Guidance and Methodology for Reporting on Water Conservation and Water Use

developed by

Texas Water Development Board

and

Texas Commission on Environmental Quality

in consultation with

Water Conservation Advisory Council

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Table of Contents

Foreword

Senate Bill 181, passed by the 82nd Texas Legislature in 2011, has a requirement that:

> *"Not later than January 1, 2013, the Texas Water Development Board and the Texas Commission on Environmental Quality, in consultation with the Water Conservation Advisory Council, shall develop the water use and conservation calculation methodology and guidance and the data collection and reporting program required by Subsections (b) and (d), Section 16.403, Water Code."*

This guidance document has been prepared to meet the requirement and is provided to retail water providers and certain other water use sectors as a guide for preparation of water use reports, water conservation plans, and reports on water conservation efforts. It is subject to revision as the Texas Water Development Board (Board) and the Texas Commission on Environmental Quality (Commission) determine that changes are necessary to improve the collection and use of information on water conservation and water use in the state.

Introduction

STATUTORY REQUIREMENTS

In 2011 the 82nd Texas Legislature passed Senate Bill 181 (relating to the calculation and reporting of water usage by municipalities and water utilities for state water planning and other purposes) and Senate Bill 660 (relating to the review and functions of the Texas Water Development Board). These bills improve conservation reporting procedures as well as establish a consistent method for reporting water use data.

Senate Bill 181 requires the Board and the Commission, in consultation with the Water Conservation Advisory Council, to develop a uniform, consistent methodology for calculating water use and a guidance document for reporting on water conservation. Municipalities or water utilities are to use them in their efforts to develop water conservation plans and prepare annual reports and five-year implementation reports. This guidance document should also be used by self-supplied industrial and agricultural entities in their efforts to develop water conservation plans and required reports.

Senate Bill 181 added Texas Water Code 16.403(3) stating:

> "using a single gallons per capita per day metric to compare the water use of municipalities and water utilities does not produce a reliable comparison because water use is dependent on several variables, including differences in the amount of water used for commercial and industrial sector activities, power production, permanent versus temporary service populations, and agricultural sector production."

Texas Water Code Section 16.403 provides:

> "(a) The legislature finds that:
>
> (1) tracking water use over time and evaluating the effects of water conservation programs or strategies are vital components of planning for and managing the state's water resources to estimate and meet future water demand requirements;
>
> (2) gallons per capita per day, the common metric used by municipalities and water utilities for water supply planning and the calculation of water use, is not an accurate measure of water use or water conservation because a uniform, consistent methodology for the calculation of gallons per capita per day has not been established;
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> (3) using a single gallons per capita per day metric to compare the water use of municipalities and water utilities does not produce a reliable comparison because water use is dependent on several variables, including differences in the amount of water used for commercial and industrial sector activities, power production,

permanent versus temporary service populations, and agricultural sector production;

(4) if valid water use comparisons and evaluations of a municipality's or water utility's water conservation programs are to be made over time for statewide resource management and water supply planning and permitting purposes, the methodology used to calculate gallons per capita per day must be uniform for all water suppliers;

(5) a municipality's or water utility's industrial and agricultural sector's gallons per capita per day figures are not an accurate measure of actual water use and conservation by entities within those sectors because water use in the industrial and agricultural sectors is not population-dependent and therefore not accurately calculated using a population-based metric; and

(6) a sector-based water use metric, adjusted for variables in water use by municipalities and water utilities, is necessary in order to provide an accurate comparison of water use and water conservation among municipalities and water utilities.

