

6. Water Conservation and Drought Management Recommendations

This chapter consolidates the water conservation and drought management recommendations in the *2011 Region C Water Plan*, presenting an introduction (Section 6.1); a summary of Region C Water Planning Group decisions regarding water conservation, reuse, and drought management (Section 6.2); a discussion of trends in per capita water use in different regions of the state (Section 6.3), a discussion of current water conservation practices, current reuse projects, and recommended water conservation and reuse strategies for Region C (Section 6.4); a review of the projected per capita use in Region C with the recommended strategies (Section 6.5), a discussion of water conservation policy recommendations (Section 6.6); a discussion of model water conservation plans (Section 6.7); and a discussion of drought management planning (Section 6.8). An evaluation of consistency of the *2011 Region C Water Plan* with the water conservation and drought management planning requirements is presented in Section 6.9.

6.1 Introduction

In the *2006 Region C Water Plan* ⁽¹⁾, the projected total water demands for Region C included water conservation savings of 11 percent of total water [supply-demand](#) for the region by 2060. The Region C Water Planning Group adopted the following strategies in the 2006 Plan to pursue water conservation:

- Take active measures to achieve the 11 percent water conservation savings included in the supply projections. Municipal measures were categorized based on potential for water savings, opinions of probable cost, and likelihood of implementation. The basic package, recommended for every water user group (WUG) in Region C, includes the following measures:
 - Low flow plumbing fixtures (included in water demand projections)
 - Public and school education
 - Water use reduction due to increasing water prices
 - Water system audit, leak detection and repair, and pressure control
 - Federal residential clothes washer standards

The expanded package, recommended for 129 of the 271 WUGs in the 2006 Region C Plan, includes the following measures:

- Water conservation pricing structure
- Water waste prohibition
- Coin-operated clothes washer rebate
- Residential water audit
- Industrial, commercial, and institutional (ICI) general rebate
- ICI water audit, water waste reduction, and site-specific conservation program
- Non-municipal measures include estimated conservation savings from efficient new steam electric power plant savings and manufacturing and irrigation rebates.
- Assess the effectiveness and applicability of specific water conservation measures in Region C during the next five years.
- Encourage state funding for research on the effectiveness of water conservation programs and for support of education programs.

Since the Region C Water Planning Group made these recommendations, new water conservation studies have been produced, and the Texas Water Development Board (TWDB) has updated the regional water planning rules. Relevant water conservation legislation passed since 2006 will also have an effect on recommended water conservation strategies. New information is discussed below, following a review of the definitions of conservation and drought management measures.

Definitions

The Texas Water Code §11.002(8) defines *conservation* as “the development of water resources; and those practices, techniques, and technologies that will 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.” By this definition, it is clear that reuse of treated wastewater effluent is a water conservation measure.

Although water conservation measures and drought or emergency water management measures both save water, water conservation measures are fundamentally different from drought or emergency management measures. *Drought/emergency management measures* are temporary measures that are implemented when certain criteria are met and are terminated when these criteria are no longer met, while water conservation measures are designed to provide permanent or long-term water savings.

Information Developed Since 2006 *Region C Water Plan*

The 80th Regular Session of the Texas Legislature (2007), via the passage of Senate Bill 3 and House Bill 4, directed the TWDB to appoint members to the newly created Water Conservation Advisory Council. The Water Conservation Advisory Council replaced the Water Conservation Implementation Task Force, which was created in 2003 and abolished on January 1, 2005. Duties of the Council include: monitoring trends in water conservation implementation and new technologies for possible inclusion as best management practices; monitoring the effectiveness of the statewide water conservation public awareness program; developing and implementing a state water management resource library; developing and implementing a public recognition program for water conservation; monitoring the implementation of water conservation strategies by water users included in regional water plans; monitoring target and goal guidelines for water conservation to be considered by the TWDB and TCEQ; and conducting a study to evaluate the desirability of requiring the TWDB to designate entities and programs that provide assistance to retail public utilities in developing water conservation plans as certified water conservation training facilities and to give preference to certified water conservation training facilities in making loans or grants for water conservation training and education activities.

In December 2008, the Advisory Council published *A Report on Progress of Water Conservation in Texas*⁽²⁾. The report included a number of recommendations regarding water conservation and regional water planning. These recommendations include the following:

- Develop methodology, metrics, and standards for water conservation implementation measurement and reporting.
- Develop specific guidelines for how gallons per capita per day should be determined and how it should be applied to population-dependent water use only.
- Develop reporting guidelines for improved data collection.
- Expand data collection efforts to include all water providers and water use categories.
- Develop a pilot project for water use data reporting.
- Develop a pilot project for determining population figures appropriate for certain water use metrics.

- Provide the Council with the necessary resources to sufficiently develop and implement tools to monitor implementation of water conservation strategies recommended in the regional water plans.
- Expand public awareness of water conservation statewide and coordinate campaigns at the state, regional, and local levels.
- Establish a statewide water conservation recognition program.
- Collaborate with national efforts to develop a clearinghouse of resources, tools, and best management practices.
- Direct the TWDB to develop a certification process for conservation training programs and provide preference for technical and financial assistance to these certified programs.

New Regional Planning Requirements

The TWDB has revised its planning guidelines since the last round of regional water planning. Based on updated legislation, TWDB now requires that:

- Retail public utilities with populations greater than 20,000 implement a landscape irrigation permitting, inspection and enforcement program under HB 1656
- Retail public utilities with more than 3,300 connections submit a water conservation plan under Texas Water Code §13.146
- The TWDB review each water conservation plan and annual report to determine compliance with minimum requirements and submission deadlines under Texas Water Code §16.402.

In addition, new legislation (House Bill 2667) enacted in 2009 will require toilets purchased after January 1, 2014 to have a maximum flush volume of 1.28 gallons per flush. This will supplant the existing 1.6 gallons per flush maximum rate defined in the Water Saving Performance Standards for Plumbing Act (Chapter 372 of Texas Health and Safety Code, effective January 1992) and should be used as appropriate to estimate water savings. Further discussion of this Bill and estimated savings are included in Section 6.4.

6.2 Summary of Region C Water Planning Group Decisions

TWDB planning rules call for “evaluation of all water management strategies that the regional water planning group determines to be potentially feasible,” including water conservation practices, reuse of treated wastewater effluent, and drought management

measures. This section summarizes the decision of the Region C Water Planning Group for each of these water management strategies.

Water Conservation

As discussed above, the legislature, the Water Conservation Advisory Council, and the TWDB have been active in the area of water conservation since the development of the 2006 *Region C Water Plan* ⁽¹⁾. New information about the potential for water conservation in Region C has been developed in the interim period, and the revised planning rules require incorporation of water conservation strategies for certain water user groups.

Summary of Decision: Incorporate water management strategies involving water conservation as a major component of the long-term water supply for Region C. Encourage planning and implementation of water conservation projects. Monitor legislation and regulatory actions related to water conservation.

Reuse of Treated Wastewater Effluent

Reuse of treated wastewater effluent is becoming an increasingly important source of water in Region C and across the state of Texas. The 2006 *Region C Water Plan* ⁽¹⁾ projected that the reuse of reclaimed water would provide supply equal to approximately 16 percent of the 2060 Region C water supply. There are a number of water reuse projects in operation in Region C, and many others are currently in the planning and permitting process. Reuse will serve a major role in meeting future water supply requirements for the region.

Direct reuse and indirect reuse have significantly different permitting requirements and potential applications. Direct reuse occurs when treated wastewater is delivered from a wastewater treatment plant to a water user, with no intervening discharge to waters of the state. Direct reuse requires a notification to the Texas Commission on Environmental Quality (TCEQ), which is routinely accepted so long as requirements of the agency's regulations regarding direct reuse, designed to protect public health, are met. Direct reuse is most commonly used to supply water for landscape irrigation (especially golf courses) and industrial uses (especially cooling for steam electric power plants).

In 2008, the TCEQ adopted rule language (§30 TAC Chapter 321) that applies specifically to permitted wastewater treatment facility owners who plan to produce reclaimed water at a site other than an existing permitted domestic wastewater treatment facility. The new rule, which streamlines the permitting of offsite or remote reclaimed water production facilities that do not discharge to waters of the state, could potentially reduce costs associated with the transportation of raw wastewater to an existing facility and from the existing facility to reclaimed water users.

Indirect reuse occurs when treated wastewater is discharged to a stream or reservoir and is diverted downstream or out of a reservoir for reuse. The discharged water mixes with ambient water in the stream or reservoir as it travels to the point of diversion. Many of the water supplies within Region C have historically included return flows from treated wastewater as well as natural runoff. New indirect reuse projects may require a water right permit from the TCEQ and may also require a wastewater discharge permit from the TCEQ if the discharge location is changed as part of the reuse project. Many Region C reservoirs have water right permits in excess of firm yield, and are currently using return flows in their watersheds to provide a supplement to supply. These return flows may not be a long-term reliable supply if they are diverted for future direct reuse projects or redirected to other water bodies for future indirect reuse projects.

Potential applications for water reuse in Region C include:

- Landscape irrigation (parks, school grounds, freeway medians, golf courses, cemeteries, residential)
- Agricultural irrigation (crops, commercial nurseries)
- Industrial and power generation reuse (cooling, boiler feed, process water, heavy construction, mining)
- Recreational/environmental uses (lakes and ponds, wetlands, stream flow augmentation)
- Supplementing potable water supplies (surface and groundwater supplies).

There are a number of benefits associated with water reuse as a water management strategy, including:

- Water reuse represents an effective water conservation measure.

- Water reuse provides a reliable source that remains available in a drought.
- Water reuse quantities typically increase as population increases.
- Water demands that can be met by reuse are often near reuse sources.
- Water reuse is a viable way to defer and avoid construction of new surface water impoundments.

Available reuse quantities are dependent on water use, and as such are subject to reduced supplies from ongoing conservation strategies. It should also be noted that reliable reuse quantities should be based on dry-weather flows, which are likely to occur during periods of drought.

Summary of Decision: Incorporate water management strategies involving reuse as a major component of the long-term water supply for Region C. Encourage planning and implementation of additional reuse projects. Monitor legislation and regulatory actions related to reuse.

Drought Management

Drought management and emergency response planning are intended to preserve water resources for the most essential uses when water supplies are threatened by an extraordinary condition such as a multi-year drought, an unexpected increase in demand, or a water supply system component failure.

Regional water supply plans are required to include potential trigger conditions for drought and emergency response measures and potential measures to be taken for each water source in the region. Appendix L includes a summary of current drought contingency and emergency management plans in Region C and potential triggers and response measures. Drought management measures are also discussed in Section 6.8.

Drought management and emergency response measures are important planning tools for all water suppliers. They provide protection in the event of water supply shortages, but they are not a reliable source of additional supplies to meet growing demands. They provide a backup plan in case a supplier experiences a drought worse than the drought of record or if a water management strategy is not fully implemented when it is needed.

Therefore, drought management measures are not recommended as a water management strategy to provide additional supplies for Region C.

Summary of Decision: Continue efforts to implement drought management and emergency response planning, but do not treat these as water management strategies to provide additional long-term supplies.

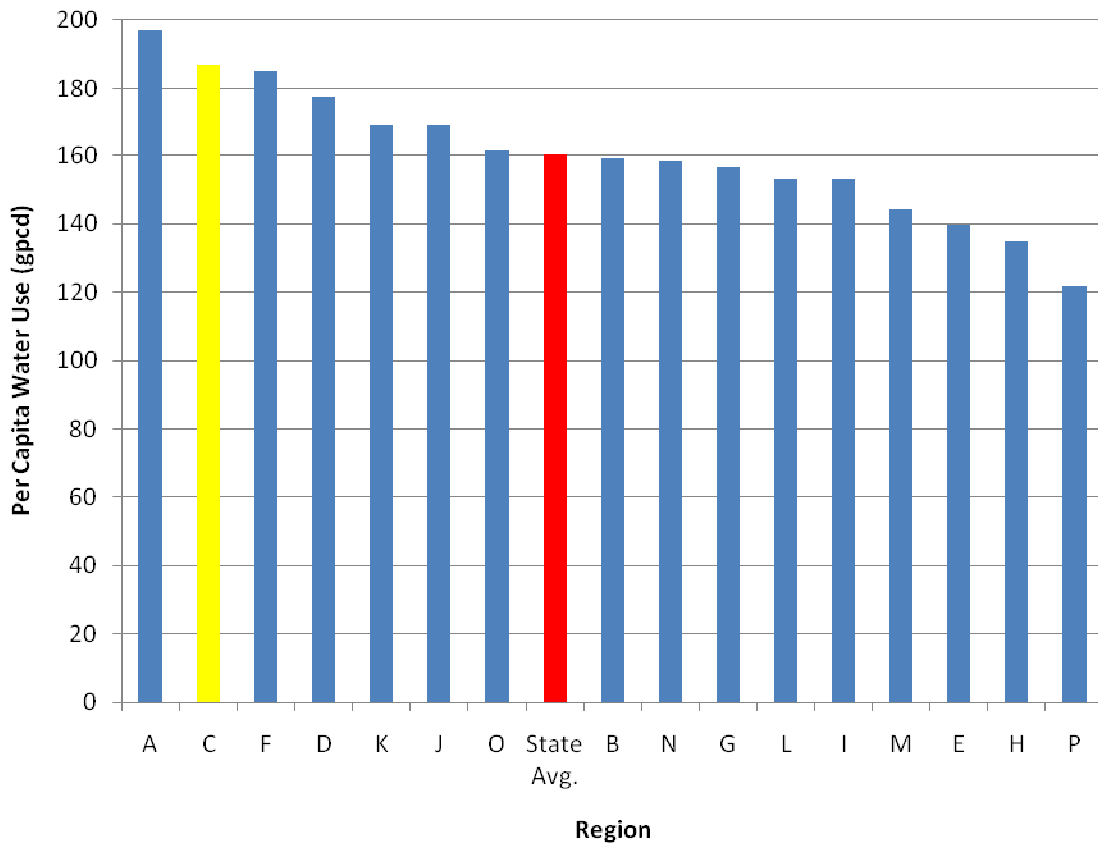
6.3 Trends in Per Capita Water Use in Various Regions

Due to the many variables involved in determining the total volume of water used in municipal water systems, total gallons per capita per day values are not ideally suited for comparisons between different utilities. Many categories of water use (such as agriculture and industry) are not directly related to population data and would benefit from specific water use and conservation metrics that are appropriate for their specific uses. The Water Conservation Advisory Council⁽²⁾ has recommended that a clearly-defined population-specific metric be developed to better allow for comparisons between utilities. The following discussion on trends throughout planning regions is based on TWDB per capita calculations, as defined later in this section, and does not currently define per capita demands based solely on population-specific metrics. The value of the current comparisons is found more appropriate for making individual regional comparisons over time. The usefulness of the planning region comparisons will be increased when a uniform metric is developed.

