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From Policy to Reality: Maximizing Urban Water Conservation in Texas

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ENVIRONMENTAL DEFENSE FUND
finding the ways that work

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Contents

Executive summary

Ensuring that Texas is sustainable in the 21st century depends in large part on smart management of the state's water resources. A central element of that challenge is improving the efficiency of water use in the rapidly growing urban areas of the state. More efficient water use technologies, more sophisticated understanding of water pricing and the ability to more carefully measure water use at both the individual and municipal level provide new opportunities to reach advanced levels of water use efficiency.

Water supply planning is constantly evolving and forces such as population growth and climate change are making it more difficult. Texas leaders have increasingly recognized that municipal water conservation is an important part of planning to meet future needs. In recent years, lawmakers have strengthened municipal water conservation planning requirements. Cities large and small are beginning to implement these requirements, some with more enthusiasm and foresight than others.

This report's evaluation of 18 municipal water conservation plans demonstrates that the quality and scope of these of plans vary significantly. A few of the plans—and their early results—represent some of the most progressive municipal water conservation efforts in the country. Others—in fact, the majority of plans reviewed—lack aggressive conservation targets or fail to incorporate the full range of price and nonprice conservation measures and technologies readily available.

Water supply planning is constantly evolving and forces such as population growth and climate change are making it more difficult.

This report highlights both the good and the "not-so-great" in a broad sampling of current municipal conservation plans. It is our hope that this discussion will foster a more widespread appraisal of how state agencies and cities can improve water conservation planning and achieve the kind of major efficiency gains necessary to meet municipal water needs while still providing healthy rivers and streams for current and future generations.

CHAPTER 1
Introduction

Rapid population growth, coupled with the effects of climate change on precipitation patterns and average temperatures, is placing increased stress on water supplies throughout many parts of the United States and the world. For example, in 2007, Atlanta's water supply dwindled to a 90-day supply. North Carolina, Florida and other southeastern states have recently been implementing mandatory water use restrictions to cope with severe drought. The major reservoirs on the Colorado River, which supply water to more than 30 million people and provide irrigation for four million acres in the United States and Mexico, are less than half full, with no prospect of refilling any time soon. In California, the legislature is gridlocked over how to address the rapidly declining Bay-Delta ecosystem while providing water to the state's booming population. Elephant Butte Reservoir on the Rio Grande in New Mexico, which supplies water for agriculture and the cities of Las Cruces and El Paso, is at less than 10% capacity and has hovered at that level for the last few years. Although 2007 was a wet year in much of Texas, the deep drought that plagued most of the state in 2005 and 2006 is fresh in the memory of water suppliers and state planners.

The 2005–2006 drought is fresh in the memory of Texas water planners.

These constraints, combined with the high costs of developing new reservoirs (and lack of good reservoir sites), have led many municipal water suppliers to recognize the potential of water conservation and efficiency programs to sustain their growing cities while saving ratepayers money.[1] In cities where conservation is taken seriously, impressive results have followed. For example, increased water use efficiency allowed Los Angeles to grow by about one million people over the last 25 years without increasing the amount of water it uses.

Closer to home, in 1993, San Antonio Water Systems (SAWS) adopted an aggressive conservation and reuse plan. At the time, the city's average water use was 160 gallons per capita per day (gpcd).[2] The first goal was to reduce use to 140 gpcd by 2008. This goal was reached in 2001, and in the drought year of 2006, the city averaged only 135 gpcd. This reduction resulted in a decrease of overall usage of 3.3 million gallons between 1993 and 2004, while population in the city's service area increased by almost 230,000 over the same time frame.[3] The city's new goal is to achieve 116 gpcd in an average year and 132 in a dry year by 2016. El Paso has also had great conservation success. Water use in this desert city was reduced from 185 gpcd in 1994 to only 134 gpcd in 2007.

The Texas 2007 State Water Plan predicts total water demand from all sectors will increase 27% by 2060.[4] It projects that by 2060, municipal water use will double from the 2000 usage of 3.77 million acre-feet to almost 8.26 million acre-feet.[5] In large part, this projected increase is tied directly to predicted population growth. The state's population is projected to pass 45 million people by 2060, roughly double the current population.[6] Some of the highest growth rates are predicted in areas of the state that are not considered to be water rich, including the Texas/Mexico border, the Dallas-

Fort Worth metroplex and the Hill Country. The plan posits that a number of areas might face shortages by 2060 during severe drought under this kind of demand scenario, if new supplies are not developed.

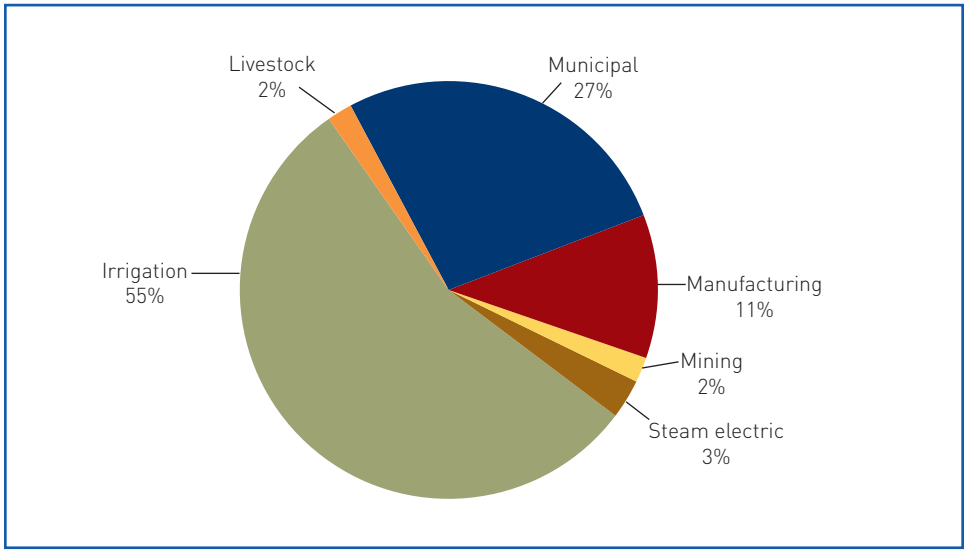
However, these dire predictions are based on a general assumption that current water use patterns will continue well into the future. They do not reflect an effort to fully incorporate the advanced water conservation potential achievable with existing and new technologies, nor do they reflect a full application of tools such as more aggressive conservation pricing.

Although consideration of conservation as a supply strategy in the state water plan has increased since the 2002 state plan, significant conservation potential remains untapped. The 2007 state plan proposes 612,000 acre-feet per year of municipal water conservation by 2060. However, the plan overlooks at least an additional one million acre-feet per year of potential savings—achievable if cities would reduce their per-person water use to 140 gpcd by 2060. Such a goal has already been achieved by several Texas cities, including San Antonio and El Paso.[7]

The relative underestimation of water conservation potential in the municipal water use sector in the 2007 State Water Plan is further demonstrated by the fact that the anticipated 600,000 acre-feet per year of water savings represents only about 7.5% of the total projected eight million acre-feet per year of municipal water demands in 2060.

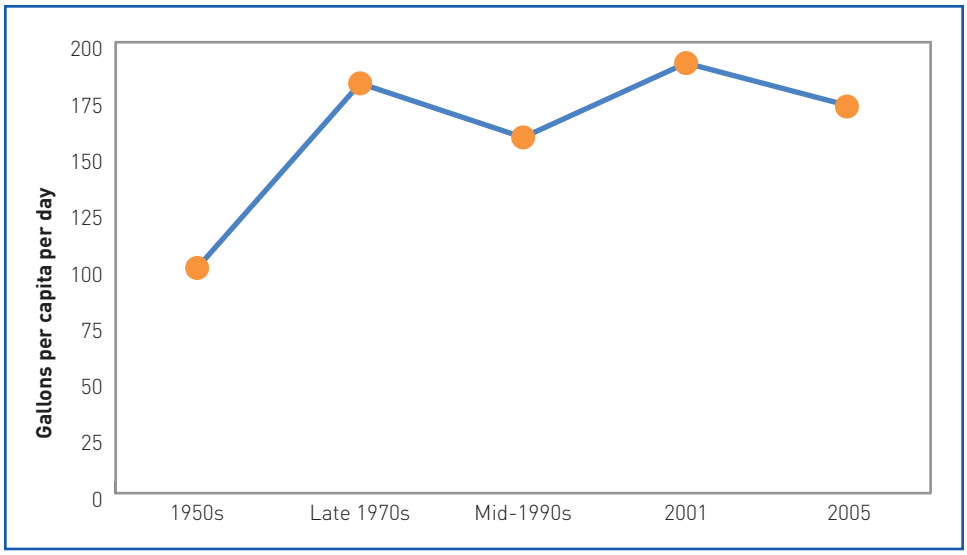
Conservation in the municipal sector is also taking on added importance as population growth increases the share of urban water use in the state. As the state has urbanized, changing demographics have resulted in a shift from agricultural to municipal water use (Figure 1). In 1974, agricultural irrigation accounted for more than 75% of the water used in the state. By 2004, irrigation accounted for less than 60% of total water use, and municipal use had grown from 11% to nearly 25% of the total water used in Texas.[8] Municipal use is predicted to grow to 40% of the total water use by 2060.