(b) At a minimum, the methodology and guidance must include:

(1) a method of calculating total water use by a municipality or water utility, including water billed and nonrevenue water used, and a method of calculating water use for each sector of water users served by a municipality or water utility;

(2) a method of calculating total water use by a municipality or water utility in gallons per capita per day;

(3) a method of classifying water users within sectors;

(4) a method of calculating water use in the residential sector that includes both single-family and multifamily residences, in gallons per capita per day;

(5) a method of calculating water use in the industrial, agricultural, commercial, and institutional sectors that is not dependent on a municipality ’s population or the number of customers served by a water utility; and

(6) guidelines on the use of service populations by a municipality or water utility in developing a per-capita-base method of calculation, including guidance on the use of permanent and temporary populations in making calculations.

(c) The board or the commission, as appropriate, shall use the methodology and guidance developed under Subsection (b) in evaluating a water conservation plan, program of water conservation, survey, or other report relating to water conservation submitted to the board or the commission under Texas Water Codes:

(1) Section 11.1271;

(2) Section 13.146;

(3) Section 15.106;

(4) Section 15.607;

(5) Section 15.975;

(6) Section 15.995;

(7) Section 16.012(m);

(8) Section 16.402;

(9) Section 17.125;

(10) Section 17.277;

(11) Section 17.857; and
(12) Section 17.927.

(d) The board, in consultation with the commission and the Water Conservation Advisory Council, shall develop a data collection and reporting program for municipalities and water utilities with more than 3,300 connections."

Texas Water Code Section16.404 includes:

"The commission and the board, as appropriate, shall adopt rules and standards as necessary to implement this subchapter. **At a minimum, the rules adopted under this subchapter must require an entity to report the most detailed level of water use data currently available to the entity.** The commission may not adopt a rule that requires an entity to report water use data that is more detailed than the entity's billing system is capable of producing. The rules may require that billing systems purchased after September 1, 2011, be capable of reporting detailed water use data described in this subchapter."

CONTENT

This guidance document was developed by the Board and the Commission in consultation with the Water Conservation Advisory Council and is intended to be used for the purpose of internal and long-term conservation planning.

- The Retail Water Providers section is intended to be used by retail water providers such as municipalities, water supply corporations, special utility districts, municipal utility districts, and water control improvement districts that are required to complete a water use survey, water conservation plan, conservation plan annual report, or five-year implementation report. Wholesale water providers may also benefit from the guidance on water conservation plans and annual reports.

- The Self-Supplied Agricultural Water Use Entities section is intended to be used by agricultural entities such as irrigation districts that are required to complete a water conservation plan, conservation plan annual report, or five-year implementation report.

- The Self-Supplied Industrial Water Use Entities section is intended to be used by industries that are required to complete a water use survey, water conservation plan, conservation plan annual report, or five-year implementation report.

Many utilities across the state are required by statute to submit various reports and surveys to the Board or Commission for the purposes of conservation reporting or water use accounting. This reported information enables state agencies to evaluate trends in water usage and project our state's long term water needs. Texas has 16 regional water planning areas, and for each of those water planning areas, this type of information is necessary to evaluate conservation strategies and for the development of the regional and state water plans. For many utilities it is also very important to maintain and collect data relating to water use, population, and conservation plan implementation because that information is critical in planning for a utility's long-term needs.

Residential users, industrial users, commercial users, institutional users, and agricultural users should compare their own water use over time to discover any long-term reduction brought about by the implementation of various programs. Long-term improvement by individual users rather than the comparison of water use between "like" entities should be the benchmark for evaluating success.

METHODOLOGY

This guidance document describes the methods for identifying and determining certain numerical data that are utilized in various reporting requirements. The guidance and methodology are designed to help entities complete their conservation and water use reporting forms in a consistent and uniform manner. The key points of the methodology are summarized below.

- Identifies how a municipality or water utility should calculate total water use in gallons per capita per day.

- Identifies how a municipality or water utility should calculate water use in the residential sector, including both single-family and multi-family residences, in gallons per capita per day.

- Identifies how a municipality or water utility could determine water use in each of the following sectors using non-population dependent metrics: industrial, agricultural, commercial, and institutional sectors.

- Identifies how an agricultural entity or industrial entity should report on their water use and implementation of their water conservation plan.