Figures 6.1 and 6.2 show the 2006 per capita water use, determined using data from TWDB⁽⁴⁾, for Region C in a statewide context. All referenced TWDB data from water use surveys from water users and as such the accuracy is limited to the response rate to each survey. 2006 was selected for comparison because it was a relatively dry year for the region, and more comparable to year 2000 data used in the previous plan⁽¹⁾. As shown in Figure 6.1, the year 2006 municipal per capita water use varies among the planning regions from 197 gallons per person per day (gpcd) to 122 gpcd. As shown in Figure 6.2, the year 2006 total per capita water use in Region C is by far the lowest of any region in the state at 206 gpcd, and was much lower than the statewide average of 549 gpcd.

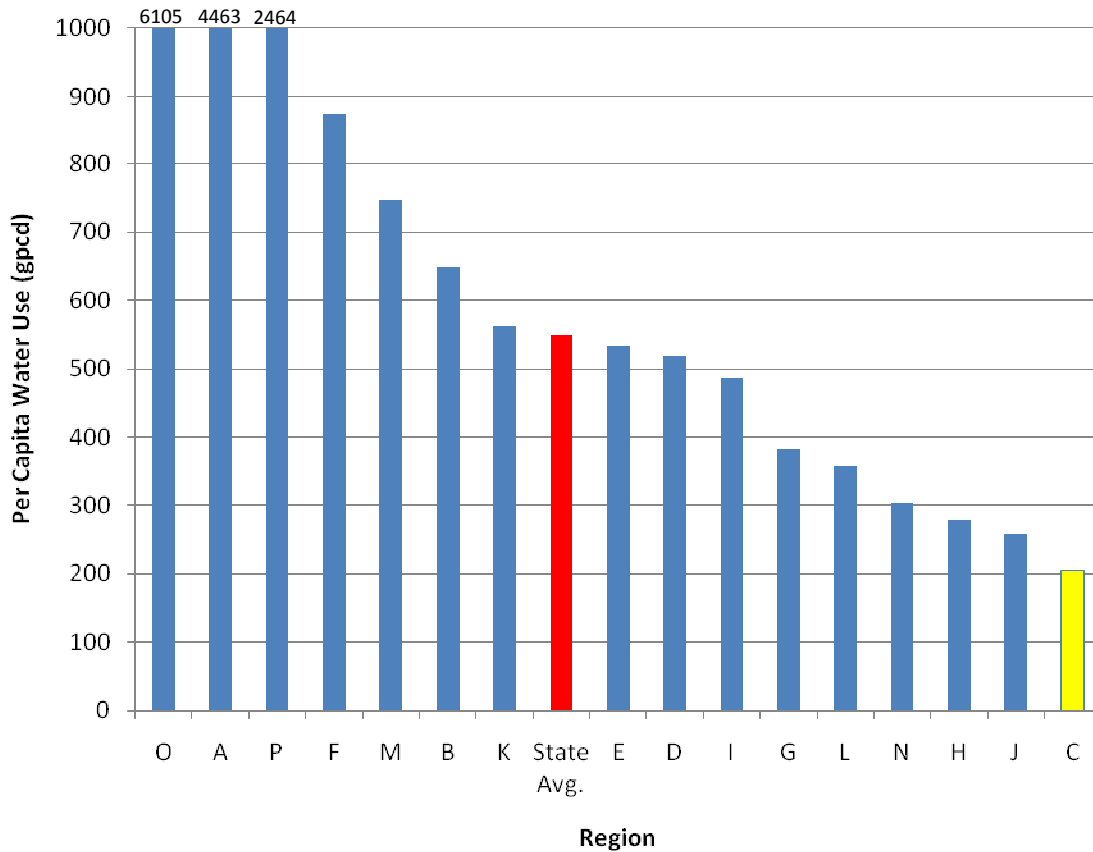
There are several reasons for differences in per capita water use across the state. Some of the differences lie in the accounting of water use and the ability of some municipalities to accurately separate municipal water use from other uses that are supplied through the municipal retail provider. In some regions, most of the major users receive water from municipal providers. In other regions, there are significant self-supplied users. (Large users tend to develop their own supplies in areas where major groundwater wells can easily be developed and in areas where substantial surface water supplies are available.) Significantly, some regions have a much greater commercial and industrial base, and thereby experience greater commercial and institutional water usage than others. Other factors that may impact water use include climate, local economy, water prices, availability of water supplies, and active conservation programs.

Figure 6.1
2006 Municipal Per Capita Water Use by Region



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Figure 6.2
2006 Total Per Capita Water Use by Region



Comparison of Historical Per Capita Municipal Water Use in Various Parts of the State

Municipal Per Capita Water Use. Gallons per capita per day (gpcd) is a measurement of water use, and it is often used as a tool to assess changes in water use. However, as discussed above, depending on how gpcd is defined, its usefulness as a measuring tool can be limited. There are several different approaches proposed to define municipal gpcd. The TWDB has historically calculated a municipal gpcd indicator by this formula:

$$\text{GPCD} = \frac{\text{(water diverted and/or purchased)} - \text{(wholesale sales + industrial sales + power sales)}}{\text{Population of service area}}$$

This formula provides an estimate of municipal per capita water use that includes commercial, residential, some light industrial, and institutional water users and in some cases, municipal golf course irrigation. This definition provides a historical context for water use by a single water provider and may be a reasonable tool to assess water conservation trends over time for that provider. However, it is not a good tool for comparing water usage between regions of the state or between different providers because of different concentrations and types of non-residential water users (commercial and industrial water users, for example) in different areas. Even for a single provider, if there are significant shifts in development patterns or in the percentages of commercial/institutional water use to residential use, this measurement may not accurately reflect changes in water use due to conservation practices.

In 2004, the Water Conservation Implementation Task Force defined gpcd as:

$$\text{GPCD} = \frac{(\text{total water diverted and/or purchased}) - (\text{wholesale sales} + \text{indirect reuse})}{\text{Population of service area}}$$

This definition takes into account reuse as a conservation strategy; however there are still potential inaccuracies in the formula. In particular, this approach includes industrial use in per capita figures, which shifts the formula towards total per capita, since industrial use is not necessarily related to population. The Task Force further stated that the purpose of gpcd data was not for comparison between entities, but for use by each entity to track its progress towards meeting its water conservation goals. Simple comparison of per-capita water use among Texas municipal water-supply providers that may have significant differences in climate and geography, as well as in their service and population profiles may, without additional data and analysis, lead to inaccurate conclusions about comparative water use efficiencies among those providers.

The Water Conservation Advisory Council has undertaken the challenge of identifying a measurement that can be used to accurately normalize water use by an entity. In its draft report to the Texas Legislature, the Council recommends defining per capita usage by use type, such as residential, industrial, etc. This methodology would provide additional detail from which comparisons could be made. However, very clear, consistent definitions of each use type are required to ensure that data are comparable between each reporting entity. In

addition, usage categories that are not dependent on population may still not normalize consistently on a per capita basis and there are still potential inconsistencies with this method. For example, different utilities report multi-family usage as either residential or commercial usage, making even residential comparisons difficult. Furthermore, there is little historical data to date at this level of detail.

Municipal and Residential Per Capita Water Use by Category. Water usage data from TWDB ⁽⁴⁾ were used to compare per capita usage for several cities in Texas. For 2007, TWDB included estimates of residential per capita use in addition to municipal per capita use. Twelve major cities in Texas were selected for a comparison of historical per capita municipal water use in various parts of the state: Amarillo, Austin, Beaumont, Brownsville, Corpus Christi, Dallas (DWU), El Paso, Fort Worth, Houston, Laredo, Lubbock, and San Antonio (SAWS). In general, cities do not report water volumes for other categories (such as unbilled authorized consumption or water losses) to the TWDB, so to some extent, other categories are included in the estimates for most of the cities in Table 6.1. The five-year trailing average was selected to dampen annual changes in water use that occur due to external factors, such as variations in weather. Some utilities are currently performing special water conservation studies that will, once completed, provide more extensive water accounting estimates. In the absence of these studies TWDB data was used for comparison purposes.

Several cities have 2007 total per capita water use greater than 200 gpcd: Amarillo, Dallas, and Beaumont: each of these cities showed a decrease in per capita water usage from 2004 to 2007. San Antonio currently has the lowest municipal per capita water use (146 gpcd) based on 2007 five year trailing averages. All data presented in Table 6.1 originated from TWDB data sources ⁽⁴⁾.

Although the data presented in Table 6.1 is based on 5 year trailing averages, it should be reiterated that gpcd comparisons can be misleading when comparing between cities. With this consideration a general trend of reduced per capita demand can still be seen in cities throughout different regions in Texas. Potential variations due to temperature and precipitation are discussed in more detail for the North Texas area specifically in the section below. In 2007, residential per capita estimates were added to TWDB data. These

estimates attempt to remove industrial, commercial, institutional and other uses from population-dependent demands. The cities in this data set range from a low of 38% of municipal demand as residential demand (Dallas) to a high of 67% (Beaumont), with an average of 54%.

Table 6.1
Per Capita Water Use in Selected Cities ⁽⁴⁾
 - Values in Gallons per Capita per Day (gpcd) –

City	Municipal 5yr Trailing Averages			Residential Single Year
	1999	2004	2007	2007 ^b
Amarillo	226	225	223	92
Austin	163	164	171	87
Beaumont	190	217	207	133
Brownsville	179	222	183	65
Corpus Christi	166	162	153 ^a	68
DWU (Dallas)	222	247	237	92
El Paso	163	169	157	^c
Fort Worth	199	186	180	^c
Houston	150	162	155	67
Laredo	181	181	172 ^a	79
Lubbock	188	184	170	81
San Antonio (SAWS)	148	143	146	86

(a) Data not available in 2006

(b) Residential gpcd is the estimated water use for single family and multi-family residences, expressed on a per capita (population) basis. These estimates, based on responses to the TWDB annual water use survey, are being published for the first time. Different systems may categorize and report residential water use differently.

(c) Residential gpcd data not available.

Seasonal Assessment

Seasonal analyses of water use were conducted, as part of the *Region C Water Conservation and Reuse Study* ⁽⁵⁾, in an effort to determine the impacts of water conservation measures implemented in Region C. In order to conduct these analyses, a study group of five WWPs and five WUGs was selected. The entities in the study group consisted of nine municipalities in or near the Dallas-Fort Worth Metroplex and one regional water district. In order to differentiate water saved through conservation rather than drought restrictions, none of these entities were under drought restrictions for the period of time covered by this analysis.

The total monthly water use data for the entities included in the study group were obtained for the years 2000 and 2006. These years were selected because both years were

dry and had similar weather patterns. Winter water use, defined as the period January through March, was compared with summer water use, defined as the period May through September, to estimate the indoor water use and outdoor water use for each year.

For the entities in the study group, total water usage increased by 19.7% between 2000 and 2006. Water usage in the winter months increased by 25.6% between 2000 and 2006, and water usage in the summer months increased by 16.0% between 2000 and 2006. The population during this seven-year period increased 26% for the study group. For the entities in the study group, the total populations for 2000, the estimated total populations for 2006, and the relative population changes for each entity from 2000 to 2006 are listed in Table 6.2. The population estimates are from the Texas State Data Center ⁽⁶⁾. Based on reported water demands and populations, the municipal gallons per capita usage for almost every entity decreased over the study period. The decrease may be attributable to changes in usage patterns, conservation, water rationing by some entities in 2006, weather patterns or other causes.

To assess the portion of water usage attributable to outdoor irrigation and cooling water demands, the winter months of January through March were used as a baseline, and an assumption was made that the increase in the summer period of May through September over the baseline was attributable to outdoor irrigation. Therefore, it was assumed that there was no outdoor water use in the winter months, although there is some irrigation and cooling water use in the winter. Using these assumptions, the portion of water usage attributable to outdoor irrigation has declined from 39.2% in 2000 to 36.6% in 2006 for the entities in the study group.

