015 meeting.
3. Article 13.06 Water Conservation Plan from the Fair Oaks Ranch Code of Ordinances, Page 1. This document was provided to Calvin Finch at the 12/18/2014 meeting with Mayor Cheryl Landman, Public Works Director Ron Emmons, and others from the City of Fair Oaks Ranch and the Trinity Glen Rose Groundwater District.
4. Ron Emmons opinion offered at the meeting of 12/18/14 between the authors, the Mayor Landman, George Wissman, Fair Oaks Ranch water staff, and Trinity Glen Rose Groundwater District Board Members and staff.
5. Ibid.
6. Rate and Surcharge information is provided by Article A9.000 Water Charges from the Fair Oaks Code of Ordinances provided by Ron Emmons at the 1/7/15 meeting. The opinion on surcharge impact is offered by Calvin Finch based on his experience in drought restriction enforcement.

7. Ibid.
8. Ibid. See note #6. Ron Emmons at the 1/7/15 discussion.
9. Ibid. See note #4. Ron Emmons at the 12/18/14 meeting.
10. Opinions of the authors based on their experiences with drought management planning.

Lost/Non-revenue Water (Page 215)

1. Water Loss Audit, Texas Water Development Board, http://www.twdb.texas.gov/conservating/municipal/waterloss/. The web item describes that a water purveyor must have 3300 connections to be required to prepare an audit annually even if they do not have a financial obligation to TWDB.
2. Christine Picioccio, City of Fair Oaks Ranch Public Utility, email communications on 2/17/15, 4/10/15, 4/16/15 City of Fair Oaks Lost Water Determination
3. Ibid.

Relationship with Neighboring Communities (Page 217)

1. Canyon Lake, SAWS website at www.saws.org. Relates the relationship between SAWS and their purchase of water prior to the smaller purveyors taking their full contracted quantity.
2. Mayor Cheryl Landman, City of FOR Mayor, Q&A Meeting with City of Fair Oaks Ranch and Trinity Glen Rose Groundwater District officials at the City of Fair Oaks Ranch offices on 12/18/14.
3. Gregg Eckhardt, "The Trinity Aquifer", The Edward Aquifer website, http://www.edardsaquifer.net.html.
4. Robert Mace; Ali Chowdhury; Roberto Anaya; Shao-Chih (Ted) Way. Groundwater Availability of the Trinity Aquifer, Hill Country Area, Texas: Numerical Simulations through 2050. Page 2. September 2000. Texas Water Development Board.
5. Ibid.
6. Greg Eckhardt "The Trinity Aquifer," the Edwards Aquifer website, http://www.edwardsaquifer.net.html. Page 6.
7. Ibid.
8. San Antonio Water System 2012 Water Management Plan. Page 25. www.saws.org. The 2009 Plan did not consider the Trinity as a firm supply. The 2012 Plan considers it firm for 2000 acre feet of the 8000 acre feet of water available in an average rainfall year.
9. Ron Emmons, City of Fair Oaks Ranch Public Works Director, email communications, March 11, 2015.

Trinity Glen Rose GCD (Page 219)

1. Trinity Glen Rose Groundwater Conservation District Rules Chapter 1. Available on the TGRGCD website at www.trinityglenrose.com/.
2. HB 2005 the legislation creating TGRGCD in 2001. The document was provided to Calvin Finch in a meeting with TGRGCD General Manager George Wissman on 1/7/15.
3. Ibid. Page 2.
4. George Wissman, TGRGCD General Manager, in a meeting on 1/7/15 at his office with Calvin Finch. Date of election correction provided by Mayor Landman, June 4, 2015.
5. Ibid.
6. Ibid.
7. Ibid.
8. In the opinion of author Calvin Finch based on his interaction with both water purveyors.

9. The "50% rule" makes it possible for Fair Oaks Ranch and other water purveyors to escape paying TGRGCD fees as long as Trinity Aquifer water makes up less than 50% of their total water use.
10. Map provided to Calvin Finch in a meeting with TGRGCD General Manager George Wissman at a meeting on 1/7/15.