FIGURE 1
2005 Texas water use survey summary



Source: TWDB.

FIGURE 2
Historic Texas water use



Source: Texas Environmental Profiles, Water Use by Sector, available at www.texasep.org/html/wqn/wqn_1trn_sctr.html (last visited 4/24/07).

Urban water use accounts for an increasing share of total water use in Texas.

Other noteworthy trends in Texas' water use patterns can be identified (see Figure 2). Between the 1950s and late 1970s, the statewide average per capita municipal use rose from around 100 gallons per day to 182 gallons per day. That rate declined in the 1980s and leveled off at around 158 gallons per capita per day in the mid-1990s. It reached 191 gallons per capita per day in 2001, in part as a result of dry weather patterns.[9] The 2005 average of usage in Texas cities was 172 gpcd.

The remainder of this report examines the broad range of water conservation strategies available to municipalities (Chapter 2); the legal framework in Texas for water conservation (Chapter 3); and how various Texas cities are, or are not, effectively implementing water conservation measures (Chapter 4). Chapter 5 offers recommendations for achieving advanced municipal water conservation and efficiency.

CHAPTER 2

The benefits of and strategies for maximizing water use efficiency

Water supply planners in arid environments are increasingly dependent on conservation as an important component of a diversified water supply. Conservation becomes particularly vital during peak summer months when water consumption can increase by up to 50% because of outdoor watering. Conservation has even become a strategy in water-rich areas because of the high costs of water treatment and supply.[10] Reducing the amount of water that must be pumped and treated reduces both capital construction and operational costs for water suppliers. These "avoided costs" are becoming increasingly more significant as the cost of construction materials and energy increases.[11]

Reducing per capita demand, even during population growth, allows for more equitable allocation of water for other purposes, effectively extending the available supply. Conservation can also have environmental benefits, allowing water to remain instream for fish, wildlife and water quality benefits and avoiding the need for new dams or large-scale groundwater extraction. Using less water saves the consumer money by reducing monthly bills for water, sewer and energy.

Water conservation strategies usually fall into one of two categories: price and nonprice. Pricing programs involve rate structures that provide incentives to reduce use. Pricing programs are cost effective and relatively straightforward for a municipality to implement. This approach also provides consumers the choice of how they are going to use their water, as opposed to setting mandatory water use restrictions. These programs can also stabilize or increase revenues for municipal water systems without increasing water use. Increased revenues can, in turn, be used for various programs, including funding nonprice conservation measures.

Nonprice measures include leak detection programs; plumbing fixture retrofits (toilets, showerheads, faucet aerators); audits of household and industrial water use; landscaping audit and incentive programs; and public education. These approaches can be implemented through an entirely voluntary structure or they can be supported with rebate and incentive programs. Similar measures can also be mandated by the city through municipal ordinances or an alternative enforceable structure. Studies show that in most cases, mandatory restrictions on certain uses, such as outdoor watering, are considerably more effective than voluntary efforts.[12] Similarly, incentive programs greatly increase participation over voluntary programs.

Each efficiency approach or combination of approaches has a different cost-benefit ratio associated with it. San Antonio found that spending an average of $1/person on conservation programs saved $4–7/person.[13] Its $4.4 million in conservation program expenditures in 2006 translated to approximately $308 per acre-foot saved.[14] Comparatively, new water rights from the Edwards Aquifer currently cost about $5,000 per acre-foot. The 2002 State Water Plan estimated that saved water cost between $399–574 per acre-foot. New supply by dam or pipeline projects could cost from $600–1,000 per acre-foot.[15] The price of newly developed supply can increase dramatically with increases in energy and construction prices.

Toilets account for more than 30% of indoor water use.

The Houston Department of Public Works and Engineering, which provides water directly to more than a half-million people and sells wholesale water to an additional 16 communities, has also had conservation success. Houston implemented water conservation measures in response to legal requirements and increasing threats of subsidence and saltwater intrusion because of overpumping of groundwater. As part of the plan, a pilot program to retrofit a 60-unit housing development dropped average monthly water and wastewater bills from $8,644 to $1,810 per month and inspired the city to invest more money to retrofit additional housing units.[16] In addition, conservation kits were distributed to users that resulted in an average water savings of 18% per household. Together, the projects were predicted to produce a total drop in water demand of 17.2% by 2006.

Some programs are more cost effective than others. Outreach and education programs are less effective alone, but appear to be more effective if a "critical mass" of nonprice programs are implemented at the same time. Retrofitting toilets saves water at a cost of about $150–200 per acre-foot. A water-efficient toilet has been

Industrial water use

Water use in the industrial and manufacturing sectors has been relatively consistent over the past 30 years. In 1974, it accounted for just under 1.6 million acre-feet of water. That number has fluctuated downward on occasion (as low as 1.37 million acre-feet in 2000); however, by 2004, it was at 1.53 million acre-feet. Likewise, as a percentage of total water used in the state, industrial and manufacturing sector use has reliably fluctuated between 8.4 and 10.8% during the past 30 years. In 2004 it was 9.9% of the total water used.[19] The 2007 state plan projects that water use in the manufacturing sector will intensify in the next few decades, growing to 2.58 million acre-feet by 2060. It also projects that water use for steam-electric power generation will increase from 561,394 acre-feet/year in 2000 to 1.53 million acre-feet/year over the same time period.

shown to save 12 gpcd. The low cost of replacement, evaluated in conjunction with the fact that toilets account for 32% of residential indoor usage, makes toilet replacement a cost-effective measure.[17] Low-flow showerheads, which cost as little as $15, can save as much as 500 gallons per week per family. Rebates for energy-efficient appliances can also produce cost savings. San Antonio estimated that its initial rebate program for water-efficient washing machines saved 271 acre-feet of water at $600 per acre-foot.

Because a large amount of municipal water is used for lawn watering, particularly in peak summer season, some cities have created incentive programs to replace traditional lawns with more climate-appropriate, drought-resistant plants. San Antonio offered homeowners a rebate of $0.10 per square foot of installed, approved water-wise landscape. In 2001, the program saved an estimated 314 acre-feet at a cost of $235 per acre-foot. Large, landscaped industrial users can also benefit from these types of programs.

In addition to residential programs, there is significant conservation potential in the industrial and commercial sectors. Although often viewed differently by utilities, these sectors sometimes constitute a large percentage of overall city consumption and should not be overlooked in a conservation plan.[18] The biggest opportunities for savings are water efficiency and water reclamation. Technological advancements can save water for on-site reuse in the same process, like cooling towers, or water can be recovered and used in alternative on-site applications, such as irrigation. Houston launched a pilot program to audit cooling towers to save 375 million gallons annually. The city estimated that for every $1 spent on the project, approximately $18.60 would be saved in reduced water and wastewater costs. In addition, point-of-use reductions, such as fixtures retrofits similar to those seen in the residential sector, can be promoted for commercial establishments. By first examining the way water is used in commercial and industrial settings, plans can be made to expand reductions. The more a city reduces water used by existing businesses, the more room there is for growth without the need for new supply.

Re-use v. maximizing efficiency

The Texas Water Code definition of water conservation includes the concept of "reuse." Reuse generally refers to using highly treated wastewater from a municipal or industrial treatment system for another purpose, such as landscape irrigation or in cooling towers, instead of returning it to the stream. The state's Water Conservation Implementation Task Force recommendations also allow giving credit for reuse [to be included] in the calculation of municipal per capita use. That is, treated wastewater used for another purpose does not have to be included as additional water use in the gallons per day per capita calculation. If the amount of water demand supplied via reuse is significant, that can lower reported per capita municipal consumption, but it does not actually mean that less water is being used. Under the right circumstances, reuse is an appropriate water management option, but it does not increase the actual efficiency of water use. It reduces the amount of freshwater withdrawn from a stream or aquifer to meet water demands but also reduces the amount returned to the stream. This report focuses on water efficiency measures other than reuse.

CHAPTER 3

Legal requirements for water planning in Texas

Texas water law has for some time included provisions related to water conservation, especially municipal water use. These statutory requirements have been expanded over the last few years, to cover a broad range of water suppliers and water rights permit applications. In general, however, the provisions focus more on the preparation of "conservation plans" rather than on substantive criteria by which the quality of those plans can be reviewed and improved.

Conservation is broadly defined in Texas law to mean "those practices, techniques and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses."[20] Water conservation plan requirements first appeared in Texas law in the 1985 House Bill 2 (HB 2).[21] In permissive language, the bill stated "[T]he Texas Water Commission[22] could . . . require applicants for water-use permits to submit conservation plans." In order to obtain a permit, an applicant was required to show that waste would be avoided and water would be conserved with "reasonable diligence." Although requiring conservation plans was only suggested by the Legislature, it was an important first step in tying water conservation planning to surface water right permit applications.