To assess the impact of climate on the decline in outdoor water usage from year 2000 to 2006, the historical average temperatures and rainfall data from 1971 to 2000 were compared with actual monthly temperatures and rainfall data for 2006. As obtained from the Dallas-Fort Worth International Airport climate station, the average daily temperatures from May through September of 2006 were only slightly lower than the average temperatures in 2000 ⁽⁷⁾. Thus, it does not appear that the decline in outdoor water usage can be attributed to cooler temperatures in 2006. The total precipitation from May through September of 2006 was 7.1 inches, versus 9.3 inches in 2000 ⁽⁷⁾. Thus, it does not

appear that the decline in outdoor water usage can be attributed to higher precipitation in 2006. More detailed climatology information can be found in the 2009 *Region C Water Conservation and Reuse Study* ⁽⁵⁾.

**Table 6.2
Population Growth for Entities in Seasonal Analysis**

Study Group Entity	Total Population 2000	Estimated Total Population 2006	Net Change Over Period
City of Fort Worth	534,694	650,344	22%
City of Mansfield	28,031	40,819	46%
City of North Richland Hills	55,635	61,784	11%
City of Weatherford	19,000	23,118	22%
City of Allen ^(a)	43,554	68,001	56%
City of Azle	9,600	10,606	11%
City of Frisco ^(a)	33,714	76,168	126%
City of Lewisville	77,737	97,771	26%
City of Plano ^(a)	222,030	262,722	18%

(a) Water rationing initiated during 2006: once per week watering.

The Water Conservation and Reuse Study concluded that the decrease in outdoor water usage in 2006 likely relates to the implementation of water conservation best management practices (BMPs) by the entities in the study group⁽⁵⁾. Other factors may also drive water use such as economic conditions and adding large customers.

6.4 Water Conservation and Reuse in Region C

This section discusses historical water use, current water conservation, current reuse projects, conservation assumptions in the water demand projections, and recommended water conservation and reuse strategies.

Historical Water Use in Region C

Water use data obtained from the TWDB⁽⁴⁾ were used to analyze historical water use in Region C. Table 6.3 shows the summary of water use in Region C for year 2006. According to these data, 90.7 percent of the water use in Region C in the year 2006 was for municipal purposes.

**Table 6.3
TWDB Region C Summary of Water Use for Year 2006**

Category	Reported Water Use (acre-feet)	Percentage of Regional Water Use
Irrigation	31,067	2.2%
Livestock	20,063	1.4%
Manufacturing	53,027	3.8%
Mining	10,367	0.7%
Municipal	1,274,014	90.7%
Steam Electric Power	15,997	1.1%
TOTAL	1,404,535	100.0%

Recommended Conservation Strategies for Region C

Water conservation has been a major component of the Region C Water Plans, including the first plan published in 2001 and the 2006 plan. The Region C Water Planning Group continues to place strong emphasis on water conservation and reuse as a means of meeting projected water needs in the region. Region C is projected to have 29% of the state population in 2060 and 47% of the municipal water conservation based on the *2007 State Water Plan* ⁽⁸⁾.

As part of the development of the recommended water conservation strategies for the *2011 Region C Water Plan*, the region conducted a survey of conservation practices ⁽⁵⁾. That survey identified numerous strategies that were currently being used, with the most widely implemented strategies being water system audits, leak detection and repair, education programs and water conservation pricing. Specifics of that survey are described in the next section of this report.

In addition to the survey, Region C conducted an analysis of each of the Best Management Practices (BMPs) identified by the *2006 Region C Water Plan* ⁽¹⁾, considering cost, potential water savings and opportunities for implementation. Based on the findings from the conservation survey and the analysis of the conservation practices, the region updated the two previously created water conservation packages: Basic Water Conservation Package and Expanded Water Conservation Package.

The Basic Package reflects practices that are most likely to be implemented in the region and were cost effective for small and large water user groups. This package (in

whole or in part) was recommended to be implemented by each municipal water user group in the region that demonstrated:

- A projected demand greater than existing supply
- A projected total gallons per capita per day greater than 140 gpcd. The 140 gpcd goal was introduced as a recommended total gpcd utility goal by the WCTF⁽⁹⁾ and utilized in the *2006 Region C Water Plan*⁽¹⁾ as a threshold to determine selected conservation strategies. This threshold was utilized as a starting point for recommendation of conservation strategies in the 2011 Region C Plan: it is a suggested goal and not a planning or regulatory requirement.
- The strategy is not already implemented (if fully implemented savings should be inherent in demand projections) and if the strategy is applicable to the WUG.

The Basic Water Conservation Package includes:

- Low flow plumbing fixture rules (required by state and federal law)
- Public and school education
- Water use reduction due to increasing water prices
- Water system audit, leak detection and repair, and pressure control
- New efficient residential clothes washer standards
- Water conservation pricing structure (in Expanded Package in 2006 Water Plan)
- Water waste prohibition (in Expanded Package in 2006 Water Plan).

Two of the water conservation practices included in the Basic Package are federally-mandated initiatives that will reduce water use over time simply through the natural replacement of high water use fixtures. These initiatives are discussed below.

The Water Saving Performance Standards for Plumbing Act, implemented by Texas in 1992, prohibits the sale, distribution, or importation of plumbing fixtures that do not meet certain low flow performance standards. The “low flow plumbing fixture rule” strategy assumes that all new construction will be built with water saving plumbing fixtures, and existing plumbing fixtures will be replaced over time with low flow fixtures. Estimates of

the water savings from this strategy were provided by the TWDB for Region C. The total projected 2060 regional water demand is about 5 percent less than it would be without the Water Saving Performance Standards for Plumbing Act. House Bill 2667, implemented September 1, 2009, further reduces the maximum volume per flush of toilets available for sale after January 1, 2014 from 1.6 gallons per flush (high efficiency toilets, or HETs) to 1.28 gallons per flush (ultralow flow toilets, or ULFTs). The further reduction in water demands from this legislation is not included in the water demand estimates. The Region C Water Planning Group has estimated the additional savings from ULFTs and accounted for it where appropriate. The total projected 2060 regional water demand is reduced an additional 1% (6% total) from what it would be without low flow fixtures. It is assumed that the TWDB will include this new plumbing fixture requirement in subsequent demand projections.

The second federal initiative requires residential clothes washers manufactured on or after January 1, 2004, to be 22 percent more energy-efficient than pre-2004 models and clothes washers manufactured on or after January 1, 2007, to be 35 percent more energy-efficient than pre-2004 models. The new energy standards are also projected to produce significant water conservation savings. The water savings associated with the replacement of clothes washers were assumed to occur over time with little to no action by the water user group. More detailed descriptions of the other Basic Package strategies are included in Chapter 4 of the *2011 Region C Water Plan*.

The Expanded Water Conservation Package includes strategies that are slightly more costly to implement and demonstrate greater applicability to larger water user groups. The Expanded Package includes strategies for industrial, commercial, and institutional facilities as well as wastewater reuse. All or part of the expanded conservation package is recommended in the *2011 Region C Water Plan* for 145 out of 277 municipal water user groups.

The Expanded Water Conservation Package includes the Basic Water Conservation package, plus:

- Coin-operated clothes washer rebate
- Residential customer water audit

- Landscape irrigation restrictions (new in 2011 Water Plan)
- Industrial, commercial, and institutional (ICI) water audit, water waste reduction, and site-specific conservation program
- Reuse of treated wastewater effluent (if applicable).

One strategy, the ICI general rebate, was removed from the 2006 Water Plan expanded package due to low levels of implementation across the region. All of the recommended water conservation strategies were evaluated (water savings and costs) at the individual water user group (WUG) level. Water savings for wholesale water providers were estimated from the associated savings calculated for their customers. All costs for water conservation in the *2011 Region C Water Plan* were applied at the WUG level. In reality, some of the water conservation strategies, such as public and school education programs, are being implemented and financed on a regional basis by WUGs and by wholesale water providers. More detailed descriptions of the Expanded Package strategies are included in Chapter 4 of the *2011 Region C Water Plan*.

The development of the 2011 Region C recommended water conservation strategies also included several assumptions related to adoption rates and realization of full benefits over time. These assumptions varied by WUG, depending on current per capita water use (some BMPs were not recommended for entities with per capita water use at or below 140 gpcd), whether the strategy has already been implemented, and the applicability of the recommended strategy to the WUG. Generally, the strategies in the basic package were recommended for all WUGs with water use above 140 gpcd with full benefits being realized by 2020. The strategies in the expanded package were applied individually at the WUG level and were assumed to be implemented by 2020. Costs and estimated savings for each recommended strategy for each WUG are located in Appendix K.

Current Water Conservation in Region C

Data presented in this section comes primarily from surveys of water suppliers, telephone interviews with selected water suppliers, and other sources including Water Conservation and Drought Contingency Plans from water suppliers, TWDB historical water

use records, the TCEQ water right database, and historical wastewater return flow records. Detailed data results and analysis can be found in the 2009 *Region C Water Conservation and Reuse Report* ⁽⁵⁾.

Survey. The first task of this study was to determine what water conservation and reuse strategies are currently being practiced in Region C. This was accomplished through a survey that asked for information regarding recent history of population and water use, current and future water conservation and reuse strategies, the effectiveness of the strategies (water savings realized, public perception, etc), what customer class was targeted with each strategy (residential, industrial, or commercial), and the cost of the strategies. Additional questions were asked regarding public outreach programs, water loss, updates to water conservation and drought contingency plans, and recent water right permits. On August 31, 2007, this survey was sent to the 35 wholesale water providers (WWPs) and the 235 water user groups (WUGs) in Region C. To help participants complete the survey, a list of the water conservation strategies (BMPs) from the 2006 *Region C Water Plan*, with detailed descriptions of each BMP, were provided with the survey. The detailed descriptions of the BMPs are included in Appendix K. Table 6.4 summarizes the data collected from the surveys.

Survey responses were received from 25 WWPs and 96 WUGs. An additional 17 WUGs returned the survey, but indicated that they were not involved in water supply activities and could not provide any data. Overall, the survey had a 51 percent response rate, with 71 percent of the WWPs and 48 percent of the WUGs (including the 17 WUGs who are not involved with water supply) responding. To encourage the water providers to respond to this survey, entities who had not responded by the requested due date were contacted up to two times by phone and offered assistance.

Other Data Collection. Along with the returned surveys, many WWPs and WUGs included their current Water Conservation and Drought Contingency Plans. Information in these plans was used to supplement the survey responses. Historical water use data was also collected from the TWDB for some entities. Water rights information and wastewater return flow information was obtained from the TCEQ.

Telephone Interviews. From among the 121 entities that returned completed surveys, 24 were selected to further query for more comprehensive cost and public education information related to the implementation of the water conservation BMPs. This query was accomplished through telephone interviews. In addition to the cost and public education questions, the respondents were also asked open-ended questions to identify which BMPs required the least amount of implementation effort or cost but proved the most effective. Lessons learned from the implementation of these water conservation measures were also requested. A matrix summarizing the water providers contacted for this study, the number of customers they serve, and the BMPs they have implemented is included in Appendix K.

It should be noted that even though the BMPs for “low flow plumbing fixture rules” and for “new efficient residential clothes washer standards” were included in the survey, these BMPs are in effect already implemented for all entities because they are mandated by law. Therefore, these BMPs have not been included in portions of the analyses in this report. Only data collected on the perceived effectiveness of these strategies and public reaction was included in the survey results.

Survey responses also identified nine additional BMP strategies beyond the basic and expanded packages suggested for consideration. Six of these additional BMPs were implemented by at least one entity and three were listed as under consideration.

Case Studies

Case studies were performed for three cities to analyze the procedures and processes a city undertakes to implement a BMP or a set of BMPs. These case studies were performed to determine the ease or difficulty certain sizes of cities face when implementing various BMPs. This information is intended to inform other cities that desire to implement BMPs in the future. These studies were performed for three categories: small town, mid-sized city, and large city. The criteria for selecting the cities were as follows:

**Table 6.4
Water Conservation Response Data from Water Retailers**

	Basic Package							Expanded Package			
	Low flow plumbing fixture rules	Public and school education	Water use reduction due to increasing water prices	Water system audit, leak detection and repair, and pressure control	New efficient residential clothes washer standards	Water conservation pricing structure	Water waste prohibition	Coin-operated clothes washer rebate	Residential customer water audit	ICI water audit, water waste reduction, and site-specific conservation program	Reuse of treated wastewater effluent
BMP Implementation											
Implemented		49%	62%	58%		46%	29%	0%	13%	4%	10%
Target Res. ^(a)		78%	84%	68%		71%	73%	0%	47%	0%	18%
Target Ind. ^(b)		13%	43%	34%		37%	52%	0%	0%	40%	27%
Target Comm. ^(c)		29%	61%	48%		49%	64%	0%	0%	40%	45%
Target Inst. ^(d)		31%	48%	38%		43%	61%	0%	0%	60%	27%
Level of BMP Effectiveness											
Very Effective	20%	9%	25%	31%	10%	33%	27%	0%	20%	0%	45%
Somewhat Effective	61%	64%	45%	46%	60%	25%	45%	0%	60%	20%	36%
Not Effective	2%	9%	13%	3%	20%	10%	9%	0%	7%	0%	0%
No Response	16%	18%	16%	20%	10%	31%	18%	0%	13%	80%	18%
Plans to Maintain BMP											
Yes		87%	86%	80%		71%	94%	0%	67%	80%	73%
No		2%	0%	0%		0%	0%	0%	0%	0%	0%
No Response		11%	14%	20%		29%	6%	0%	33%	20%	27%
Would Consider Implementing BMP											
Yes		28%	30%	30%		33%	18%	17%	23%	25%	20%
No		11%	9%	9%		7%	15%	23%	15%	14%	20%
No Response		61%	60%	62%		61%	67%	60%	62%	61%	60%
Public Reaction											
Favorable	7%	53%	7%	28%	0%	14%	33%	0%	47%	20%	55%
Unfavorable	2%	0%	28%	0%	0%	18%	15%	0%	0%	0%	0%
No Reaction	36%	13%	19%	23%	50%	16%	6%	0%	0%	0%	0%
No Response	52%	33%	43%	48%	50%	49%	39%	0%	53%	80%	45%

- (a) Respondents indicated that BMP was targeted to residential customers
- (b) Respondents indicated that BMP was targeted to industrial customers
- (c) Respondents indicated that BMP was targeted to commercial customers
- (d) Respondents indicated that BMP was targeted to institutional customers

Case Studies

~~Case studies were performed for three cities to analyze the procedures and processes a city undertakes to implement a BMP or a set of BMPs. These case studies were performed to determine the ease or difficulty certain sizes of cities face when implementing various BMPs. This information is intended to inform other cities that desire to implement BMPs in the future. These studies were performed for three categories: small town, mid-sized city, and large city. The criteria for selecting the cities were as follows.~~

Small Town:

- Does not get water from a Wholesale Water Provider (WWP) and therefore is not subject to the conservation plans of that WWP.
- Located well away from Dallas/Fort Worth Metroplex area.
- Population less than 5,000.
- Is representative of other towns in the category.
- Implementing some, but not all BMPs that are typical of small towns.