- Requires that an entity report the most detailed level of water use data currently available to the entity; however, it is recognized that some utility systems will have only minimum separation of water use by sectors.

Questions about the guidance may be directed to the Commission's Water Availability Division at 512-239-4600 or the Board at *waterusesurvey@twdb.texas.gov or wcpteam@twdb,texas.gov*.

Chapter 1: Texas Water Development Board Required Documents and Reports for Conservation and Water Use

The following documents and reports are required by statute and/or Texas Water Development Board rules to be submitted to the Board.

WATER CONSERVATION PLAN

Texas Water Code: 13.146; 17.125(b); 17.277(b)
Texas Administrative Code: 31 Texas Administrative Code Chapter 363, Subchapter A, Rule 363.15
Who is required to submit:

- Entities applying for Board financial assistance greater than $500,000
- Entities with 3,300 connections or greater
- A non-irrigation surface water right greater than 1,000 acre-feet/year
- An irrigation surface water right greater than 10,000 acre-feet/year

Report goes to: All required plans should be submitted to the Board.
When to submit: Submit a water conservation plan along with the utility profile once every five years or whenever a revision to the plan is needed.
Purpose and Function: The purpose of a water conservation plan is to establish a strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, and for increasing the recycling and reuse of water. The water conservation plan contains the utility profile which is the foundation of water conservation plan development and ensures that important information and data are considered when establishing targets and goals. The plan should establish a schedule for achieving 5- and 10-year targets and goals for water use and water loss and a method for tracking progress in meeting the targets and goals.

UTILITY PROFILE

Texas Administrative Code: 31 Texas Administrative Code Chapter 363, Subchapter A, Rule 363.15(b)(1)(A)
Who is required to submit:

- Entities applying for Board financial assistance greater than $500,000
- Entities with 3,300 connections or greater

Report goes to: All required utility profiles should be submitted to the Board.
When to submit: Submit a utility profile along with the water conservation plan once every five years or when a plan is revised as necessary.
Purpose and Function: The utility profile is the foundation of water conservation plan development and ensures that important information and data be considered when establishing 5- and 10-year targets and goals for water use and water loss.

WATER CONSERVATION PLAN ANNUAL REPORT

Texas Water Code: 16.402(b)
Texas Administrative Code: 31 Texas Administrative Code Chapter 363, Subchapter A, Rule 363.15

Who is required to submit: Entities currently required to have a water conservation plan on file with the Board or the Commission are required to submit a conservation plan annual report.
Report goes to: The water conservation plan annual report should be submitted to the Board.
When to submit: The water conservation plan annual report should be submitted every year by May 1.
Purpose and Function: The purpose of a conservation plan annual report is for a utility to internally collect and track key water use and water loss data as well as measure and evaluate their conservation program and activities. The water conservation plan annual report shall detail progress toward implementing each of the minimum requirements in the water conservation plan. As the report form is completed, an entity should review their water conservation plan to see if they are making progress towards meeting stated goals.

WATER LOSS AUDIT

Texas Water Code: 16.0121
Texas Administrative Code: 31 Texas Administrative Code Chapter 358, Subchapter B, Rule 358.6
Who is required to submit: All retail public utilities providing potable water are required to submit a water loss audit once every five years.
Report goes to: The water loss audit should be submitted to the Board.
When to submit: Water loss audits should be submitted once every five years by May 1. The next due date is May 1, 2016. ***Note: Any public utility that receives financial assistance from the Board in an amount greater than $500,000 is required to submit a water loss audit annually by May 1.***
Purpose and Function: The purpose of a water loss audit is to enable an entity to identify significant losses in their system. This allows the entity to determine long-term infrastructure needs and save money by establishing an efficient repair and maintenance program. Water loss audits conserve the state's water resources by reducing water losses from the systems of drinking water utilities.