The 1985 law also authorized $800 million to the Texas Water Development Board (TWDB) for a "Water Loan Assistance Fund" for various types of enumerated projects, including water conservation. The law defined water conservation as both developing supply and reducing consumption. Recipients of funding are required to "adopt or have already implemented a water-conservation program approved by the TWDB." Several sample conservation measures were listed, including alternate-day lawn watering, education and rate structures.

HB 2 was followed in 1997 by the omnibus Senate Bill 1.[23] This legislation amended Section 11.1271 of the water code and shifted the submission of a water conservation plan from a permissive to a mandatory requirement for any applicant requesting a new or amended surface water right. In addition, all existing surface water permit holders of 1,000 acre-feet or more for municipal, industrial or other uses, and irrigation permits of 10,000 acre-feet a year or more were required to develop, submit, and implement water conservation plans. These plans must be consistent with regional water plans and include "reasonable water conservation measures."[24] A further change in 2003 required the plans to be submitted by May 1, 2005 and to include quantified five-year and 10-year water savings targets.[25] These targets must include goals to reduce water system losses and target municipal per capita use rates. The bill also required the TWDB and the Texas Commission on Environmental Quality (TCEQ) to establish target per capita goals and develop

model water conservation programs to assist water suppliers in achieving the "highest practicable levels of water conservation and efficiency."

Senate Bill 1 also required the preparation of drought contingency plans by wholesale and retail public water suppliers and irrigation districts holding existing water rights. These plans are to be "consistent with the approved regional water plan and designed to reduce water use during times of water shortage and drought."[26]

Before granting an application for a new and amended surface water right, TCEQ is required to ensure that the applicant will use "reasonable diligence" to "avoid waste and achieve water conservation."[27] Like the plans for existing water rights, the water conservation plans to be submitted with permit applications must "include specific, quantified five-year and 10-year targets for water savings . . . Targets must include goals for water loss programs and goals for municipal use in gallons per capita per day."[28]

In rules implementing this section of the law, TCEQ provides that the plan shall be considered in determining "whether any practicable alternative to the requested appropriation exists, whether the requested amount of appropriation . . . is reasonable and necessary for the proposed use, the term and other conditions of the water right, and to ensure that reasonable diligence will be used to avoid waste and achieve water conservation."[29] The conservation plan submitted with a permit application is to include data and information that "supports the applicant's proposed use of water with consideration of the water conservation goals of the water conservation plan; evaluates conservation as an alternative to the proposed appropriation; and evaluates other feasible alternatives to new water development, including but not limited to, waste prevention, recycling and reuse, water transfer and marketing, reservoir system operations, and optimum water management practices and procedures."[30] The regulations specifically place the burden of proof on the applicant to demonstrate that the requested amount of water to be appropriated is "necessary and reasonable" for the proposed use.

Applicants for surface water rights are required to show how they will achieve water conservation.

Applications for surface water permits that include an interbasin transfer are subject to more stringent water conservation requirements. By state law, the entity seeking an interbasin transfer of water must demonstrate that it has implemented "the highest practicable level of water conservation and efficiency achievable."

The precise extent to which these requirements are being fully implemented in the permitting process is beyond the scope of this study. However, there is some evidence to suggest that the review of water conservation plans as part of a permit application is not rigorous, especially if the permit is not subject to a contested hearing process.

Drought contingency measures

This report focuses only on water conservation—increasing water use efficiency—under normal precipitation and water availability conditions. It does not deal with "drought contingency," which is treated separately under Texas law and water planning protocols. Drought contingency planning is required of major surface water users and entails the establishment of more aggressive short-term water-saving measures that would be enacted during times of serious or severe drought. Example drought contingency measures include limitations on filling outdoor water features or restrictions on car washing facilities.

For example, the "boilerplate" permit condition on water conservation included in most new surface water permits reads as follows:

Owner shall implement water conservation plans that provide for the utilization of those practices, techniques, and technologies that reduce or maintain the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water, so that a water supply is made available for future or alternative uses.

The use of "or" versus "and" in the list of measures means that a small action to reduce water pollution could theoretically be adequate to meet conservation obligations. In addition, the use of the word "maintain" detracts from emphasis on increased efficiency. Thus, the standard permit provision fails to impose any enforceable requirement for improved water use efficiency.

Senate Bill 1 also created the Water Conservation Implementation Task Force, which included representatives from a wide variety of stakeholder groups. The group was tasked with developing a guide to best management practices for water conservation. This completed guide includes specific goals for municipal water conservation and water efficiency.[31] The Task Force recommended a statewide average goal of 140 gallons per person per day or less for all municipal water user groups. The Task Force recommended that any entity using above that amount should strive for a minimum of a 1% per year reduction until that goal is obtained.[32]

The Task Force recommended a statewide average goal of 140 gallons per person per day or less for all municipal water user groups.

The most recent amendment to these requirements was Senate Bill 3 (SB 3) in 2007. SB 3 expanded the conservation plan requirements to include all retail public utilities that provide potable water service to 3,300 or more connections. Plans are to include best management practices[33] or other water conservation strategies. The next revision of the municipal conservation plans must be submitted to the TCEQ no later than May 1, 2009, to coincide with the regional water planning process. As discussed below, Water Conservation Implementation Reports must also be submitted by that time. Plans are to be updated every five years thereafter.[34] Senate Bill 3 also required that the water conservation plans be submitted to TWDB for review.[35]

The specific requirements of water conservation plans have been set out in regulations adopted by TCEQ.[36] Among other things, all municipal users must include local information such as number of users and current water use. They must also provide their five- and 10-year per capita goals as well as discuss how those goals will be achieved. Accurate metering devices and line inspections are required to minimize leakage and maximize accountability of water use. Additional content is prescribed for municipalities serving a current or projected population of 5,000 or more users.

The 2009 and subsequent water conservation plan submittals must be accompanied by an implementation report. The purpose of an implementation report is to assess which of the proposed measures from the 2005 conservation plan have been executed. The report must include the date and description of implemented measures, the amount of water saved, whether or not targets were met and an explanation of any unmet targets.

In addition, the municipality is required to demonstrate how its plan will be implemented and enforced.[37] The city may submit a copy of an ordinance, resolution

or tariff that demonstrates adoption of the plan by the water supplier. Cities have complied with this requirement in various ways, ranging from adoption of the full plan within the ordinance to an enumeration of specific projects in a city ordinance or comparable enforceable measure.

Both TCEQ and TWDB have developed guidance for those required to prepare and submit water conservation plans. The TCEQ has a series of forms for municipal, wholesale, industrial and agricultural water users. These forms list the minimum requirements for a conservation plan. Although most submittals made to the TCEQ include information beyond that required by the form, some municipalities have simply submitted the completed form as their conservation plan. TCEQ's guidance does not differentiate plan requirements based on the size of the city. Thus a large municipality, with more resources, is subject to the same requirements as a small city with fewer resources available for conservation plan development and implementation.

TWDB has also developed a plan guidance checklist. Water conservation plans are evaluated by the TWDB as part of a financial assistance program for regional water programs and for water research grants, and also on a routine basis pursuant to Sec. 16.402 of the Water Code.[38] One of the criteria that must be met for grant or loan consideration is the submission of an adequate conservation plan and an evidenced commitment to water conservation.[39] The checklist closely tracks the statutory requirements of a conservation plan. (Appendix A).

CHAPTER 4

Evaluating municipal conservation plans

In light of the municipal water conservation plan requirements added to Texas law in recent years and the increasing emphasis on water conservation to meet growing demand, Environmental Defense Fund set out to evaluate a representative sample of year 2005 plans (the most recent year for which plans are required). We examined the plans of 18 cities, including Texas' 10 largest cities, most of the Dallas-Fort Worth metroplex and a sampling of midsize cities. We developed a matrix for evaluating the plan that included a look at per capita consumption targets and pricing and nonpricing water conservation measures.

The evaluation matrix and full results are presented in Appendices B and C to this report. This section highlights a few of the key findings.

Overall, we found that the plans selected represented a wide range of approaches to conservation. Some of the plans contained a wide variety of price and nonprice measures; others were little more than a repetition of the TCEQ form. Interestingly, the depth of the plans appears to bear little relationship to the size of the city. Some of the smaller cities demonstrated a fairly thorough approach to water conservation, while some of the larger cities submitted relatively bare bones plans. In general, however, we conclude that there is substantial room for improvement in most of the year 2005 plans we reviewed, as explained in more detail below.

Of all the cities reviewed, only three had a goal of 140 gpcd or less.

PER CAPITA TARGET GOALS

As noted previously, Texas law requires that cities include five- and 10-year targets for water use in their conservation plans. As shown in Table 1, the five-year gpcd goals in the surveyed plans ranged from 139 to 301 gpcd and the 10-year goals ranged from 116 to 294 gpcd. The cities with the most aggressive targets include San Antonio, Houston and El Paso, while Plano, Waco and Dallas still project very high use even under their 10-year goals. Of all the cities reviewed, only three had a 10-year goal of 140 gpcd or less.