Mid-sized City:

- Does not get water from a Wholesale Water Provider (WWP) and therefore is not subject to the conservation plans of that WWP.
- Not bordering Dallas or Fort Worth, but possibly within the surrounding counties.
- Population between 20,000 and 70,000.

Large City:

- City within Dallas/Fort Worth Metroplex area.
- Population greater than 100,000.

Based on these criteria, the cities of Muenster, Corsicana, and Arlington were selected for the case studies.

Small Town – Muenster. Based on the returned water conservation survey, Muenster’s current BMPs include:

- Increasing water prices
- Water system audit, leak detection and repair, and pressure control

- Water conservation pricing structure

The year 2008 population for Muenster was 1,701⁽⁶⁾. As with most small towns, there is no dedicated budget for water conservation. Muenster's current Water Conservation and Drought Contingency Plan was developed by city staff in November 1999 using the template and guidelines provided by the state.

The BMPs employed by Muenster are fairly typical for small towns. The Increasing Water Prices BMP is really a function of collecting adequate funds for maintaining and operating the water system with a side benefit of conservation. The Water Conservation Pricing Structure BMP is a response to the TCEQ's requirement to eliminate decreasing block water pricing. Both of the BMPs associated with water pricing are effective in bringing about conservation results and are fairly inexpensive to implement. For a small town, the steps involved in implementing these BMPs are: city staff calculation of needed rates, presenting the new rates to the City Council at regularly scheduled meetings, notifying customers of proposed change via inserts in water bills and public notices in the newspaper, adopting the new rate structure ordinance, and adjusting the billing calculations to include the new rate structure. Much of this can be done as part of normal city staff operations and may not require additional funds to accomplish.

As with most small towns, the BMP related to water system audit and leak detection and repair in Muenster is covered by the city's water maintenance staff and is not considered explicitly for water conservation purposes. It is intended more for system maintenance purposes, was implemented when the system was created, and is conducted on a continuous basis. Currently the city replaces 10 percent of its water meters per year.

Mid-Sized City – Corsicana. Based on the returned water conservation survey, Corsicana's current BMPs include:

- Low flow plumbing fixture rules
- Public and school education
- Water system audit, leak detection and repair, and pressure control
- New efficient residential clothes washer standards
- Water conservation pricing structure
- Water waste prohibition

- Residential customer water audit
- Industrial, commercial, and institutional (ICI) water audit, water waste reduction, and site-specific conservation program

The year 2008 population for Corsicana was 26,602. Corsicana’s annual budget for water conservation is approximately \$10,000. Corsicana’s original Water Conservation and Drought Contingency Plan was prepared by a consulting engineering firm in 1997 and was adopted by the city on March 18, 1997. The Plan has been updated numerous times since 1997. When the Plan was originally adopted, a number of BMPs were implemented including:

- Public and school education,
- Water system audit, leak detection and repair, and pressure control,
- Residential customer water audit, and
- Industrial, commercial, and institutional (ICI) water audit, water waste reduction, and site-specific conservation program.

The Water Conservation Plan and these BMPs were written into the city’s Code of Ordinances under the Utilities and Solid Waste Planning Chapter. All elements of the conservation plan are maintained on file in the City Secretary’s office and are available to the public. The Water Conservation and Drought Contingency Plan was updated and amended again in October 2008 to include specific conservation goals (per capita use) and associated timeframes. Corsicana currently sells water to 21 wholesale water customers. Any contracts with these wholesale customers include the requirement that the customers develop and implement a water conservation plan.

The basis of the city’s public and school education program is pre-printed brochures from TWDB, available on the TWDB website. Cities may receive up to 500 pieces of literature per year at no charge from TWDB, and additional pieces may be purchased. During the first year of the program, brochures were distributed semi-annually via water bills in conjunction with newspaper articles. In following years, various brochures have been distributed annually in May or June (corresponding to peak summer periods) along with news releases to the local newspaper. The news releases are used to provide

information on water-conserving practices, encourage water conservation and report progress on achieving the city's water conservation goal. New customers are given information on the city's conservation program at the time that they apply for service. The school education program involves presentations at schools as well as tours of the water plant at the request of the school. These requests are made to the City's Environmental Services Department, and tours are conducted by the plant superintendent. Water conservation is emphasized as part of these presentations and tours.

The city's water system audit and leak detection and repair program also began in 1997. An annual water audit is performed to identify unaccounted-for water. The city's goal is to meter all water used, including water used for city services. All customer meters were replaced in 2002 and 2003. The current average meter replacement is 8 to 10% per year. The city has a goal that meters will be maintained within 1 percent accuracy. The city staff manually audits monthly meter readings of large water customers (2-inch meters and larger) against the previous two or three months to determine if there is a significant change in water use or if there is an indication of an improperly operating meter. The city has a schedule of meter testing where larger meters are tested annually and smaller (residential) meters are tested every 7 years. Meter age is recorded for each billing account. In addition to the audits and meter replacement, city employees conduct daily leak inspections as they travel within the city. Citizens are also asked to report leaks when observed. When leaks are found or reported, a work order is issued for repair as soon as possible. Residential customers may request individual audits if leaks are suspected.

In August 2006, the city eliminated its decreasing block rate structure. With the new structure, no discounted rate is given for higher volumes of use. In addition, the new rates represent a 20 percent increase over the previous rates, which will encourage water conservation. Steps involved in this process were having a consultant perform a water rate study, proposing the new rate structure to the City Council, notifying customers of proposed change in rates and rate structure via inserts in water bills and public notices in the newspaper, holding public meetings to discuss the new rate structure, adopting the new rate structure ordinance, incorporating this change into the City ordinances, and adjusting the billing software to include the new rate structure. The city has a rate study

performed about every three years and intends to move toward an increasing block rate structure.

The City also lists “low flow plumbing fixture rules” and “new efficient residential clothes washer standards” as part of their BMPs. Customers and/or owners of buildings that do not have water conserving plumbing devices are encouraged by the City to retrofit their old fixtures. The City’s educational and advertising program helps inform customers of the advantages of installing water-saving devices as well as the availability of these items.

Large City – Arlington. Based on the returned water conservation survey, Arlington’s current BMPs include:

- Public and school education
- Increasing water prices
- Water system audit, leak detection and repair, and pressure control
- Water conservation pricing structure
- 10am-6pm water restrictions; rain-freeze sensors required

Other BMPs planned or proposed for 2008 are:

- Low flow plumbing fixture rebate program
- Water waste prohibition
- Residential customer water audit
- Industrial, commercial, and institutional (ICI) water audit, water waste reduction, and site-specific conservation program
- Low-water landscape code and conversion incentives
- Irrigation ET controllers required
- High efficiency irrigation required and conversion incentives

Arlington’s fiscal year 2007 budget for conservation was approximately \$44,000. The budget increased to \$184,000 for fiscal year 2008. The year 2008 population of Arlington was 374,943.

As with most cities, water rates for the City of Arlington have been steadily increasing through the years to maintain adequate revenue for their water system as well as to

promote conservation. In 2003, the city introduced a water conservation pricing structure. The city now has an increasing block rate structure, in which the cost of water increases as water use increases. There are two tiers each for commercial and irrigation accounts and five tiers for residential accounts. Steps involved in increasing rates and implementing the new rate structure are similar to those performed for the small and medium sized cities.

In 2005, Arlington's Water Utilities prepared a Water Conservation Plan in accordance with TCEQ regulations. This plan was updated in 2008. The plan identified conservation goals and explained conservation practices that the city would implement.

Arlington's public and school education program includes regularly utilizing public service announcements on Arlington's public cable television channel, using bill inserts (at least twice per year), maintaining a conservation website, placing conservation advertising in local newspapers, and making presentations to school and community groups. Another part of Arlington's public education is its partnership with a number of agencies to promote a regional water conservation message to the public. The city's partnership with Tarrant Regional Water District involves the WaterWise Program for 5th graders, the Major Rivers Program (produced by TWDB) for 4th graders, and the Star-Telegram Newspapers in Education (NIE) program. Arlington advertises the Texas Smartscape CD and Website developed by the North Central Texas Council of Governments. Arlington also partners with the Arlington Conservation Council and the Lone Star Irrigation Association to disseminate conservation information. The city distributes and makes available materials developed by city staff as well as material obtained from the TWDB, TCEQ, and other sources.

As part of its conservation efforts, the city's goal for unaccounted water is less than 8 percent. This is well below the typical goal for a city, which is around 10 to 12 percent. The city maintains efforts to manage non-revenue water uses. These efforts include metering of all customers as well as all public and government users, following AWWA standards for meter testing and repair/replacement, and maintaining accurate metering of raw water supplies from Lake Arlington. In addition, leak detection and repair are part of the routine operations of the city staff including meter readers, field operations and meter

services personnel. The city does not have an aggressive pipe replacement system because of the relatively young age of the distribution system.

A primary water conservation goal of Arlington is to decrease waste in landscape irrigation through implementation and enforcement of a landscape water management ordinance. In December of 2006, this ordinance was strengthened by making the 10 a.m. to 6 p.m. water restrictions year-round. In addition, beginning in January 2007, all new irrigation systems (commercial and residential) must be equipped with rain and freeze sensors. The city has provided customers with a list of approved rain and freeze sensor equipment. The city is imposing a \$500 fine on violators of this ordinance.

Arlington currently sells water directly to some customers within the City of Grand Prairie and is considering wholesale water sales to Grand Prairie. Any future wholesale water contract would include the requirement that the customers develop and implement a water conservation plan.

Summary of Existing Conservation Efforts in Region C

Significant efforts have been made by water providers and water users to conserve water in Region C. Regional coordination is one tool that has been utilized by wholesale water providers in the region. The North Texas Municipal Water District, Dallas Water Utilities and Tarrant Regional Water District jointly sponsor the North Texas Regional Water Conservation Symposium, now in its third year. Outdoor water conservation practices, such as time of day watering restrictions, have become part of local ordinances in Fort Worth, Dallas, and most of the larger cities in the area. Cities and water utilities have begun allocating conservation staff and budgeting dollars as part of their full time water management strategies. These individual conservation efforts are part of the ongoing Region C effort to promote conservation as a permanent, valuable water management strategy.

Existing Reuse Projects

Water reuse has been a source of water supply in Region C for a number of years. Table 6.5 lists currently operating reuse projects in Region C and the amount that can be used with existing infrastructure and current users (for direct reuse). There are several reuse projects that are permitted, but that do not have infrastructure to utilize this water. Others are not fully utilized due to infrastructure limitations. Development of the infrastructure for these projects is considered a water management strategy. Further discussion of current reuse projects is included in Appendix I.

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Recommended Reuse Projects

Table 6.6 lists recommended reuse strategies for Region C. A total of 24 reuse projects are recommended with a cumulative 2060 supply amount of ~~292,032~~300,574 acre-feet per year. More detailed discussions of the recommended reuse projects are included in Chapters 4B and 4E.

Table 6.7 shows a regional summary of estimated water savings from recommended water conservation and reuse strategies. It also shows the amount of conservation that is included in the approved water demands for the region. Non-municipal conservation associated with efficient new steam electric power is included in the new steam electric power demand projections. General rebates are the recommended non-municipal conservation strategies associated with irrigation and manufacturing demands. The projected 2060 Region C water demand with no conservation is 3,200,977 acre-feet per year (this amount includes the TWDB-approved 2060 demand value plus 211,201 acre-feet per year of conservation from low flow plumbing fixtures and 65,619 acre-feet per year of conservation from increases in steam electric power efficiency that is included in the TWDB demands). The existing and recommended 2060 water conservation and reuse strategies, including those that are assumed in the demands, will meet 1,204,128 ~~1,195,586~~ acre-feet per year (or 37-38 percent) of the pre-conservation demand.

6.5 Per Capita Water Use in Region C with the Implementation of the Recommended Plan

The Report to the 81st Legislature (2) from the Water Conservation Advisory Committee recommends refining water conservation data collection, formatting and processing procedures. The report does not quantify specific water conservation targets or goal gpcd values. It recommends avoidance of a total municipal gpcd. The Report to the 79th Legislature (9) from the Water Conservation Implementation Task Force suggested that when establishing conservation targets and goals, a water supplier should consider “a minimum annual reduction of one percent in total gpcd, based upon a five-year rolling average, until such time as the entity achieves a total gpcd of 140 or less.” The gpcd values used for Region C projections are dry year estimates, whereas the 140 gpcd

recommendation is based on a five-year rolling average. The five-year average gpcd is typically 10-15% less than a dry year gpcd. As discussed earlier in this chapter, comparison between entities on a per capita basis can lead to erroneous conclusions regarding water use and water conservation effectiveness.