WATER USE SURVEY

Texas Water Code: 16.012
Texas Administrative Code: 31 Texas Administrative Code Chapter 358, Subchapter B, Rule 358.5
Who is required to submit: Entities using surface water or groundwater for municipal, industrial, power generation, or mining purposes are required by Texas Water Code Section 16.012(m) to submit a water use survey.
Report goes to: The water use survey should be submitted to the Board.
When to submit: The water use survey should be submitted every year by March 1.
Purpose and Function: The Board is legislatively directed to plan for, and to assist financially, the development and management of the water resources of Texas. The usefulness of the Board's water planning and funding activities is dependent upon the accuracy and completeness of the information that water users provide. To this end, the Board annually collects and maintains accurate information concerning the current use of water.

For more information regarding the Water Conservation Plan, the Water Conservation Annual Report, and the Water Loss Audit, please contact the Board's Water Conservation Division at 512-463-7988 or wcpteam@twdb.texas.gov.

For more information regarding the Water Use Survey, please contact the Board's Water Resources Planning Division at 512-936-0829 or waterusessurvey@twdb.texas.gov.

Chapter 2: Texas Commission on Environmental Quality Required Documents and Reports for Conservation and Water Use

The following reports are required by statute and Texas Commission on Environmental Quality rules to be submitted to the Commission.

WATER CONSERVATION PLAN

Texas Water Code: 11.1271

Texas Administrative Code: 30 Texas Administrative Code Chapter 288, Subchapter A, Rules 288.2, 288.3, 288.4, 288.5

Who is required to submit:

- Any existing non-irrigation surface water right greater than 1,000 acre-feet/year
- Any existing irrigation surface water right greater than 10,000 acre-feet/year
- Any and all new municipal, industrial and irrigation water right applications

Report goes to: The water conservation plan should be submitted to the Board and the Commission.

When to submit: Submit a water conservation plan once every five years for non-irrigation water right holders of 1,000 acre-feet or more and irrigation water right holders of 10,000 acre-feet or more.

Purpose and Function: The purpose of a water conservation plan is to establish a strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water. The water conservation plan contains the utility profile which is the foundation of water conservation plan development and ensures that important information and data be considered when establishing targets and goals. The plan should establish a schedule for achieving 5- and 10-year targets and goals and a method of tracking progress in meeting the targets and goals.

FIVE-YEAR IMPLEMENTATION REPORT

Texas Water Code: 11.1271(f)(1)

Texas Administrative Code: 30 TAC Chapter 288, Subchapter C, Rule 288.30

Who is required to submit:

- A non-irrigation surface water right greater than 1,000 acre-feet/year
- An irrigation surface water right greater than 10,000 acre-feet/year

Report goes to: The implementation report should be submitted to the Commission.

When to submit: The implementation report is submitted once every five years with the next report due May 1, 2014.

Purpose and Function: The implementation report must contain

1. the list of dates and descriptions of the conservation measures implemented,
2. data about whether or not targets in the plans are being met,
3. the actual amount of water saved, and
4. if targets are not being met, an explanation as to why the targets are not being met, including any progress on that particular target.

DROUGHT CONTINGENCY PLAN

Texas Water Code: 11.1272

Texas Administrative Code: 30 TAC Chapter 288, Subchapter B, Rules 288.20, 288.21, 288.22

Who is required to submit:

- Retail public water suppliers with 3,300 or more connections
- Wholesale public water suppliers
- Irrigation districts
- Water rights applicants for municipal use

Report goes to: The drought contingency plan should be submitted to the Commission.

When to submit: The drought contingency plan is submitted every five years.

Purpose and Function: The drought contingency plan is designed to establish triggers and responses for periodic and temporary water supply, water demand, mechanical, or contamination issues.

For more information regarding the above Commission required reports, please contact the Commission's Water Availability Division at 512-239-4600.