Many of the plans reflected the TWDB conservation Task Force's recommendation of achieving a minimum 1% reduction per year. However, this recommendation also included a goal of reaching a statewide average of 140 gpcd, which most of the cities surveyed will not have achieved after 10 years.

Some cities did not use the most straightforward approach in calculating conservation goals. Arlington, for example, based its projected five- and 10-year goals on TWDB Regional Water Planning Group projections, which results in a five-year goal that is 30 gpcd higher than the city's current reported per capita use. Several

TABLE 1
Summary of per capita use targets

City	Total per capita use as reported in 2005 plan (unit: gpcd)	2005 per capita use according to TWDB data	Target goals in 2005 plan (gpcd)	
			5-year goal	10-year goal
Arlington	148 (2004)	147	174 or less	171 or less
Austin	148.61 (2005)	172	159.90 mgd (2010)	172.48 mgd (2015)
Beaumont	192 (2004)	194	181 (2009)	180.5 (2014)
Carrollton	202 (2001) 157 (2004)	175	189 (2010 per capita water use)	194 (2015)
Corpus Christi	218 (2004)	180	210 (2009)	200 (2014)
Dallas	244 (2003) 240 (2005)	244	227 (2010)	223 (2015)
Denton	189 (2000)	152	180 (2009) Total per capita saving: 9	171 (2014) Total per capita saving: 18
El Paso	139 (2004)	166		
Fort Worth	210 (2001) 200 (2005)	184	190 (2010)	180 (2015)
Garland	164 (2003)	155	157 (2010)	151 (2015)
Houston	181 (2000), 140 (2004)	166	139 (2010)	137 (2015)
Irving	186	234	Residential average: 116 (2009) Municipal average: 212	Residential average: 112 (2014) Municipal average: 212
Laredo	130	182		110 by 2015
Lubbock	190 (2005)	171	180 (2011)	170 (2016); 160 (2020)
Plano		238	301 (2009)	294 (2014)
San Antonio	130 (2003) 121 (2004)	142	140 (2010)	138 (2015)
Tyler	189.59 (2004)	192	1% reduction annually until they reach 140	
Waco	241 (2004)	184	229 (2009)	218 (2014) 140 (2058)
Tarrant County (Tarrant Regional Water District: TRWD)	186 (2004)		177 (2009)	169 (2014)

Most data found in 2005 water conservation plans as submitted.

Calculating per capita use

Municipal use in gallons per capita per day is defined by TCEQ as " [t]he total average daily amount of water diverted or pumped for treatment for potable use by a public water supply system. The calculation is made by dividing the water diverted or pumped for treatment for potable use by population served. . . ." However, all cities do not calculate daily use the same way. Some cities present a separate figure for residential use, which can underestimate the actual gpcd in comparison to the TCEQ definition used by other cities. Because formulas can vary, conflicts have arisen about comparing gpcd rates among cities. This points to the need for TCEQ to ensure that cities follow the definition laid out in its rules for calculating overall municipal gpcd, even if the plans also include residential-only gpcd. If one city cannot accurately be compared to another, a city can be compared to itself over the years to successfully measure reductions.

cities, including Arlington, Beaumont, Dallas, Garland and Irving project no or only very modest decreases between five-year and 10-year per capita consumption targets, even though their 10-year targets are substantially above 140 gpcd. Carrollton's plan actually projects that per capita consumption rate will increase from 189 gpcd to 194 gpcd over the 10-year target period.

Although regional variations in water use can be expected because of differing climate conditions, as well as a city's industrial and commercial mix, some of the plans have targets that appear inexplicably high. Plano's per capita five-year goal of 301 gpcd is double that of several Texas cities; it is much higher than the 2001 state average of 191 gpcd and higher than the TWDB-reported 2005 use for Plano of 238 gpcd.[40]

Many of the projected five- and 10-year per capita use rates in the cities in the Dallas-Fort Worth (DFW) Metroplex are higher than those of the other cities reviewed here. Concurrently, the 2007 state water plan projects that the DFW Metroplex is one of the areas that is likely to experience "shortages" in 2050 and beyond. This situation highlights the need for continued focus on advanced conservation implementation in the DFW region.

PRICING STRUCTURES

Another required element of a conservation program is to implement a "non-promotional" rate structure. This is described as a "rate structure which is cost-based and which does not encourage the excessive use of water."[41]

All but one of the cities surveyed have implemented a rate structure that adheres to this requirement, but few of these pricing structures appear to be effective in promoting advanced water conservation. As shown in Table 2, most of the cities surveyed have adopted an increasing block structure. Using this rate design, the unit price for water increases as the volume consumed increases. Pricing is set for each "block" of water use. A base price is set for a minimum quantity of water, which is followed by a staircase of block quantities available at increasing prices per unit of water used. Tyler was the only city of those evaluated to still have a promotional rate

structure in which water becomes less expensive per unit as more water is used. Although the 2005 plan indicates that Tyler will consider a conservation rate structure, none appears to have been adopted.

The size of the blocks and other factors in the pricing approaches of the surveyed cities vary considerably, however, as illustrated in Table 3. The first area of difference is the size of the initial block, which ranges from 1,000 to 15,000 gallons per month, with 2,000 to 3,000 gallons per month being the most common base quantity of water.

Prices for the base amount also showed wide variation, ranging from $0.80 to $13.79 for the first 1,000 gallons, although the high-end value includes the cost of the meter rolled into the first water block.

Whereas most of the rate structures are in effect throughout the year, Carrollton and Denton opted to have the increasing block rate apply only during May through October. The other months have a price per 1,000 gallons for any quantity used.

TABLE 2
Water prices in various Texas cities

	2,000 gallons	5,000 gallons	15,000 gallons
Arlington	$3.00	$8.08	$27.98
Austin	$1.60	$7.90	$37.60
Beaumont**	$10.45	$18.37	$44.77
Carrollton**	Summer $10.27 Winter $10.27	Summer $17.98 Winter $17.98	Summer $48.13 Winter $43.68
Corpus Christi**	$7.60	$15.49	$41.79
Dallas*	$6.72	$12.11	$42.71
Denton*	Summer $14.75 Winter $14.75	Summer $22.55 Winter $22.55	Summer $48.55 Winter $48.55
El Paso	Based on winter usage		
Fort Worth*	$10.81	$18.03	approx. $50.52
Garland*	$9.47	$15.95	$39.05
Houston	$7.19	$16.66	$26.99
Irving**	$6.18	$12.46	$43.86
Laredo**	$7.50	$11.46	$25.56
Lubbock	Based on winter usage		
Plano**	$14.11	$15.07	$31.47
San Antonio*	$8.16	$10.56	$23.91
Tyler**	$7.88	$15.14	$39.34
Waco**	$16.00	$23.62	$49.02

* Prices include a meter charge in addition to cost per quantity pricing.
** Prices include a fee for an initial quantity of water followed by per quantity pricing. .

TABLE 3
Water conservation pricing/rate structures (based on 5/8" pipe where applicable)

City	
Arlington	0-2,999 Gallons: $1.50/1,000 gallons; 3,000-10,999 $1.79/1,000 gallons; 11,000-15,999 $2.29/1,000 gallons
Austin	0-2,000 Gallons: $0.80 per 1,000 gallons; 2,000-9,000 $2.10/1,000 gallons; 9,000-15,000 $3.55/1,000 gallons
Beaumont	first 1,000 gallons $7.81; Over 1,000 gallons $2.64/1,000 gal.
Carrollton	May-September 0-2,000 gallons: $10.27; 2,000-10,000 gallons: $2,57 per 1,000 gallons, over 10,000 gallons: $3.46 per 1,000 gallons
Corpus Christi	0-2,000 gallons: $7.60; 2,000-15,000 gallons: $2.63 per 1,000 gallons, next 15,000 gallons: $3.70 per 1,000 gallons
Dallas	$3.90 meter rate. 0-4,000 gallons $1.41/1,000 gallons; 4,001-10,000 gallons $2.57/1,000 gallons; 10,001- 15,000 gallons $3.55/1,000 gallons; over 15,000 gallons $4.52/1,000 gallons.
Denton	0-15,000 gallons: $2.60; 15,001-30,000 gallons: $3.50; Over 30,000 gallons: $4.35
El Paso	$4.48 up to 400 cubic feet. Block 1 $1.22 per CCF Over 400 CCF's to 150% of average winter consumption (AWC); Block 2 $3.40 per CCF Over 150% to 250% of AWC; Block 3 $4.87 per CCF Over 250% of AWC
Fort Worth	residential: first 1,000cf: $1.77/100cf or 748 gallons. Next 2,000cf: $2.21/100 cf. More than 3,000 cf: $2.90/100cf
Garland	$5.75 plus 0 to 3,000 gallons $1.86/1,000 gal.; Next 12,000 gallons $2.31/1,000 gal; over 15,000 gallons $3.48/1,000 gal.
Houston	0-1000 Gallons: $3.05; 2,000-3,000 gallons $7.19; 4,000 gallons $14.07; 5,000 gallons $16.66; 6,000 gallons $19.25; 7,000 -12,000 gallons $19.25 +$2.58 per additional 1,000 gallons over 6,000; Over 12,000 $34.73 +$4.65 per additional 1,000 gallons over 12,000
Irving	0- 3,000 gallons $6.18; Next 17,000 gallons $3.14/1,000 gal; All over 20,000 gallons: October-May $3.14/1,000 gal. June -September $3.29/1,000 gal
Laredo	0-2,000 Gallons: $7.50; 2,000-4,000 additional $1.29/1,000 gallons; 4,000-10,000 $1.38/1,000 gallons; 10,000-20,000 $1.44/1,000 gallons; 20K-30K $1.53/1,000 gallons
Lubbock	$7.66 plus Block 1 is 100% of average winter consumption (AWC) $2.09 /1,000 gal; Block 2 AWC plus 40,000 gal. $2.61/1,000 gal; Block 3 above blocks 1 and 2 $3.61/1,000 gal.
Plano	First 1,000 gallons: $13.79; 1,000-5,000 gallons: $0.32 per 1,000 gallons; over 5,000 gallons: $1.64 per 1,000 gallons; over 20,000 gallons April 1 - Oct. 31: $3.27 per 1,000 gallons
San Antonio	$6.56 meter fee plus 0-7,481 Gallons: $0.08/100 gallons; next 5,236 gallons $0.13/100 gallons; next 4,488 gallons $0.20/100 gallons; beyond 17,205 gallons $.041/100 gallons .Nine cents per 100 gallons of the 4th block water used funds the residential conservation program
Tyler	0-2,000gal $7.88; Next 23K gallons an additional $2.42/1,000 gal; next 975K gallons $1.58/1,000 gal.; next 4 mill. Gal. $1.31/1,000 gal
Waco	0-2000 gallons $16.00; 2,001-15,000 Gallons additional $2.54 per 1,000; 15,001-25,000 Gallons $2.98 per 1,000; Over 25,000 Gallons $3.82 per 1,000