Table 6.5
Existing Reuse Projects in Region C
 - Values in Acre-Feet per Year -

Provider	Project Name	Type	County ^(a)	2010	2020	2030	2040	2050	2060
Alcatel Network Systems	Alcatel Network Systems Reuse	direct	Dallas	20	20	20	20	20	20
Athens	Athens Fish Hatchery Reuse	direct	Henderson	2,872	0	0	0	0	0
Azle	Azle Reuse	direct	Tarrant	300	300	300	300	300	300
Bryson	Jack County Reuse	direct	Jack	27	27	26	26	25	25
Country Club WSC	Country Club WSC Reuse	direct	Kaufman	92	92	92	92	92	92
Crandall	Crandall Reuse	direct	Kaufman	484	666	666	666	666	666
Dallas	Cedar Crest Golf Course Reuse	direct	Dallas	561	561	561	561	561	561
Dallas	Indirect Reuse	indirect	Denton	29,961	42,046	53,147	60,646	69,861	85,000
DCPCMUD	Sale to Grapevine	indirect	Tarrant	3,317	3,696	3,964	4,142	4,276	4,386
Deer Creek Waterworks/ Willow Park	Willow Park Reuse	direct	Parker	11	11	11	11	11	11
Denton	Denton Direct Reuse	direct	Denton	1,233	2,242	2,690	3,251	3,924	4,708
Denton	Denton Indirect Reuse	indirect	Denton	1,682	8,861	11,557	12,927	12,726	12,545
Denton County FWSD#1/ UTRWD/Lewisville	UTRWD Reuse	direct	Denton	897	897	897	897	897	897
Ennis	Ennis Reuse	direct	Ellis	800	800	800	800	800	800
Fort Worth	Village Creek Reuse	direct	Tarrant	897	897	897	897	897	897
Gainesville	Kenetso Park Reuse	direct	Cooke	9	9	9	9	9	9
Garland/Forney	Garland/Forney Reuse	direct	Kaufman	8,979	8,979	8,979	8,979	8,979	8,979
Jacksboro	Jacksboro Reuse	indirect	Jack	385	385	385	385	385	385

(a) - County reflect location of reuse project.

(b)(a)

(c)

Table 6.5 (continued)

Provider	Project Name	Type	County ^(a)	2010	2020	2030	2040	2050	2060
Millsap WWTP	Millsap ISD Reuse	direct	Parker	2	2	2	2	2	2
NTMWD	Rowlett Creek Reuse	direct	Collin	1,540	1,540	1,540	1,540	1,540	1,540
NTMWD	Buffalo Creek Reuse	direct	Rockwall	672	672	672	672	672	672
NTMWD/Royse City	Royse City Reuse	direct	Rockwall	112	112	112	112	112	112
NTMWD	Wilson Creek Reuse	indirect	Collin	50,000	60,941	71,882	71,882	71,882	71,882
NTMWD	East Fork Reuse	indirect	Kaufman	51,790	67,148	87,102	102,000	102,000	102,000
NTMWD/Frisco	Stewart Creek West Reuse	direct	Collin	307	307	307	307	307	307
Pinnacle Club	Pinnacle Club Reuse	direct	Henderson	32	32	32	32	32	32
TRWD	Richland Chambers Reservoir Reuse Project	indirect	Navarro	10,000	10,000	10,000	10,000	10,000	10,000
The Colony	Collin County Reuse	direct	Collin	380	380	380	380	380	380
TRA	Ellis County Irrigation	direct	Ellis	125	125	125	125	125	125
TRA	Ten Mile Creek WWTP Reuse	direct	Dallas	125	125	125	125	125	125
TRA	TRA/Waxahachie Reuse	indirect	Ellis	4,998	5,129	5,129	5,129	5,129	5,129
TRA/DCURD	Las Colinas Reuse	direct/ indirect	Dallas	8,000	8,000	8,000	8,000	8,000	8,000
Trophy Club	Denton County Golf Reuse	direct	Denton	800	800	800	800	800	800
UTRWD	Lake Chapman Indirect Reuse	indirect	Denton	6,634	6,634	6,634	6,634	6,634	6,634
Wise County	Wise County Mining Reuse	direct	Wise	15,930	14,074	12,152	10,643	9,236	8,061
TOTAL				203,974	246,510	289,995	312,992	321,405	336,082

(a) County reflect location of reuse project.

Table 6.6
Recommended Reuse Projects in Region C*
 - Values in Acre-Feet per Year -

Provider	Project Name	Type	County ^(a)	2010	2020	2030	2040	2050	2060
Athens	Athens Fish Hatchery	direct	Henderson	0	2,872	2,872	2,872	2,872	2,872
Cooke County	Direct Reuse	direct	Cooke	0	70	70	70	70	70
Cooke County Mining	Mining Reuse	direct	Cooke	0	99	67	71	74	77
DWU	Direct Reuse	direct	Dallas	0	20,458	20,458	20,458	20,458	20,458
DWU/NTMWD	NTWMD WWTP Discharges to the Lake Ray Hubbard Watershed	indirect	Dallas/Kaufman/Collin/Rockwall	0	31,612	35,872	39,459	40,244	41,029
Ennis	Indirect Reuse	indirect	Ellis	0	0	0	333	2,521	3,696
Fort Worth	Village Creek Direct Reuse	direct	Tarrant	1,552	3,469	3,526	3,526	3,526	3,526
Fort Worth/TRA	Alliance Corridor Direct Reuse	direct	Tarrant	0	1,120	4,694	4,694	4,694	4,694
Fort Worth	Fort Worth Future Direct Reuse	direct	Tarrant	0	0	3,460	7,979	7,979	7,979
Frisco	Collin/Denton County Direct Reuse	direct	Collin/Denton	0	2,240	3,360	5,650	5,650	5,650
Jacksboro	Indirect Reuse (Jack County mining)	indirect	Jack	385	385	385	385	385	385
Irving/TRA	Irving Direct Reuse	direct	Dallas	0	6,000	8,000	8,000	8,000	8,000
NTMWD	Additional Supplies from Dallas for East Fork	indirect	Dallas/Kaufman/Collin/Rockwall	0	34,900	15,100	0	0	0
Tarrant County SEP	Tarrant County SEP	direct	Tarrant	0	0	1,528	2,360	2,360	2,360
TRA	Tarrant County Indirect Reuse	indirect	Tarrant	0	7,500	7,500	7,500	7,500	7,500
TRA	Dallas County Direct Reuse	direct	Dallas	0	0	6,760	6,760	6,760	6,760

* NOTE: Lists recommended reuse strategies for Region C and does not include existing reuse projects.

(a) County reflects location of reuse project.

Table 6.6* (continued)

Provider	Project Name	Type	County ^(a)	2010	2020	2030	2040	2050	2060
TRA	Joe Pool Lake Indirect Reuse (New WWTP)	indirect	Dallas	0	4,368	4,368	4,368	4,368	4,368
TRA	Ellis County Direct Reuse	direct	Ellis	0	0	0	0	0	2,200
TRA	Freestone County Direct Reuse	indirect	Freestone	0	0	0	0	6,760	6,760
TRA	Kaufman County Direct Reuse	indirect	Kaufman	0	1,000	1,000	1,000	1,000	1,000
TRA	Las Colinas Direct Reuse	direct	Dallas	0	7,000	7,000	7,000	7,000	7,000
TRA	Tarrant and Denton Counties Direct Reuse	direct	Tarrant/ Denton	0	7,500	7,500	7,500	7,500	7,500
TRWD	Trinity River Indirect Reuse - Richland Chambers	indirect	Navarro	0	53,000	53,000	53,000	53,000	53,000
TRWD	Trinity River Indirect Reuse - Cedar Creek	indirect	Henderson/ Kaufman	0	52,500	52,500	52,500	52,500	52,500
UTRWD	Indirect Reuse of Lake Ralph Hall Water	indirect	Fannin	0	6,810	13,620	20,430	20,430	20,430
UTRWD	Direct Reuse	direct	Denton	0	0	560	1,121	2,240	2,240
Wise County Mining Reuse	Wise County Mining Reuse	direct	Wise	0	14,133	22,428	19,652	24,648	28,520
Total				<u>1,937</u> 1,552	<u>257,036</u> 54,242	<u>275,628</u> 27,218	<u>276,688</u> 68,152	<u>292,539</u> 84,000	<u>300,574</u> 92,032

* NOTE: Lists recommended reuse strategies for Region C and does not include existing reuse projects.

(a) County reflects location of reuse project.

Table 6.7
Summary of Existing and Recommended Conservation (Including Reuse) for Region C
 - Values in Acre-Feet per Year -

Strategy	2010	2020	2030	2040	2050	2060
Municipal Conservation						
Low flow plumbing fixture rules ^(a)	22,029	69,122	86,663	105,067	151,981	211,201
Municipal Recommended Conservation	46,690	106,835	151,586	192,720	235,718	284,916
Non-Municipal Conservation						
Efficient new steam electric power plants	3,262	7,824	14,545	26,725	43,403	65,619
Non-Municipal conservation strategies ^(b)	57	1,069	3,334	4,518	5,147	5,737
Reuse Strategies						
Existing Reuse	203,974	246,510	289,995	312,992	321,405	336,082
Proposed Reuse Strategies	1,937,455 2	257,0362 54,242	275,62827 0,218	276,68826 8,152	292,53928 4,000	300,57429 2,032
Total Conservation and Reuse	277,9492 77,564	688,3966 85,602	821,75081 6,340	918,71091 0,174	1,050,192 1,041,653	1,204,128 1,195,586
Total Region C <u>Municipal</u> Demands	1,546,970	1,833,671	2,087,597	2,344,115	2,612,176	2,924,157
Total <u>Municipal</u> Demand without Conservation	1,572,261	1,910,617	2,188,805	2,475,907	2,807,560	3,200,977

- a. The Total Region C Demands on the line above includes projected conservation savings from low flow plumbing fixtures and efficient new steam electric power plants. These savings were added to the Region C Demands to obtain "Total Demand without Conservation", a projection of Region C's demands if no conservation occurred.
- b. Non-municipal water conservation measures include estimated conservation savings from manufacturing and irrigation rebates.

~~6.5 Per Capita Water Use in Region C with the Implementation of the Recommended Plan~~

~~The Report to the 81st Legislature ⁽²⁾ from the Water Conservation Advisory Committee recommends refining water conservation data collection, formatting and processing procedures. The report does not quantify specific water conservation targets or goal gpcd values. It recommends avoidance of a total municipal gpcd. The Report to the 79th Legislature ⁽⁶⁾ from the Water Conservation Implementation Task Force suggested that when establishing conservation targets and goals, a water supplier should consider "a minimum annual reduction of one percent in total gpcd, based upon a five-year rolling~~

~~average, until such time as the entity achieves a total gpcd of 140 or less.” The gpcd values used for Region C projections are dry year estimates, whereas the 140 gpcd recommendation is based on a five year rolling average. The five year average gpcd is typically 10-15% less than a dry year gpcd. As discussed earlier in this chapter, comparison between entities on a per capita basis can lead to erroneous conclusions regarding water use and water conservation effectiveness.~~ The 140 gpcd goal has no specific regulatory basis, and may not be appropriate for all entities based on differences in climatic conditions and other water use characteristics. However, since this number has been used in previous plans and is recognized statewide, it is used to provide a baseline for comparison in the discussion below.

This section of the report compares the per capita water use that would result from implementation of the 2011 Plan to the suggested voluntary goal of 140 gpcd.

Region C Per Capita Municipal Water Use

This plan recommends significant conservation efforts and the development of substantial new supplies from reuse. Table 6.8 summarizes the projected per capita municipal water use for Region C with the implementation of the plan. As discussed previously, the TWDB demand estimates do not take into account the recent HB 2667, which mandates lower flow toilets by January 1, 2014. The additional estimated savings realized by this legislation is shown as a line item in both Table 6.8 and Table 6.9. Figure 6.3 is a graph of the data from Table 6.8. The figure and the table show the following:

- With no conservation or reuse at all, the projected dry-year per capita municipal water use in Region C is 212 gpcd in 2060.
- Implementation of the plumbing code requiring the use of low flow plumbing fixtures had already reduced the per capita use in Region C by 6 gpcd as of the year 2007. It is expected to reduce per capita use by another 8 gpcd, to a total of 14 gpcd, by 2060.
- The recommended water conservation measures in the 2011 Plan will reduce the projected 2060 per capita municipal use by an additional 20 gpcd, to 178 gpcd.
- The existing and recommended municipal water reuse projects will reduce the projected 2060 per capita municipal use by an additional 43 gpcd, to 135 gpcd.
- The projected normal year per capita use would be 10-15 percent lower than dry-year use, well under the recommended goal of 140 gpcd.

- Many of the recommended reuse projects in this plan are proposed for implementation between now and 2030, leading to a rapid reduction in per capita use in Region C after crediting for reuse.

Region C Per Capita Municipal and Manufacturing Water Use

The Water Conservation Implementation Task Force recommended goal of 140 gpcd is based on potable water supplied to municipal retail customers. In Region C, manufacturers also use wholesale, self-supplied, and non-potable water. Therefore, the region-wide per capita use to be compared to the recommended goal of 140 gpcd will be between the region-wide per capita municipal use and the region-wide per capita municipal and manufacturing use.