Chapter 3: Definition of Terms

The words and terms found in this chapter, when used in the context of this guidance document and in the context of required reports, shall have the following meanings, unless the context clearly indicates otherwise.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY CHAPTER 288.1 DEFINITIONS
The following terms have been defined by the Commission in Texas Administrative Code Chapter 288.1 and refer specifically to water conservation plans, drought contingency plans, guidelines, and requirements.

Agricultural or Agriculture **-** Any of the following activities:
(A) cultivating the soil to produce crops for human food, animal feed, or planting seed or for the production of fibers;
(B) the practice of floriculture, viticulture, silviculture, and horticulture, including the cultivation of plants in containers or non-soil media by a nursery grower;
(C) raising, feeding, or keeping animals for breeding purposes or for the production of food or fiber, leather, pelts, or other tangible products having a commercial value;
(D) raising or keeping equine animals;
(E) wildlife management; and
(F) planting cover crops, including cover crops cultivated for transplantation, or leaving land idle for the purpose of participating in any governmental program or normal crop or livestock rotation procedure.

Agricultural use - Any use or activity involving agriculture, including irrigation.

Best management practices - Voluntary efficiency measures that save a quantifiable amount of water, either directly or indirectly, and that can be implemented within a specific time frame.

Conservation - Those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

Commercial use - The use of water by a place of business, such as a hotel, restaurant, or office building. This does not include multi-family residences or agricultural, industrial, or institutional users.

Drought contingency plan - A strategy or combination of strategies for temporary supply and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies. A drought contingency plan may be a separate document identified as such or may be contained within another water management document(s).

Industrial use - The use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, and the development of power by means other than hydroelectric, but does not include agricultural use.

Institutional use - The use of water by an establishment dedicated to public service, such as a school, university, church, hospital, nursing home, prison or government facility. All facilities dedicated to public service are considered institutional regardless of ownership.

Irrigation - The agricultural use of water for the irrigation of crops, trees, and pastureland, including, but not limited to, golf courses and parks which do not receive water from a public water supplier.

Irrigation water use efficiency - The percentage of that amount of irrigation water which is beneficially used by agriculture crops or other vegetation relative to the amount of water diverted from the source(s) of supply. Beneficial uses of water for irrigation purposes include, but are not limited to, evapotranspiration needs for vegetative maintenance and growth, salinity management, and leaching requirements associated with irrigation.

Mining use - The use of water for mining processes including: hydraulic use, drilling, washing sand and gravel, and oil field re-pressuring.

Municipal use - The use of potable water provided by a public water supplier as well as the use of treated sewage effluent for residential, commercial, industrial, agricultural, institutional, and wholesale uses.

Nursery grower - A person engaged in the practice of floriculture, viticulture, silviculture, and horticulture, including the cultivation of plants in containers or non-soil media, who grows more than 50 percent of the products that the person either sells or leases, regardless of the variety sold, leased, or grown. For the purpose of this definition, grow means the actual cultivation or propagation of the product beyond the mere holding or maintaining of the item prior to sale or lease, and typically includes activities associated with the production or multiplying of stock such as the development of new plants from cuttings, grafts, plugs, or seedlings.

Pollution - The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to the public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.

Public water supplier - An individual or entity that supplies water to the public for human consumption.

Residential use - The use of water that is billed to single and multi-family residences, which applies to indoor and outdoor uses.

Residential gallons per capita per day - The total gallons sold for residential use by a public water supplier divided by the by the residential population served and then divided by the number of days in the year.

Regional water planning group - A group established by the Texas Water Development Board to prepare a regional water plan under Texas Water Code, §16.053.

Retail public water supplier - An individual or entity that for compensation supplies water to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants when that water is not resold to or used by others.

Reuse - The authorized use for one or more beneficial purposes of use of water that remains unconsumed after the water is used for the original purpose of use and before that water is either disposed of or discharged or otherwise allowed to flow into a watercourse, lake, or other body of state-owned water.