Most municipal price plans reviewed do not appear to offer strong conservation incentives.

Lubbock and El Paso tie the base quantity to some percentage above average winter consumption. This can be an effective measure, assuming residents are not overusing water during the winter months; however, beyond potentially targeting outdoor use, this type of program does not necessarily promote conservation for other household uses of water.

Another area of difference is found in the subsequent blocks and their pricing (Table 3). Some cities chose multiple tiers with significant price increases while others opted for large secondary blocks. Houston increases its price every 1,000 gallons for the first 6,000 gallons. Comparatively, Corpus Christi's second block ranges from 2,000 to 15,000 gallons, charging the same price for every thousand gallons. Denton's second tier ranges from 15,000 to 30,000 gallons without a price change. Although Beaumont technically has an increasing block rate structure, it consists of only two blocks. The first is for 1,000 gallons and the second is anything above 1,000 gallons, at a constant price of $2.64 per 1,000 gallons. Plano, although starting with a high initial charge of $13.79, which includes the first 1,000 gallons and the meter, charges only $0.32 per 1,000 gallons up to 5,000 gallons.

Beyond these differences, some of the municipal conservation pricing structures are not likely to be very effective in promoting reduced water use and increased efficiency because they do not increase the price per unit of water used beyond a use rate of 15,000 or 20,000 gallons per month. Thus, a household using more than 20,000 gallons per month pays the same price per unit of water used, whether their total monthly consumption is 30,000 or 60,000 gallons.

Cities in this category include Arlington, Austin, Beaumont, Carrollton, Dallas, Garland, Irving and Plano. Considering an average 160 gpcd (and many cities are higher) for a family of four, monthly water use would be about 19,200 gallons. Thus, for pricing structures that do not have increasing the per unit prices above an average monthly use quantity of 20,000 gallons, there is no financial incentive to reduce use because the price per unit of water used above 20,000 is the same. A more effective

conservation-pricing ordinance would have steep price increases (and small blocks) on use that exceeded the average of 20,000 gallons per month. Such a structure would provide greatly increased financial incentive for high-use households to conserve.

NONPRICING PROGRAMS

Very few of the cities surveyed have included a full range of nonprice programs to foster conservation. Particularly lacking are incentive and rebate programs for plumbing retrofits, drought-tolerant landscaping or installation of more efficient appliances (Table 3).

San Antonio, Austin and El Paso have washing machine incentive programs offering customers a $100 rebate with their purchase. Low-flow toilet replacement or rebate programs are available in these same cities, as well as in Dallas. El Paso is actually phasing out its rebate program due to its overwhelming success and extensive placement of toilets. San Antonio also provides a rebate for tankless water heaters. Half of the rebate is provided by the water utility and the other half is from the electric utility.

Because lawn watering is one of the primary municipal water uses, particularly in the summer, strong incentive programs for use of native plants could result in significant water savings. Although the majority of the cities surveyed have adopted landscape-watering ordinances, considerably fewer cities offer an incentive program for replacing traditional lawns with drought-resistant plants. Only Austin, El Paso and San Antonio offer rebates for replacement of non-native turf with drought-resistant turf or plants. A couple of other cities, including Dallas, have programs for sprinkler audits and replacements. While this is important, maintaining landscapes with high water requirements does not maximize conservation.

The energy-water nexus

A frequently overlooked conservation opportunity is the link between water and energy. Energy use and water use have many intricate connections. The water supply sector utilizes large amounts of energy to transport, treat and deliver water. Similarly, vast quantities of water are required for resource extraction as well as power generation. As energy and water shortages become growing concerns, the importance of joint planning becomes more apparent, with crosscutting opportunities for energy savings to yield water savings, and water savings to yield energy savings. A recent study in California revealed that water-related energy use for supply and treatment consumes 19% of the state's electricity, 30% of its natural gas and 88 billion gallons of diesel fuel every year. Texas has a similar need to understand more about the nexus of energy and water in order to identify opportunities to save in both sectors.

Many of the cities surveyed provide educational programs on xeriscaping; however, monetary incentives give additional motivation for people to make the necessary landscape changes.

By law, a program of continuing education must be included in a water conservation plan, and all the cities surveyed described some form or another of promoting public awareness. The major variation in this category was between cities that sought to distribute information and those that simply provided access at limited locations. Although active distribution might be slightly more expensive, it is likely to reach a much wider audience. Almost all the cities surveyed include bill inserts as part of their education plan. Some cities provide these monthly, whereas others limit distribution to twice a year. In addition to inserts, San Antonio formats water bills to educate users about trends in their monthly water use and the comparison of their use to the average.

CHAPTER 5

Policy recommendations

Improving municipal water use efficiency is absolutely critical to meeting the needs of an increasingly urbanized and growing Texas. Municipal use will account for an ever-larger share of Texas' overall water use. The increasing costs of infrastructure construction and energy, and the prospect of much less certain precipitation patterns as the result of climate change are additional forces of change that can only be met through advanced municipal water conservation. In order to achieve the level of water use efficiency necessary for a sustainable 21st century, Texas will require action on a variety of fronts: state, community and individual.

Our recommendations for action in each of these areas follows:

STATE

State law now contains strong requirements for existing water right holders and surface water permit applicants, including cities, to prepare conservation plans. The challenge now is to ensure that TCEQ and TWDB aggressively and effectively implement these requirements by conducting a substantive review of plans submitted, including the updated plans due in 2009 and those accompanying major surface water appropriation permit requests.

Improving municipal water use efficiency is critical for Texas.

This review should go beyond a perfunctory "boxes checked" level of scrutiny. Instead, it should include evaluation of whether the cities have included reasonable five- and 10-year gpcd targets and whether those targets were calculated in accordance with TCEQ rules. It should also include a substantive review of the efficacy of the water pricing ordinances contained in the plan, as well as whether the city has included a sufficient range of effective nonprice measures.

Clearly, this will require more staff time from TCEQ and TWDB, but there are few natural resource issues with higher priority for the state. TCEQ should evaluate whether it can focus existing staff in its "compliance assistance" and local government outreach programs on helping cities develop strong water conservation plans. There is substantial information already available on effective water conservation measures, including the "best management practice" recommendations of the state's own Water Conservation Implementation Task Force. It is really a matter of the state agencies making sure that cities have access to and use that information in developing their conservation plans.

In addition, TCEQ needs to ensure that it provides a thorough substantive review of the conservation plans required to be submitted with applications for new and amended surface water rights permits. This should be much more than a *pro forma* review of the plan, and should apply the substantive statutory test of whether existing supplies are being used efficiently and whether there is a need for the requested appro-

priation.[42] It is also vital that TCEQ vigorously apply the "highest practicable level of water conservation and efficiency" test to those applying to transfer water from another basin. TCEQ should also revise the boilerplate surface water rights permit condition on water conservation to make it more accurately reflects statutory requirements.

The agencies should also improve their model conservation plans and checklists and tailor them to different size cities vs. using a one-size-fits-all approach.

MUNICIPALITIES

Our review of the various municipal water conservation plans discussed in this report indicates that although progress is being made, there remain several important areas for improvement.