Table 6.9 summarizes the projected per capita municipal and manufacturing water use for Region C with the implementation of this plan. Figure 6.4 is a graph of the data from Table 6.9. The figure and the table show the following:

- With no conservation or reuse at all, the projected per capita municipal and manufacturing water use in Region C would be 220 gpcd in 2060.
- Implementation of the plumbing code requiring the use of low flow plumbing fixtures had already reduced the per capita use in Region C by 8 gpcd as of the year 2007. It is expected to reduce per capita use by another 7 gpcd, to a total of 205 gpcd, by 2060.
- The recommended water conservation measures in the 2011 Plan will reduce the projected 2060 per capita municipal and manufacturing use by an additional 20 gpcd, to 185 gpcd.
- The existing and recommended water reuse projects will reduce the projected 2060 dry-year per capita municipal and manufacturing use by an additional 43 gpcd, to 142 gpcd.
- The projected normal year per capita use would be 10-15 percent lower than dry-year use, well under the recommended goal of 140 gpcd.

- **6.6 Water Conservation Policy Recommendations**

- The Region C Water Planning Group policy recommendations are discussed in Chapter 8 and included in Appendix Y. Recommendations specific to water conservation and reuse, once collected and provided by the Region C Water Planning Group, will be summarized below for reference.

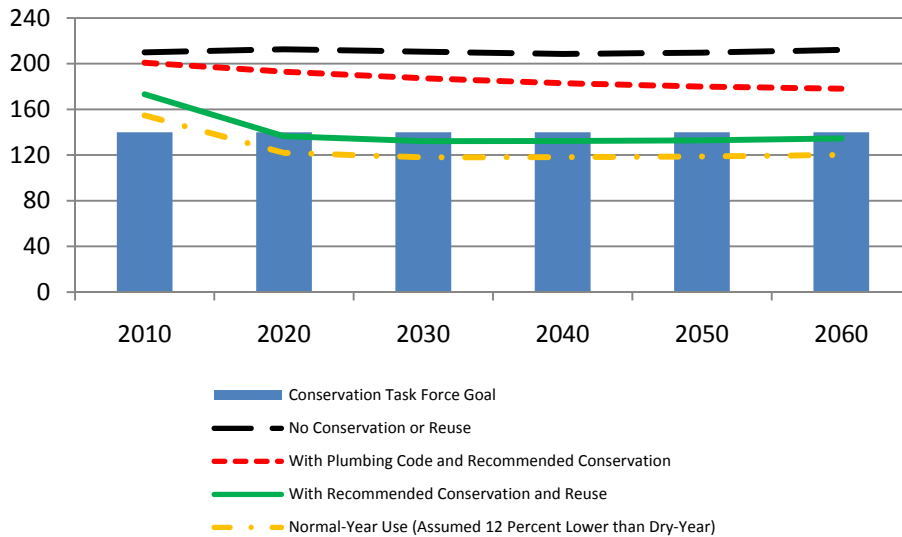
6.7 Model Water Conservation Plans

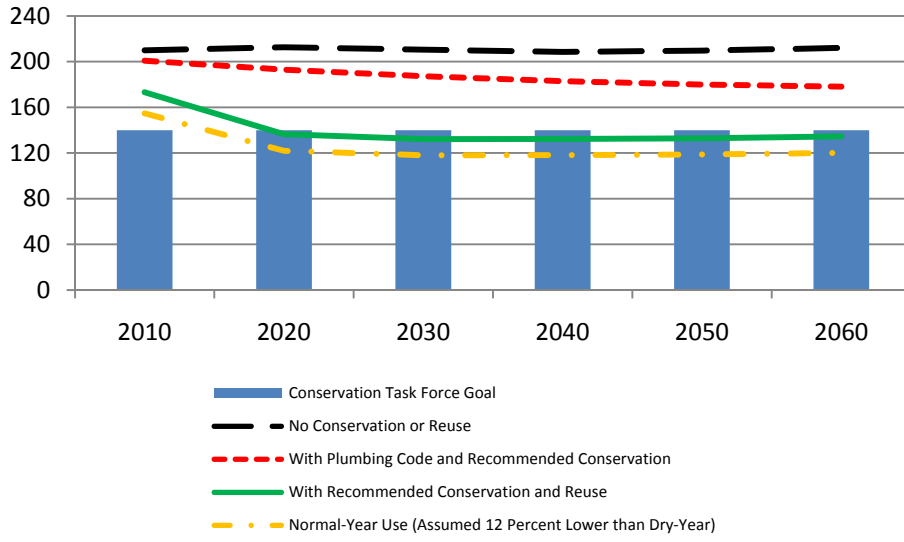
Model water conservation plans have been developed for four different water user types: municipal, irrigation, manufacturing, and steam electric power. The model water conservation plans are presented in Appendix L. The model plans are designed to show the content required by the TCEQ, optional content suggested by the TCEQ, and optional content suggested by the Region C Water Planning Group (e.g., potentially feasible water conservation strategies). The model plans are intended to be a template that Region C water user groups can use as a starting point and customize to develop their own situation-specific water conservation plans.

**Table 6.8
Projected Municipal Per Capita Use in Region C**

	Projections					
	2010	2020	2030	2040	2050	2060
Basic Data						
Population	6,670,493	7,971,728	9,171,650	10,399,038	11,645,686	13,045,592
Municipal Demand without Low Flow Plumbing (Acre-feet)	1,568,999	1,898,716	2,162,241	2,428,587	2,735,232	3,098,539
Municipal Demand with Low Flow Plumbing (Acre-feet)	1,546,970	1,833,671	2,087,597	2,344,115	2,612,176	2,924,157
1.28 gpf plumbing savings	0	4,077	12,019	20,595	28,925	36,819
Recommended Municipal Water Conservation (Acre-feet)	46,690	106,835	151,586	192,720	235,718	284,916
Current Municipal Reuse (Acre-feet)	203,954	246,490	289,975	312,972	321,385	336,062
Recommended Municipal Reuse (Acre-feet)	1,937 <u>1,552</u>	257,036 <u>25</u> 4,242	275,628 <u>270</u> ,218	276,688 <u>268</u> ,152	292,539 <u>284</u> ,000	300,574 <u>292</u> ,032
Per Capita Use (Gallons per Capita per Day)						
No Conservation or Reuse	210	213	210	208	210	212
With All Plumbing Codes	207	205	202	199	198	198
With Plumbing Code and Recommended Conservation	201	193	187	183	180	178
With Recommended Conservation and Reuse	173	137	133 <u>132</u>	133 <u>132</u>	134 <u>133</u>	135
Normal-Year Use (Assumed 12 Percent Lower than Dry-Year)	155	122	119 <u>118</u>	119 <u>118</u>	119	121 <u>120</u>

**Figure 6.3
Projected Municipal Per Capita Water Use in Region C**



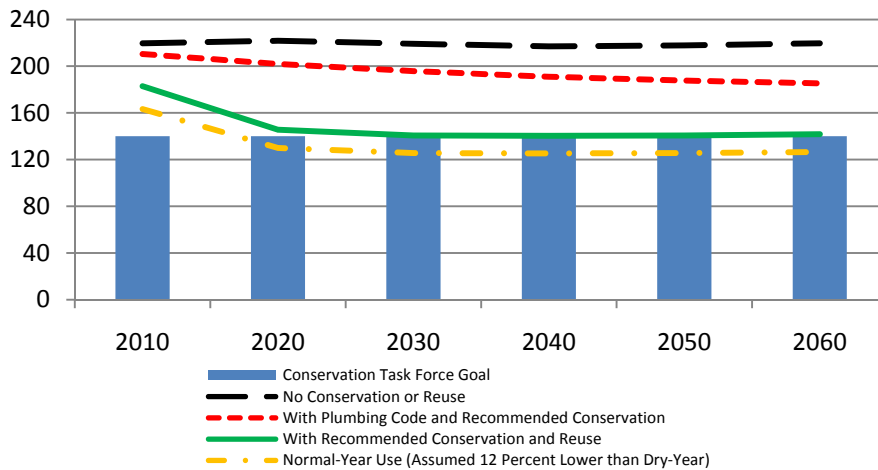


**Table 6.9
Projected Municipal and Manufacturing Per Capita Use in Region C**

	Projections					
	2010	2020	2030	2040	2050	2060
Basic Data						
Population	6,670,493	7,971,728	9,171,650	10,399,038	11,645,686	13,045,592
Municipal Demand without Low Flow Plumbing	1,568,999	1,898,716	2,162,241	2,428,587	2,735,232	3,098,539
Municipal Demand with Low Flow Plumbing	1,546,970	1,833,671	2,087,597	2,344,115	2,612,176	2,924,157
1.28 gpf plumbing savings	0	4,077	12,019	20,595	28,925	36,819
Manufacturing Demand	72,026	81,273	90,010	98,486	105,808	110,597
Recommended Mun. and Man. Water Conservation	46,747	107,904	154,920	197,238	240,865	290,653
Current Municipal and Manufacturing Reuse	203,974	246,510	289,995	312,992	321,405	336,082
Recommended Municipal and Manufacturing Reuse	<u>1,937,552</u>	<u>257,036²⁵ 4,242</u>	<u>275,628²⁷ 0,218</u>	<u>276,688²⁶⁸ ,152</u>	<u>292,539²⁸ 4,000</u>	<u>300,574²⁹² ,032</u>
Per Capita Use (Gallons per Capita per Day)						
No Conservation or Reuse	220	222	219	217	218	220
With Plumbing Code	217	214	211	208	206	205
With Plumbing Code and Recommended Conservation	210	202	196	191	188	185
With Recommended Conservation and Reuse	183	146	141	<u>141</u> ¹⁴⁰	141	142
Normal-Year Use (Assumed 12 Percent Lower than Dry-Year)	163	130	126	<u>126</u> ¹²⁵	126	127

a. Manufacturing water conservation measures include estimated conservation savings from manufacturing rebates.

Figure 6.4
Projected Municipal and Manufacturing Per Capita Water Use in Region C



~~6.6 Water Conservation Policy Recommendations~~

~~The Region C Water Planning Group policy recommendations are discussed in Chapter 8 and included in Appendix Y. Recommendations specific to water conservation and reuse, once collected and provided by the Region C Water Planning Group, will be summarized below for reference.~~

~~6.7 Model Water Conservation Plans~~

~~Model water conservation plans have been developed for four different water user types: municipal, irrigation, manufacturing, and steam electric power. The model water conservation plans are presented in Appendix L. The model plans are designed to show the content required by the TCEQ, optional content suggested by the TCEQ, and optional content suggested by the Region C Water Planning Group (e.g., potentially feasible water conservation strategies). The model plans are intended to be a template that Region C water user groups can use as a starting point and customize to develop their own situation-specific water conservation plans.~~

Who Must Develop a Water Conservation Plan

The TCEQ requires water conservation plans for all municipal, industrial, and mining water users with surface water rights of 1,000 acre-feet per year or more, all irrigation water users with surface water rights of 10,000 acre-feet per year or more, and all retail public utilities with 3,300 connections or more. The retail public utility requirement is an additional reporting requirement since the *2006 Region C Water Plan*. Water conservation plans are also required for all water users applying for a state water right and may also be required for entities seeking state funding for water supply projects. Water right

information was collected to determine what changes have taken place since the *2006 Region C Water Plan*. A number of entities have applied for and/or secured the right to use their own return flows. Water conservation plans were required to be submitted to the Executive Director of the TCEQ by May 1, 2005⁽¹⁰⁾. Then, water conservation plans were required to submit an updated water conservation plan to the TCEQ by May 1, 2009, and every five years after that date⁽¹⁰⁾.

Table 6.10 lists estimated Region C entities that are required by TCEQ to develop a water conservation plan. The additional requirement that retail public utilities serving more than 3,300 connections submit water conservation plans adds approximately 71 new WUGs in Region C that are now required to develop water conservation plans. Connections for each WUG were estimated from proposed 2010 WUG populations and available WUG demographic (population per connection) data.

Municipal Water Conservation Plan Requirements

The TCEQ requires the following minimum content in a municipal water conservation plan:

- Utility profile
- Specification of conservation goals
- Accurate metering
- Universal metering
- Determination and control of unaccounted-for water
- Public education and information program

**Table 6.10
Region C Water Users Required to Develop Water Conservation Plans**

Addison	Allen	Arlington	Athens
Azle	Balch Springs	Bedford	Benbrook
Bethesda WSC	Bolivar WSC	Bonham	Carrollton
Cedar Hill	College Mound WSC	Colleyville	Coppell
Corinth	Corsicana	Crowley	Culleoka WSC
Dallas Water Utilities*	Denison*	Denton*	De Soto
Duncanville	East Cedar Creek FWSD	East Fork SUD	Ennis
Euless	Farmers Branch	Flower Mound	Forest Hill
Forney	Fort Worth*	Frisco	Gainesville*
Garland	Glenn Heights	Grand Prairie	Grapevine*
Haltom City	Highland Park	Highland Village	Hurst
Irving	Jacksboro*	Keller	Lancaster
Lewisville	Little Elm	Mansfield	McKinney
Mesquite	Midlothian	Mineral Wells*	Murphy
North Richland Hills	Plano	Red Oak	Richardson
Richland Hills	Roanoke	Rockett Sud	Rockwall
Rowlett	Royse City	Sachse	Saginaw
Sardis-Lone Elm WSC	Seagoville	Sherman	Southlake
Southwest Fannin County SUD	Terrell*	The Colony	University Park
Walnut Creek SUD	Watauga	Waxahachie	Weatherford*
West Cedar Creek MUD	White Settlement	Wylie	Dallas County Park Cities MUD*
Ellis County WCID No. 1*	Extex Laporte*	Go-Crete Inc.*	Greater Texoma Utility Authority*
Hanson Aggregates Central Inc.*	J-M Manufacturing Co. Inc.*	Lafarge Corporation*	North Texas MWD*
Red River Authority*	Tarrant Regional Water District*	Trinity River Authority*	TXU Electric Company*
Upper Trinity RWD			

*Required in 2006 Water Plan⁽¹⁾

- Non-promotional water rate structure
- Reservoir system operation plan
- Means of implementation and enforcement
- Coordination with regional water planning group.