Regulatory Agencies: Texas Water Development Board (Page 221)

1. Texas Water Development Board website, Mission Statement available at www.twdb.state.tx.us.
2. Ibid.
3. Ibid.
4. House Bill 4, Section 15.474. (a). passed in 2011.
5. Texas Water Code, Title 2, Subtitle C, Chapter 15, Subchapter R, Section 15.992.
6. House Bill 4, Section 15.474(a).
7. Texas Water Code, Title 2, Subtitle C, Chapter 15, Subchapter R, Section 15.992.
8. House Bill 4 Section 15.436a
9. Ibid, Section 15.437 (c).
10. House Bill 4, Section 15. 437 (d).
11. Robert Gulley, "Head Above Water," page 215, Item 37. Published by Texas A&M Press, 2015.

Regulatory Agencies: Texas Commission on Environmental Quality and Environmental Protection Agency (Page 224)

1. Mayor Cheryl Landman in email correspondence to authors in April 2015.
2. Sources below:
    a. U.S. Environmental Protection Agency (EPA). 2013c. "Long Term 2 Enhanced Surface Water Treatment Rule." http://water.epa.gov/lawsregs/rulesregs/sdwa/lt2/basicinformation.cfm (Accessed February 18, 2015).
    b. U.S. Environmental Protection Agency (EPA). 2014a. "Stage 2 Disinfectants and Disinfection Byproduct Rule (Stage 2 DBP rule)." http://water.epa.gov/lawsregs/rulesregs/sdwa/stage2/ (Accessed February 18, 2015).
    c. U.S. Environmental Protection Agency (EPA). 2014b. "Ground Water Rule." http://water.epa.gov/lawsregs/rulesregs/sdwa/gwr/regulation.cfm (Accessed February 18, 2015).
    d. Texas Commission on Environmental Quality (TCEQ). 2014a. Nutrient Criteria Development Plan. https://www.tceq.texas.gov/assets/public/waterquality/standards/ncdawg/NCDP/ncdevplan091014.pdf (Accessed February 18, 2015).
3. Texas Commission on Environmental Quality (TCEQ). 2014b. "History Page: Chapter 290 Public Drinking Water." http://www.tceq.state.tx.us/assets/public/legal/rules/rules/pdflib/290_his.pdf (Accessed February 18, 2015).
4. Texas Commission on Environmental Quality (TCEQ). 2012. "Strategic Plan: Fiscal Years 2013-2017." SFR-035/13.
5. Sources below:
    e. Glassmeyer, S.T. 2007. "The Cycle of Emerging Contaminants." Water Resources Impact 9(3), 5-7.
    f. U.S. Geological Survey (USGS). 2014. "Emerging Contaminants In the Environment." http://toxics.usgs.gov/regional/emc/ (Accessed February 18, 2015).

6. U.S. Environmental Protection Agency (EPA). 2010. "Treating Contaminants of Emerging Concern: A Literature Review Database." EPA-820-R-10-002.
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Residential and Commercial Water Costs and Impact Fees (Page 226)

1. http://www.fairoaksranchtx.org/index.aspx?NID=228 and http://www.fairoaksranchtx.org/DocumentCenter/Home/View/456 and arranged in graph and table by James Mjelde.
2. Ibid.
3. Opinion offered by Calvin Finch.
4. Median home price from the website http://www.city-data.com/city/Fair-Oaks-Ranch-Texas.html.
5. Fair Oaks Ranch Impact Fees from http://www.fairoaksranchtx.org/ArchiveCenter/ViewFile/Item625.
6. Ron Emmons, Fair Oaks Ranch Public Works Director, Discussion with Calvin Finch 12/18/15.
7. Residential and Commercial Volumetric Rates for Fair Oaks Ranch graphed by James Mjelde.
8. http://www.fairoaksranchtx.org
9. http://www.fairoaksranchtx.org/Archive Center/ViewFile/Item/625