First, municipal plans should contain ambitious five- and 10-year target gpcd goals. Simply using the minimum recommended reduction of 1% per year is not sufficient, especially if a city's current use is far above the recommended 140 gpcd. The Water Conservation Implementation Task Force explicitly stated that the 1% reduction was a "minimum" and noted that the state's goal is a statewide average of 140 gpcd.

One of the best tools for reaching an aggressive gpcd goal is the use of conservation-based water rate pricing structures. A combination of affordable base pricing for a reasonable minimum quantity of water and several subsequent blocks at rapidly ascending per unit rates will allow a city to protect small and efficient water users while providing obvious financial incentives to large users to improve their efficiency and reduce use. Our review indicates that among the cities reviewed, several should reassess their block structure to ensure they are, in fact, effectively providing use reduction incentives for large users. Water rate structures that fail to

provide for an increasing block rate at levels above average household use will not be fully effective.

Some cities, such as San Antonio, have also shown that proper pricing programs can help pay for implementation of effective nonprice conservation measures. This approach should be more widely adopted.

Our review also indicates that there is much room for cities to expand the use of nonprice incentive programs, particularly those that encourage the replacement of water-intensive lawns with drought-resistant turf or plants. Toilet replacement programs can also have a significant impact in overall use since toilets account for some of the largest indoor water use. Appliance rebate programs, such as those replacing water-intensive washing machines and traditional water heaters with more efficient models, offer the added benefit of saving energy and water. Rebates for appliances with dual benefits can be shared between energy and water utilities to defray costs.

Municipal conservation plans should also have a strong educational component. Informational material needs to be actively distributed, as opposed to simply being made available in limited locations. Bill inserts are an excellent tool for regular educational information about water conservation and available rebate programs. Bill format can also act as an educational tool. For example, SAWS graphically shows monthly usage in comparison to previous months and to the average user, raising awareness of water use on a regular basis.[43]

Another program that has not yet been utilized by Texas cities is the use of household meters that give users a detailed, real-time accounting of water use and associated costs. This could be modeled after similar programs for electric metering.[44] Linked with the Internet, customers could make the decision to conserve and see immediate results.

RESIDENTS AND BUSINESSES

The full participation of Texas residents and businesses will be needed to achieve advanced levels of water conservation. Residents and businesses need to take advantage of municipal rebate programs, as well as monitor their own water use, try to improve efficiency and reduce waste wherever possible. In addition, residents and businesses need to get involved in municipal water conservation planning, working with their city water utility and local elected officials to ensure the city's plan has aggressive targets and incorporates advanced conservation measures.

As a number of Texas cities have shown, reducing municipal water use saves taxpayer money, even as it helps to extend our water supplies for future growth, while protecting the beautiful rivers and streams of this state for fish, wildlife and recreation.

Appendices

APPENDIX A

TWDB water conservation plan guidance checklist

THE WATER CONSERVATION PLAN REQUIREMENTS:

1. An evaluation of the Applicant's water and wastewater system and customer use characteristics to identify water conservation opportunities and potential targets and goals. Completion of the *Water Conservation Utility Profile,* WRD-264, as part of the evaluation is required. Attach it to the Plan.

2. Beginning May 1, 2005, your plan should include 5-year and 10–year targets and goals. Target and goals should be specific and quantified for municipal use expressed in gallons per capita per day (gpcd) as well as goals for water loss programs (unaccounted-for water). Consider state and regional targets and goals, local climate, demographics, and the utility profile. Consider the anticipated savings that can be achieved by utilizing the appropriate Best Management Practices and other conservation techniques.

3. A schedule for implementing the plan to achieve the applicant's targets and goals.

4. A method for tracking the implementation and effectiveness of the plan. The method should track annual water use and provide information sufficient to evaluate the implementation conservation measures. The plan should measure progress annually, and, at a minimum, evaluate the progress towards meeting the targets and goals every five years

5. A master meter to measure and account for the amount of water diverted from the source of supply.

6. A program of universal metering of both customer and public uses of water, for meter testing, repair and for periodic replacement.

7. Measures to determine and control unaccounted-for uses of water. (for example, periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections, abandoned services, etc.)

8. A continuous program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water.

9. A program of continuing education and information regarding water conservation. This should include providing water conservation information directly to each residential, industrial and commercial customer annually, and providing water conservation literature to new customers when they apply for service.

10. A water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water.

11. A means of implementation and enforcement which shall be evidenced by adoption of the plan:

- a copy of the ordinance, resolution, or tariff indicating official adoption of the water conservation plan by the applicant and

- a description of the authority by which the applicant will implement and enforce the conservation plan.

12. If the Applicant will utilize the project financed by the TWDB to furnish water or wastewater services to another supplying entity that in turn will furnish the water or wastewater services to the ultimate consumer, the requirements for the water conservation plan also pertain to these supplier entities. These requirements may be met either through contractual agreements between the parties providing for establishment of a water conservation plan, which shall be included in the contract at the earliest of the original execution, renewal or substantial amendment of that contract, or by other appropriate measures.

13. Documentation that the regional water planning group for the service area of the applicant have been notified of the applicant's water conservation plan. **Note:** The water conservation plan may also include other conservation method or technique that the applicant deems appropriate.

14. Adopt the plan. No plan is complete without formal adoption by the governing body of the entity. For a municipal water system, adoption would be by the city council as an ordinance, or a resolution by an entity's board of directors.

15. Reporting requirement: Identify who will be responsible for preparing the annual report. Loan/Grant Recipients must maintain an approved water conservation program in effect until all financial obligations to the state have been discharged and shall report annually to the executive administrator of the TWDB on the implementation and status of required water conservation programs for at least three years after the date of loan/grant closing. If the executive administrator determines that the water conservation program is not in compliance with the approved water conservation plan, the political subdivisions shall continue to supply annual reports beyond the three years until the executive administrator determines that deficiencies in the plan have been resolved.

Available at: http://www.twdb.state.tx.us/assistance/conservation/Municipal/Plans/WaterConsPlanGuide.pdf.

APPENDIX B

Summary of municipal conservation plan goals

City	Service area (sq. mi)	Population (total)	Connections	Water supply source	Total water demand (1,000 gallons)	Total per capita use (gpcd)	Total per capita use (gpcd)		Per capita reduction (gpcd)	
							5-year goal	10-year goal	5-year goal	10-year goal
Arlington	99	315,294 (2000) 358,074 (2004)	95,847 (2004)	Lake Arlington, Tarrant Regional Water District	23,389,130 (2000) 20,013,170 (2004)	148 (2004)	174 or less	171 or less	8 (2010)	10 (2015)
Austin		803,281 (2005)				148.61 (2005)	159.90 mgd (2010)	172.48 mgd (2015)		
Beaumont	85.74	127,521 (2000) 129,130 (2004)	40,599 (2004)		6,273,221 (2000) 6,206,675 (2004)	192 (2004)	181 (2009)	180.5 (2014)	11 (2009)	11.5 (2014)
Carrollton	35	109,576 (2000) 116,500 (2005)	34,507 (2005)	City of Dallas	8,210,184 (2001) 8,498,286 (2005)	202 (2001) 157 (2004)	189 (2010 per capita water use)	194 (2015)	2 (2010)	2 (2015)
Corpus Christi		500	81,814 (2004)	Lake Corpus Christi, Choke Canyon Reservoir, Atascosa and Nueces River, Lake Texana	36.8 billion gallons (2004)	218 (2004)	210 (2009)	200 (2014)		
Dallas		1,211,000 (2003) 1,250,452 (2005)				244 (2003) 240 (2005)	227 (2010)	223 (2015)	5.1% reduction (2010)	7% reduc-tion (2015)
Denton		80,537 (2000)			5,556 (2000)	189 (2000)	180 (2009) Total per capita saving: 9	171 (2014) Total per capita saving: 18	5% (2009)	10% (2014)
El Paso						139 (2004)	150 (2005)	140 (2010)		
Fort Worth		1,440,342 (2000) 1,538,652 (2003)				210 (2001) 200 (2005)	190 (2010)	180 (2015)		
Garland		220,657 (2004)	65,564 (2004)		13,045,000 (2003)	164 (2003)	157 (2010)	151 (2015)	6	11