In addition, the TCEQ requires additional minimum content for municipal entities that are projected to supply 5,000 people or more in the following 10 years:

- Leak detection, repair, and water loss accounting
- Record management system
- Requirement for water conservation plans by wholesale customers.

The TCEQ requires additional minimum content for municipal entities that currently supply 20,000 people:

- Landscape irrigation permitting, inspection and enforcement program

The TCEQ also suggests optional content for municipal water conservation plans:

- Conservation-oriented water rates
- Ordinances, plumbing codes or rules on water-conserving fixtures
- Programs for the replacement or retrofit of water-conserving plumbing fixtures in existing structures
- Reuse and recycling of wastewater
- Pressure control and/or reduction
- Landscape water management ordinance
- Monitoring methods
- Other conservation methods.

Finally, the Region C Water Planning Group suggests optional content consisting of the potentially feasible water conservation strategies that are not discussed elsewhere in the municipal water conservation plan:

- Residential customer water audit
- Water-efficient clothes washer rebate
- Landscape irrigation system rebate
- Industrial, commercial, and institutional (ICI) general rebate
- ICI water audit, water waste reduction, and site-specific water conservation program.

Implementation of House Bill 1656

HB 1656 mandates that municipalities with populations of 20,000 or more implement a landscape irrigation permitting, inspection and enforcement program. Municipalities are required to adopt local ordinances or rules related to landscape irrigation that include

minimum standards and specifications for designing, installing and operating irrigation systems, and requires a new type of license, an irrigation inspector.

North Central Texas Council of Governments (NCTCOG) formed a committee to convene local water utility staff and building code officials to develop a model ordinance template. The committee recommended that cities and water districts consider using the draft model ordinance and consider inclusion of the irrigation and conservation elements in their respective ordinances. A copy of the model ordinance is found in Appendix L.

Irrigation Water Conservation Plan Requirements

The TCEQ requires the following minimum content in an irrigation water conservation plan:

- Description of the irrigation production process
- Description of the irrigation method or system and equipment
- Accurate metering
- Specification of conservation goals
- Description of water-conserving irrigation equipment and application system
- Leak detection, repair, and water-loss control
- Irrigation timing and/or measuring the amount of water applied
- Land improvements for retaining or reducing runoff and increasing the infiltration of rain and irrigation water
- Tailwater recovery and reuse
- Other conservation practices, methods, or techniques.

Manufacturing and Steam Electric Power Water Conservation Plan Requirements

The TCEQ requires the following minimum content in manufacturing or steam electric power water conservation plans:

- Water use in the production process
- Specification of conservation goals
- Accurate metering
- Leak detection, repair, and water-loss accounting

- Water use efficiency process and/or equipment upgrades
- Other conservation practices
- Review and update of plan.

6.8 Drought Management

As described in Section 6.2, the Region C Water Planning Group decided not to recommend drought management measures as a water management strategy to provide additional supplies for Region C. The consensus of the planning group is that:

- Drought management and emergency response planning are intended to preserve water resources for the most essential uses when water supplies are threatened by an unexpected condition such as a multi-year drought, an unexpected increase in demands, or a water supply system component failure.
- Drought contingency and emergency response measures provide protection in the event of water supply shortages, but they are not a reliable source of additional supplies to meet growing demands. They provide a backup plan in case a supplier experiences a drought worse than the drought of record or if a water management strategy is incomplete when it is needed.

This section presents TCEQ requirements for drought contingency plans, reviews existing drought contingency plans, and summarizes model drought contingency plans.

Who Must Develop a Drought Contingency Plan

The TCEQ requires drought contingency plans for wholesale and retail public water suppliers and for irrigation districts. Drought contingency plans are also required for all water users applying for a state water right and may also be required for entities seeking state funding for water supply projects.

Wholesale public water suppliers, retail public water suppliers providing water service to 3,300 or more connections, and irrigation districts were required to prepare a drought contingency plan and submit it to the Executive Director of the TCEQ by May 1, 2005 ⁽¹⁰⁾. These water suppliers were required to submit an updated drought contingency plan by May 1, 2009, and every five years after that date ⁽¹⁰⁾.

All retail public water suppliers were required to prepare and adopt a drought contingency plan and have it available for inspection by the Executive Director upon request by May 1, 2005 ⁽¹⁰⁾. Thereafter, all retail public water suppliers were required to

submit an updated drought contingency plan by May 1, 2009, and every five years after that date ⁽¹⁰⁾.

Required Content for Drought Contingency Plans

Drought contingency plans typically identify different stages of drought and specific triggers and responses for each stage. In addition, a drought contingency plan must specify quantifiable targets for water use reductions for each stage, and a means and method for enforcement. As with the water conservation plans, drought contingency plans were to be updated and submitted to the TCEQ by May 1, 2005. Required content for different types of drought contingency plans is discussed below.

Municipal. The TCEQ requires the following minimum content in a municipal drought contingency plan:

- Provisions to inform the public and provide opportunity for public input
- Provisions for continuing public education and information
- Coordination with the regional water planning group
- Criteria for initiation and termination of drought stages
- Drought and emergency response stages
- Specific, quantified targets for water use reductions
- Water supply and demand management measures for each stage
- Procedures for initiation and termination of drought stages
- Procedures for granting variances
- Procedures for enforcement of mandatory restrictions
- Consultation with wholesale supplier
- Notification of implementation of mandatory measures
- Review and update of plan.

Irrigation. The TCEQ requires the following minimum content in an irrigation drought contingency plan:

- Provisions to inform the public and provide opportunity for public input
- Coordination with the regional water planning group
- Criteria for initiation and termination of drought stages

- Specific, quantified targets for water use reduction
- Procedures for determining the allocation of irrigation supplies to individual users
- Criteria for initiation and termination of drought stages
- Procedures for use accounting
- Procedures for the transfer of water allocations among individual users
- Procedures for enforcement of water allocation policies
- Consultation with wholesale supplier
- Protection of public water supplies
- Review and update of plan.

Review of Existing Drought Contingency Plans

Regional water plans are required to include potential trigger conditions for drought and emergency response measures and potential measures to be taken for each water source in the region. Appendix L includes a summary of drought contingency and emergency management plans in Region C, including potential triggers and response measures.

Model Drought Contingency Plans

Model drought contingency plans have been developed for municipal and irrigation water users. The TCEQ does not require drought contingency plans for manufacturing or steam electric power water users. The model drought contingency plans are shown as the last chapter in the municipal and irrigation water conservation plans presented in Appendix L. The model plans are designed to show the minimum content required by the TCEQ and are intended to be a template that Region C water user groups can use as a starting point and customize to develop their own situation-specific drought contingency plan. Each plan identifies four drought stages: mild, moderate, severe and emergency. The recommended responses range from notification of drought conditions and voluntary reductions in the “mild” stage to mandatory restrictions during an “emergency” stage. Individual entities will customize the trigger conditions for and the appropriate responses to the different stages.

6.9 Evaluation of Water Conservation and Drought Management Planning Requirements

As discussed in Section 6.1, the TWDB planning rules ⁽¹¹⁾ require consideration of water conservation and drought management measures for various water user groups. Table 6.11 shows each requirement and documents that the requirements have been fulfilled.

6.10 Conservation Requirements for Interbasin Transfers of Water

Section 11.085 of the Texas Water Code includes permitting requirements for interbasin transfers of surface water. Section 11.085(1)(2) provides for an enhanced conservation standard for interbasin transfers, indicating that the Texas Commission on Environmental Quality (TCEQ) may grant a water right “to the extent that...the applicant for the interbasin transfer has prepared a drought contingency plan and has developed and implemented a water conservation plan that will result in the highest practicable levels of water conservation and efficiency achievable within the jurisdiction of the applicant.” Section 11.1721(e) of the Water Code indicates that the Texas Water Development Board (TWDB) and the TCEQ should jointly “develop model water conservation programs for different types of water suppliers that suggest best management practices for achieving the highest practicable levels of water conservation and efficiency achievable for each specific type of water supplier.” The TWDB and TCEQ have addressed this requirement by preparing TWDB Report 362, the *Water Conservation Best Management Practices Guide* ⁽¹²⁾.

For this report, the Region C Water Planning Group analyzed the applicability and appropriateness in Region C of the Best Management Practices suggested in the *Guide*. The Basic Water Conservation Package and the Enhanced Water Conservation Package recommended for Region C represent measures that can, collectively and/or individually, be implemented, provide long term water savings, provide a reasonable quantity of conservation at a reasonable cost, and be practicable for implementation in Region C.

The Basic Water Conservation Package was recommended for all suppliers with a per capita demand over 140 gallons per capita per day (gpcd) and a need for additional water supply. (Suppliers with a per capita demand of less than 140 gpcd were considered to have an effective conservation program in place.) The Basic Water Conservation Package includes:

|

**Table 6.11
Evaluation of Water Conservation and Drought Management Planning Requirements**

Requirement	Evaluation	Fulfilled?
<p>Incorporate information from first biennium study on conservation and reuse.</p>	<p>Information from the April 2009 <i>Water Conservation and Reuse Study</i> was used to supplement previous work from the <i>2006 Region C Water Plan</i>, the <i>Water Conservation Task Force Special Report</i> and the <i>Water Conservation Advisory Council Special Report</i> recommendations. References documenting the location and scope of additional information are included throughout the chapter as well as in the reference section.</p>	<p>Yes</p>
<p>Review and update model water conservation and drought contingency plans for up to four user categories.</p>	<p>Table 6.9 lists Region C entities that are required to develop a water conservation plan under Texas Water Code §11.1271. These entities include municipal water retailers, municipal water wholesalers, manufacturers, and steam electric power generators. Water conservation plans for municipal, irrigation, manufacturing/steam electric power and drought contingency plans for municipal and irrigation categories from the <i>2006 Region C Water Plan</i> have been reviewed and updated as necessary. Model plans have been consolidated into Appendix L.</p>	<p>Yes</p>
<p>Update the description of the recommended water conservation strategies for water user groups in Region C.</p>	<p>The basic conservation package is recommended for each municipal water user group, and the expanded conservation package is recommended for some municipal water user groups. In general water conservation practices were not recommended for water user groups that do not have a projected water need (with the exception of some municipal strategies that will occur without action from the water user group). Golf course conservation is recommended for each county that has a projected <u>irrigation</u> water need. There are no projected <u>livestock</u> water needs. The manufacturing general rebate strategy is recommended in each county with a projected <u>manufacturing</u> water need. The basic conservation package is recommended for each <u>municipal</u> water user group, and the expanded conservation package is recommended for some municipal water user groups. The projected <u>steam electric power</u> water demands include the assumption that new power plants will be more efficient than existing power plants. The recommended water conservation strategies were chosen from the potentially feasible water conservation strategies based on evaluation of quantity, cost, reliability, and other factors in comparison with other water supply alternatives.</p>	<p>Yes</p>
<p>Coordinate with the North Central Texas Council of Governments Water Resources Subcommittee on implementation of House Bill 1656.</p>	<p>The North Central Texas Council of Governments has produced a model ordinance to address the requirements of HB 1656. This bill covers review and inspection of landscape irrigation systems by municipalities with populations greater than 20,000 people. A copy of the ordinance is included in Appendix L for reference.</p>	<p>Yes</p>

~~The Basic Water Conservation Package was recommended for all suppliers with a per capita demand over 140 gallons per capita per day (gpcd) and a need for additional water supply. (Suppliers with a per capita demand of less than 140 gpcd were considered to have an effective conservation program in place.) The Basic Water Conservation Package includes:~~

- Low flow plumbing fixture rules (required by state and federal law)
- Public and school education
- Water use reduction due to increasing water prices
- Water system audit, leak detection and repair, and pressure control
- New efficient residential clothes washer standards
- Water conservation pricing structure
- Water waste prohibition