City	Service area (sq. mi)	Population (total)	Connections	Water supply source	Total water demand (1,000 gallons)	Total per capita use (gpcd)	Total per capita use (gpcd)		Per capita reduction (gpcd)	
							5-year goal	10-year goal	5-year goal	10-year goal
Houston	636	1,953,631 (2000) 2,055,300 (2004)			246,391,678 (2000) 216,244,442 (2004)	181 (2000) 140 (2004)	139 (2010)	137 (2015)	1% (2010)	2% (2015)
Irving	64.1	191,615 (2000) 196,750 (2004)	44,135 (2004)	Jim Chapman (Cooper) Lake and City of Dallas	16,070,820 (2000) 13,384,568 (2004)	186	Residential average: 116 (2009) Municipal average: 212	Residential average: 112 (2014) Municipal average: 212		
Laredo						130		110 by 2015		10% (2015)
Lubbock		211,187 (2005)				190 (2005)	180 (2011)	170 (2016); 160 (2020)	5% (2011)	10% (2016)
Plano							301 (2009)	294 (2014)		
San Antonio		1,162,676 (2003) 1,196,438 (2004)	300,000 (2004)		55,038.7 million (2003) 53,021.3 million (2004)	130 (2003) 121 (2004)		116 (2016) 132 (2016 dry year)		
Tyler	41	101,106 (2004)	32,348 (2004)			189.59 (2004)	1% reduction annually until they reach 140			
Waco	99.51	115,839 (2000) 119,551 (2004)	36,783 (2004)	Lake Waco, Second Trinity Aquifer, Lake Belton	10,416,435 (2000) 10,409,564 (2004)	241 (2004)	229 (2009)	218 (2014) 140 (2058)		
Tarrant County (Tarrant Regional Water District: TRWD)	5,891	1,440,342 (2000) 1,571,392 (2004)		Lake Bridgeport, Eagle Mountain Lake, Lake Benbrook, Cedar Creek Reservoir, Richard-Chambers Reservoir	275,730 (2000) 285,694 (2003)	186 (2004)	177 (2009)	169 (2014)		

APPENDIX C

Summary of other water conservation plan features

City	Leak detection and elimination	Water conservation pricing/rate structures (based on 5/8-in pipe where applicable)	Plumbing retrofit rebates/ incentives	Appliance retrofit/ Incentives	Education	Landscape irrigation incentives	Waste water reuse and recycling	Water line replacement program	Water meter audit and/or testing	Other conservation ordinances
Arlington	Ongoing	0–2,999 gallons: $1.50/1,000 gallons; 3,000-10,999 $1.79/1,000 gallons; 11,000-15,999 $2.29/1,000 gallons			billing inserts, encourage media, brochures, PSAs, WaterWise program		increased recycling of cooling water at a food processing plant.		ongoing	Prohibition of outdoor watering with sprinklers from 10:00am to 6:00pm from June 1 through September 30. All new irrigation systems must include rain and freeze sensors
Austin	ongoing	0-2,000 Gallons: $0.80 per 1,000 gallons; 2,000-9,000 $2.10/1,000 gallons; 9,000-15,000 $3.55/1,000 gallons	free toilet or a toilet installation rebate	single-family: a rebate: up to $100 (a $50 water rebate, a $50 energy rebate)	children's programming, advertisements, e-newsletter, workshops, professional irrigators training course, xeriscaping home tour, videos and print publications, webpage	free residential irrigation audits and rebates available up to $375	rebate on rainwater harvesting equipment. Reclaimed water used is over one million gallons per day.		ongoing	
Beaumont	ongoing	first 1,000 gallons $7.81; Over 1,000 gallons $2.64/1,000 gal.			ongoing			Replaced approximately 20,000 linear feet of water lines per year	ongoing	

City	Leak detection and elimination	Water conservation pricing/rate structures (based on 5/8-in pipe where applicable)	Plumbing retrofit rebates/ incentives	Appliance retrofit/ Incentives	Education	Landscape irrigation incentives	Waste water reuse and recycling	Water line replacement program	Water meter audit and/or testing	Other conservation ordinances
Carrollton	ongoing	October through April First 2,000 gallons $10.27; over 2,000 gallons: $2.57/1,000 gallons. May-September 0-2,000 gallons: $10.27; 2,000-10,000 gallons: $2.57 per 1,000 gallons, over 10,000 gallons: $3.46 per 1,000 gallons			bill inserts 2x/ year, availability for presentations, brochures, and online information	assistance provided for customers to improved efficiency of exists irrigation system. Goal is 2 GPCD in 1020 and 8 GPCD in 2015			ongoing	Landscape Water Management ordinance
Corpus Christi	ongoing	0-2,000 gallons: $7.60; 2,000-15,000 gallons: $2.63 per 1,000 gallons, next 15,000 gallons: $3.70 per 1,000 gallons			conservation coordinator, print and TV media, website, brochures, school education, water hotline	installation of waterwise landscapes at residential properties	2-3%of treated wastewater is reclaimed to irrigate gold courses and a baseball field		ongoing	landscape ordinance
Dallas	In 2005, annual budget is about $13.6 million for maintenance and upkeep of the distribution. Goal is less than 10% unaccounted water loss. Currently at 8%.	$3.90 meter rate. 0-4,000 gallons $1.41/1,000 gallons; 4,001-10,000 gallons $2.57/1,000 gallons; 10,001-15,000 gallons $3.55/1,000 gallons; over 15,000 gallons $4.52/1,000 gallons.	Toilet voucher program		print and television media including public service announcements in English and Spanish, water bill inserts, brochures, school education, Deinking Water Week, website and Special Events	Conducted a rebate program: helps customers repairs all automatic sprinkler systems as of Jan 1, 2005 (9,734 applications, $450, 344 were expended on rebates (2005)) Past rain and freeze sensor rebate program during which 9,734 application were processed and $450,344 were expended. xeriscape education programs.			ongoing	Violations of lawn ordinance are punishable by $250-2000 fine.

City	Leak detection and elimination	Water conservation pricing/rate structures (based on 5/8-in pipe where applicable)	Plumbing retrofit rebates/ incentives	Appliance retrofit/ Incentives	Education	Landscape irrigation incentives	Waste water reuse and recycling	Water line replacement program	Water meter audit and/or testing	Other conservation ordinances
Denton	Budget: approximately $1.5 million per year	$9.55 meter charge Nov-April $2.60/1,000 gal. May-Oct 0-15,000 gallons: $2.60/1,000 gal.; 15,001-30,000 gallons: $3.60/1,000 gal.; 30,000-50,000 gallons: $4.60/1,000 gal; over 50,000: $5.00/1,000 gal.			bill inserts, media, CD and brochures, xeri-scaping class, online information		reclaimed wastewater effluent: 0.5 MGD (2004) increase to 1.0 MGD by 2009	2,176 meters were replaced (2004)		landscape ordinance planned
El Paso	ongoing	$4.48 up to 400 cubic feet. Block 1 $1.22 per CCF Over 4 CCF's to 150% of average winter consumption (AWC); Block 2 $3.40 per CCF Over 150% to 250% of AWC; Block 3 $4.87 per CCF Over 250% of AWC	phasing out program	Washing Machine incentive program	school programs, brochures, videos, education kits	phasing out program				
Fort Worth	ongoing	meter fee $6.00 residential: first 8 ccf: 1.80/ccf (ccf = 748 gallons). 8-20 ccf: $2.51/per ccf. 20-30 ccf: $3.09/ccf. Above 30 ccf $3.71/per ccf.			bill inserts, educational events, plans to establish Customer Advisory Committee				ongoing	landscape ordinance
Garland	ongoing	$5.75 plus 0 to 3,000 gallons $1.86/1,000 gal.; Next 12,000 gallons $2.31/1,000 gal; over 15,000 gallons $3.48/1,000 gal.								

City	Leak detection and elimination	Water conservation pricing/rate structures (based on 5/8-in pipe where applicable)	Plumbing retrofit rebates/ incentives	Appliance retrofit/ Incentives	Education	Landscape irrigation incentives	Waste water reuse and recycling	Water line replacement program	Water meter audit and/or testing	Other conservation ordinances
Houston	ongoing program to assess unaccounted-for water (UAW). Goal is to reduce UAW by 10% in 10 years.	0-1000 Gallons: $3.05; 2,000-3,000 gallons $7.19; 4,000 gallons $14.07; 5,000 gallons $16.66; 6,000 gallons $19.25; 7,000 -12,000 gallons $19.25 +$2.58 per additional 1,000 gallons over 6,000; Over 12,000 $34.73 +$4.65 per additional 1,000 gallons over 12,000			School programs, ratio and T media, bill inserts, brochures, activity books and annual water festival		one golf course uses recycled water for grounds maintenance		ongoing	landscape ordinance
Irving	ongoing	0- 3,000 gallons $6.18; Next 17,000 gallons $3.14/1,000 gal; All over 20,000 gallons: October-May $3.14/1,000 gal. June -September $3.29/1,000 gal			school education, bill inserts, water week, materials available at city offices		nonpotable water is used for irrigation for 4 gold courses, offices, street medians and open spaces in Las Colinas		2,270 meters were replaced during FY2003-04 (about 5 % of the total number of meters)	required minimum standards for landscaping that apply to all land developed within city limits, which includes xeriscaping
Laredo	ongoing	0-2,000 Gallons: $7.50; 2,000-4,000 additional $1.29/1,000 gallons; 4,000-10,000 $1.38/1,000 gallons; 10,000-20,000 $1.44/1,000 gallons; 20K-30K $1.53/1,000 gallons	voluntary only		youth education program costing $32/student; literature, demonstrations, newsletter available at civic events		use of treated wastewater at the wastewater treatment plant for plant purposes; evaluating additional uses for water reuse.		ongoing	

City	Leak detection and elimination	Water conservation pricing/rate structures (based on 5/8-in pipe where applicable)	Plumbing retrofit rebates/ incentives	Appliance retrofit/ Incentives	Education	Landscape irrigation incentives	Waste water reuse and recycling	Water line replacement program	Water meter audit and/or testing	Other conservation ordinances
Lubbock	ongoing	$7.66 plus Block 1 is 100% of average winter consumption (AWC) $2.09 /1,000 gal; Block 2 AWC plus 40,000 gal. $2.61/1,000 gal; Block 3 above blocks 1 and 2 $3.61/1,000 gal.			ongoing					Landscape irrigation is allowed to occur between the house of 6:00 pm-10:00 am April 1-September 1. Winter irrigation may only occur when temps are above 35 degrees. Irrigation should occur without water runoff
Plano	ongoing	First 1,000 gallons: $13.79; 1,000-5,000 gallons: $0.32 per 1,000 gallons; over 5,000 gallons: $1.64 per 1,000 gallons; over 20,000 gallons April 1 - Oct. 31: $3.27 per 1,000 gallons			water bill inserts, brochures, available speakers				ongoing	
San Antonio	ongoing programs with reduction of real water loss from 10-15% to 7-8%	$6.56 meter fee plus 0-7,481 Gallons: $0.08/100 gallons; next 5,236 gallons $0.13/100 gallons; next 4,488 gallons $0.20/100 gallons; beyond 17,205 gallons $0.41/100 gallons. Nine cents per 100 gallons of the 4th block water used funds the residential conservation program	The free toilets during a distribution event (over 10,000 toilets were distributed) rebate program $75/toilet. Hot water on demand program with $150 rebate. Leak repairs and retrofits to qualified low-income homeowner customers.	$100 rebate for the purchase of an approved high efficiency washing machine	Speakers bureau, Print and TV Media, Community Conservation Committee, Conservation Displays, SAWS bill format and bill insert, Public information Events and Special Events	free analysis of ratepayers in-ground irrigation systems. Free information service to give expert advice on how lawns should be watered. Rebate for planting of drought tolerant landscape. Fifty percent rebate for purchase and installation of a wafer-type rain sensor on an irrigation system.	graywater used to water public golf courses		18,000 meters per year are scheduled to be replaced by 2010	extensive year-round conservation requirements and critical period restrictions triggered by dropping Edwards Aquifer levels.

City	Leak detection and elimination	Water conservation pricing/rate structures (based on 5/8-in pipe where applicable)	Plumbing retrofit rebates/ incentives	Appliance retrofit/ Incentives	Education	Landscape irrigation incentives	Waste water reuse and recycling	Water line replacement program	Water meter audit and/or testing	Other conservation ordinances
Tyler	ongoing	0-2,000gal $7.88; Next 23K gallons an additional $2.42/1,000 gal; next 975K gallons $1.58/1,000 gal.; next 4 mill. Gal. $1.31/1,000 gal			fact sheet, articles in local paper, conservation guide to customers, brochures, and school education					
Waco	ongoing	0-2000 gallons $16.00; 2,001-15,000 Gallons additional $2.54 per 1,000; 15,001-25,000 Gallons $2.98 per 1,000; Over 25,000 Gallons $3.82 per 1,000			public service ads, offing public information, school education				ongoing	landscape ordinance
Tarrant County (TRWD)	ongoing				workshops for customers, partnering with customers for local education campaigns, print advertising, school education		planning to reuse downstream flows from Trinity River		ongoing	

**Most data for this table was gathered from the cities' 2005 water conservation plans. More recent programs may not be included. Water rates were updates as possible from the internet.

Notes

[1] *See* Peter Gleick et al., *Waste Not, Want Not: The Potential for Urban Water Conservation in California* (2003).

[2] Dana Nichols, *A Formula for Success: Direct Incentive Programs, Community Education, Stakeholder Input, Effective Regulations*, 3 Water for People and the Environment Conference (Oct. 20, 2007).

[3] San Antonio Water System, *Conservation Plan 2005 Update* 2 (May 1, 2005).

[4] Texas Water Development Board (TWDB), *Water for Texas 2007*, Volume 1, page 2 (2007).

[5] *See* Historical Water Use; 2 *Water for Texas 2007* at 122.

[6] 2 *Water for Texas 2007*, at 120.

[7] National Wildlife Federation, *Save Water, Save Rivers, Save Money,* available at www.texaswatermatters.org/projects/save/save.pdf . The 2007 plan also underestimates water conservation by failing to analyze several proposed interbasin transfers according to state law provisions that require that applicants for such transfers first demonstrate that they have achieved the "highest practicable level of water conservation and efficiency available." See Section IV for further discussion.

[8] *See* Texas Water Development Board, Historical Water Use Information, available at www.twdb.state.tx.us/wushistorical/ (last visited 4/23/07).

[9] Texas Environmental Profiles, Water Use by Sector, available at www.texasep.org/html/wqn/wqn_1trn_sctr.html (last visited 4/24/07)

[10] Mary Ann Dickinson, Water Conservation in the United States: A Decade of Progress 1

[11] *See* Matthew L. Wald, *Utilities Turn From Coal to Gas, Raising Risk of Price Increase*, New York Times (Feb. 5, 2008).

[12] Bobby Klein et al., Factors Influencing Residential Water Demand: A Review of the Literature 13-16 (January 12, 2007); Douglas S. Kenney, *Use and Effectiveness of Municipal Water Restrictions During Drought in Colorado* J. of Amer. Water Resources Assn. 77, 83-84 (2004).

[13] Dana Nichols, *A Formula for Success: Direct Incentive Programs, Community Education, Stakeholder Input, Effective Regulations*, 13 Water for People and the Environment Conference (Oct. 20, 2007).

[14] Nichols, *A Formula for Success: Direct Incentive Programs, Community Education, Stakeholder Input, Effective Regulations*, 11 Water for People and the Environment Conference (Oct. 20, 2007).

[15] National Wildlife Federation, *Saving Waters, Rivers, and Money*, 12 (Aug. 2002), available at www.texaswatermatters.org/pdfs/conservation_report.pdf.

[16] Environmental Protection Agency, *Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs* 21-23 (July 2002).

[17] Peter Gleick et al., *Waste Not, Want Not: The Potential for Urban Water Conservation in California* 5 (2003).

[18] *See e.g.*, Dana Nichols, *A Formula for Success: Direct Incentive Programs, Community Education, Stakeholder Input, Effective Regulations*, 10 Water for People and the Environment Conference (Oct. 20, 2007) (showing commercial and industrial making up 26% of San Antonio's water usage). In California, commercial, industrial, and institutional users account for one third of urban water use. Peter Gleick et al., *Waste Not, Want Not: The Potential for Urban Water Conservation in California* 77 (2003).

[19] *See* TWDB, Historical Water Use Information, available at http://www.twdb.state.tx.us/wushistorical/ (last visited 4/23/07).

[20] 30 TAC § 288.1(3).

[21] 69th Leg., ch. 133, § 1.08.

[22] The Texas Water Commission was a predecessor agency to the existing Texas Commission on Environmental Quality ("TCEQ").

[23] 75th Leg., ch. 1010, § 1.03 eff. Sept. 1, 1997.

[24] Tex. Water Code § 11.1271(a).

[25] 78th Leg., ch. 688, § 1, eff. June 20, 2003.

[26] Tex. Water Code §. 11.1272.

[27] Tex. Water Code §. 11.134 (b)(4) and 30 TAC § 297.50(a).

[28] Tex. Water Code §. 11.1271(c), as added by 78th Leg., ch. 688, Sec. 1, eff. June 2003.

[29] 30 TAC §. 297.50(a).

[30] 30 TAC §. 297.50 (b).

[31] A full text copy of the report is available at, www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITF_Leg_Report.pdf.

[32] TWDB, 32 *Water Conservation Implementation Task Force Report to the 79th Legislature* (Nov. 2004).

[33] "'Best management practices' means those voluntary efficiency measures developed by the commission and the board that save a quantifiable amount of water, either directly or indirectly, and that can be implemented within a specified time frame." Tex. Water Code § 11.002(15).

[34] 30 TAC § 288.30.

[35] Texas Water Code, Sec. 16.402; TWDB is required to review the plans to ensure consistency with the requirements of Sec. 11.1271 of the Texas Water Code.

[36] 30 TAC §§ 288.2-288.5.

[37] 30 TAC § 288.2(J).

[38] 31 TAC § 355.1.

[39] 31 TAC § 355.5(D); 31 TAC § 363.15.

[40] TWDB, 2005 Water Use Survey Summary Estimates by City, Draft. Available at http://www.twdb.state.tx.us/data/water_use/2005est/2005City.xls.

[41] 30 TAC § 288.2 (a)(1)(H).

[42] Tex. Water Code Sec. 11.134(b)(4) and Texas Admin. Code Sec. 297.50.

[43] A sample SAWS bill is available at, http://www.saws.org/service/billpay/yourbill.shtml.

[44] *See* Steve Lohr, *Digital Tools Help Users Save Energy, Study Finds*, New York Times (Jan. 10, 2008), available at http://www.nytimes.com/2008/01/10/technology/10energy.html?_r=1&th&emc=th&oref=slogin.

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