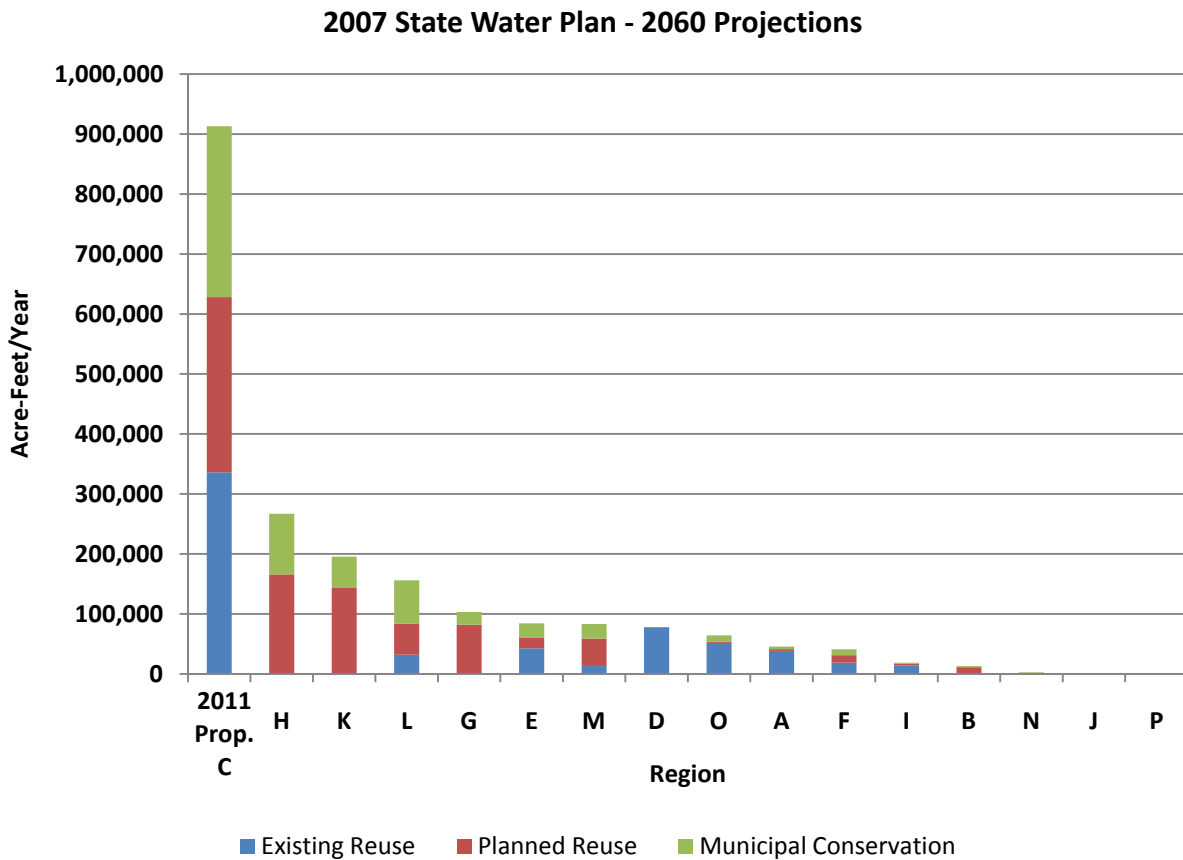
The Expanded Water Conservation Package includes strategies that are more costly to implement and that demonstrate greater applicability for larger water user groups. The Expanded Water Conservation Package includes the Basic Water Conservation Package, plus:

- Coin-operated clothes washer rebate
- Residential customer water audit
- Landscape irrigation restrictions
- Industrial, commercial, and institutional (ICI) water audit, water waste reduction, and site-specific conservation program
- Reuse of treated wastewater effluent (if applicable for the specific supplier)

The measures in each package were studied at a regional level, and more detailed studies conducted for individual suppliers may indicate that some of these measures are not practicable for individual suppliers or that alternate strategies should be implemented. A careful review of the strategies laid out in the *Guide* ⁽¹²⁾, with emphasis on the strategies recommended for Region C, and adoption of the strategies that fit the individual supplier will provide for “the highest practicable levels of water conservation and efficiency achievable.” Figure 6.5 demonstrates the size of the conservation and reuse programs

already implemented by Region C water providers and recommended in the Region C Water Plan. With a quarter of the state’s population, Region C has far more existing and proposed water reuse than any other region. Looking at conservation and reuse, Region C has by far the largest municipal conservation and reuse program planned in the state. The

Figure 6.5
Conservation and Reuse in Regional Water Plans by Region



conservation and reuse program outlined in this plan and being implemented by Region C water suppliers meets the requirements of Texas Water Code Section 11.085(l)(2).

6.11 Evaluation of Reuse Efforts in Region C

During late 2009, a survey of Chapter 210 reuse providers and indirect reuse providers in Region C was conducted. A summary of information obtained from these surveys is included in Table 6.12.

Direct reuse systems that replace potable water result in immediate reductions in per capita potable water usage. The higher levels of reuse water usage experienced during drought periods also further aid in offsetting water supply requirements during these critical periods. The 2006 Region C Water Plan estimated that the direct reuse projects included in Table 6.12 would collectively provide 36,856 ac-ft/yr of water by the year

Table 6.12
Evaluation of Existing Water Reuse in Region C

Sponsor	Project	Use	2010 Estimate (2006 Plan) (ac-ft/yr)	2010 Estimate (2011 Plan) (ac-ft/yr)	2005 (ac-ft/yr)	2006 (ac-ft/yr)	2007 (ac-ft/yr)	2008 (ac-ft/yr)
Azle	Cross Timbers	Golf Course Irrigation	811	300	243	285	32	56
Azle Direct Reuse Subtotal			811	300	243	285	32	56
Dallas	Cedar Crest	Golf Course Irrigation	561	561	251	232	166	N/A
Dallas Direct Reuse Subtotal			561	561	251	232	166	N/A
Denton	City of Garland	Steam Electric Power	3,363	1,233	388	644	173	108
Denton	Various	Irrigation	6,165		64	107	82	69
Denton	Oakmont Country Club	Golf Course Irrigation	800		310	233	119	215
Denton Direct Reuse Subtotal			10,328	1,233	762	984	373	393
Ennis	Tractabel	Steam Electric Power	3,363	800	708	706	861	N/A
Ennis Direct Reuse Subtotal			3,363	800	708	706	861	N/A
Frisco	Stewart Creek	Golf Course Irrigation	307	307	320	357	258	108
Frisco Direct Reuse Subtotal			307	307	320	357	258	108
Fort Worth	Waterchase Golf	Golf Course Irrigation	897	897	438	594	305	449
Fort Worth Direct Reuse Subtotal			897	897	438	594	305	449
Garland	Forney	Steam Electric Power	8,979	8,979	6,523	8,016	7,998	7,910
Garland Direct Reuse Subtotal			8,979	8,979	6,523	8,016	7,998	7,910
Gainesville	Keneteso Park	Irrigation	9	9	1	1	4	4
Gainesville Direct Reuse Subtotal			9	9	1	1	4	4
Grapevine	Peach St. WWTP	indirect reuse	3,317	3,317	3,502	3,377	3,924	3,838
Grapevine Indirect Reuse Subtotal			3,317	3,317	3,502	3,377	3,924	3,838
Lewisville	Castlehills Golf Course	Golf Course Irrigation	897	897	383	379	210	
Lewisville Direct Reuse Subtotal			897	897	383	379	210	0
NTMWD	Rowlett Creek	Golf Course Irrigation	1,540	1,540	384	423	140	222
NTMWD	Buffalo Creek	Golf Course Irrigation	672	682	188	245	146	159
NTMWD	Royse City	Golf Course Irrigation	112	112	112	129	0	0

NTMWD Direct Reuse Subtotal			2,324	2,324	684	797	286	381
NTMWD	Wilson Creek	indirect reuse	71,882	50,000	39,856	43,933	50,104	42,831
NTMWD Indirect Reuse Subtotal			71,882	50,000	39,856	43,933	50,104	42,831
TRA	Las Colinas	Irrigation	8,000	8,000	1,684	2,192	227	1,757
TRA	Ten Mile Creek	Irrigation	N/A	250	42	46	13	36
TRA Direct Reuse Subtotal			8,000	8,250	1,726	2,238	241	1,793
The Colony	Stonebriar Country Club	Golf Course Irrigation	380	380	115	326	180	N/A
The Colony Direct Reuse Subtotal			380	380	115	326	180	N/A
UTRWD	Lakeview Regional WRP	indirect reuse	8,441	6,634	2,686	2,691	4,264	4,071
UTRWD	Riverbend Regional WRP	indirect reuse			404	583	924	934
UTRWD	Peninsula Regional WRP	indirect reuse			76	116	147	191
UTRWD	Celina WWTP	indirect reuse			330	305	513	418
UTRWD Indirect Reuse Subtotal			8,441	6,634	3,496	3,695	5,849	5,614
TOTAL			120,496	84,888	59,007	65,921	70,792	63,379

2010. The *2011 Region C Water Plan* estimates that the direct reuse projects included in Table 6.12 will collectively provide 24,937 ac-ft/yr of water by the year 2010. Over the course of the period evaluated here (2005-2008), these projects collectively provided anywhere from 10,000 to 14,000 [acre-feet/ per year](#).

The *2006 Region C Water Plan* estimated that the indirect reuse projects included in Table 6.12 would collectively provide 83,640 [acre-feet per year ac-ft/yr](#) of water by the year 2010. The *2011 Region C Water Plan* estimates that the indirect reuse projects included in Table 6.12 will collectively provide 59,951 [acre-feet per year ac-ft/yr](#) of water by the year 2010. Over the course of the period evaluated here (2005-2008), these projects collectively provided anywhere from 46,000 to 59,000 [acre-feet per year ac-ft/yr](#).

The primary obstacles hindering the growth of direct reuse systems in Region C are the initial capital costs required to build the necessary infrastructure and securing new customers. The primary obstacles hindering the growth of indirect reuse systems in Region C are the acquisition or amendment of water rights and development of conveyance systems, particularly within very urbanized areas. In order to continue advancing reuse systems within the region, continued emphasis will need to be placed on identifying means for financing these systems.

6.12 Water Loss and Water Audit

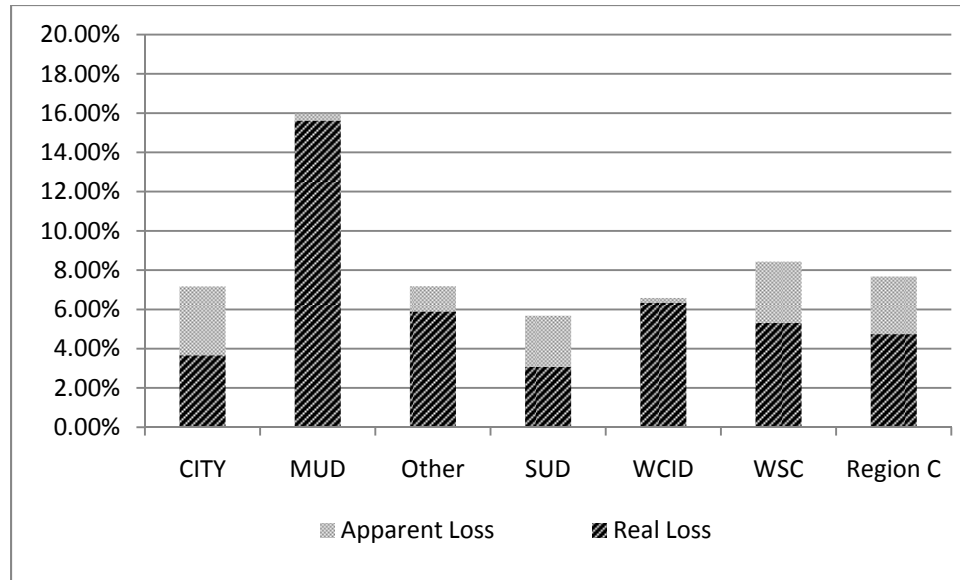
[Since the previous round of regional planning, retail public water utilities are now required to complete and submit a water loss audit form to the TWDB every five years. The](#)

first water loss audit reports were submitted to the TWDB by March 31, 2006. The data from these reports were compiled by Alan Plummer Associates Inc. through a research and planning fund grant from TWDB ⁽¹³⁾. The water audit reporting requirements follow the International Water Association (IWA) and American Water Works Association (AWWA) Water Loss Control Committee methodology.

The primary purposes of a water audit loss are to account for all of the water being used and to identify potential areas where water can be saved. Water audits track multiple sources of water loss that are commonly described as apparent loss and real loss. Apparent loss is the paper loss of water. It includes losses associated with customer meters under-registering, billing adjustment and waivers, and unauthorized consumption. Real loss is the actual water loss of water from the system, and includes main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility.

In Region C, 234 public water suppliers submitted a water loss audit to TWDB. The breakdown of the public water suppliers are 98 cities, 89 water supply corporations, seven special utility districts, two water control and improvement districts, two municipal utility districts and 36 other water suppliers. The total percentage water loss was calculated for each water supplier using a corrected input volume (The corrected input volume is water delivered divided by master meter accuracy, this represents the actual amount of water that was delivered to the utility.). Figure 6.6 shows the percentage of total water loss for the region, cities, water supply corporations, special utility districts, water control and improvement districts, municipal utility districts and other water suppliers.

Figure 6.6
Percentage of Total Water Loss in Region C



On a regional basis, the percentage of total water loss for Region C is 7.68 percent. The amount of total water loss for cities, water supply corporations, special utility districts, water control and improvement districts and other water suppliers is within the range of acceptable water loss (less than or equal to twelve percent). The amount of total water loss as a percent of corrected input volume for the municipal utility district suppliers is much higher. One explanation for this is the low density of service connections per mile of main line for municipal utility district suppliers. Table 6.13 shows the ratio of the number of connections per mile of main line by category.

Table 6.13
Service Connections per Mile of Water Main in Region C

<u>Category</u>	<u>Service Connections/Mile</u>
<u>Region C</u>	<u>51.32</u>
<u>City</u>	<u>68.60</u>
<u>MUD</u>	<u>6.20</u>
<u>Other</u>	<u>39.73</u>
<u>SUD</u>	<u>11.00</u>
<u>WCID</u>	<u>10.75</u>
<u>WSC</u>	<u>9.67</u>

The amount of real losses in Region C from the 227 public water suppliers totaled 10.65 billion gallons in 2005. This represents 2.7 percent of the total 2005 municipal water use

for the region. Based on these findings, the region is adequately addressing municipal water loss.

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CHAPTER 6 LIST OF REFERENCES

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