Total use - The volume of raw or potable water provided by a public water supplier to billed customer sectors or nonrevenue uses and the volume lost during conveyance, treatment or transmission of that water.

Total gallons per capita per day - The total amount of water diverted and/or pumped for potable use divided by the total permanent population divided by the days of the year. Diversion volumes of reuse as defined in this chapter shall be credited against total diversion volumes for the purposes of calculating gallons per capita per day for targets and goals.

Water conservation plan - A strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water. A water conservation plan may be a separate document identified as such or may be contained within another water management document(s).

Wholesale public water supplier - An individual or entity that for compensation supplies water to another for resale to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants as an incident of that employee service or tenancy when that water is not resold to or used by others, or an individual or entity that conveys water to another individual or entity, but does not own the right to the water which is conveyed, whether or not for a delivery fee.

Wholesale use - Water sold from one entity or public water supplier to other retail water purveyors for resale to individual customers.

OTHER CONSERVATION AND REPORTING TERMINOLOGY

The following terms and meanings are commonly used by the Board and the Commission in the context of water conservation planning and reporting.

Agricultural sector - Any use or activity involving agriculture, including irrigation. Such activities are classified under the North American Industry Classification System codes for Agriculture, Forestry, Fishing and Hunting (Code 11). See *Appendix* for coded activities.

Best management practices (BMPs) - Voluntary efficiency measures that save a quantifiable amount of water, either directly or indirectly, that can be implemented within a specific time frame.

Best Management Practices Guide (BMP Guide) - A guidebook containing best management practices developed by the Board and the Commission in coordination with the Water Conservation Implementation Task Force and the Water Conservation Advisory Council. It is available at http://www.savetexaswater.org/bmp/.

Census blocks - Census blocks are subdivisions of Census tracts, areas bounded on all sides by visible features such as streets, roads, streams, and railroad tracks, and by invisible boundaries such as city, town, township, and county limits, property lines, and short, imaginary extensions of streets and roads.

Census tracts - Census tracts are small, relatively permanent statistical subdivisions of a county. The primary purpose of Census tracts is to provide a stable set of geographic units for the presentation of decennial census data. 2010 is the first decennial census for which the entire United States is covered by Census tracts.

Commercial sector - The use of water by a place of business such as a hotel, restaurant, or office building. Such facilities are included in the North American Industrial Classification System categories for construction, trade, transportation, information, and professional activities. See *Appendix* for coded activities. Commercial water use does **not** include water used for multi-family residences or agricultural, industrial, or institutional users.

Direct reuse **-** The use of recycled water for a beneficial use within a distribution, transmission, or treatment system.

gpcd - gallons per capita per day.

Group quarters **–** Group quarters include such places as college residence halls, residential treatment centers, skilled nursing facilities, group homes, military barracks, correctional facilities, and workers' dormitories.

Indirect reuse **-** The discharge of recycled water to a water source or supply with the intended purpose of augmenting the supply.

Industrial sector - The use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, and the development of power by means other than hydroelectric, but does not include agricultural use. Such facilities are included in the North American Industrial Classification System categories for mining, utilities, construction, and manufacturing. See *Appendix* for coded activities.
Institutional sector - The use of water by an establishment dedicated to public service such as a school, university, church, hospital, nursing home, prison, or government facility. All facilities dedicated to public service are considered institutional regardless of ownership. Such facilities are included in the North American Industrial Classification System categories for educational services, health care, recreation, and public administration. See *Appendix* for coded activities

Multi-family - A classification of housing where multiple separate housing units for residents are contained within one building or several buildings within one complex. A common form is an apartment building. Could include condominiums, where the units are owned individually rather than leased from a single apartment building owner.

Permanent population - That portion of the population considered residents of an area (usually for longer than six months) as counted by the decennial U.S. Census.

Reclaimed water **-** Domestic or municipal wastewater that has been treated to a quality suitable for a beneficial use, also sometimes referred to as recycled water or reuse water.

Regional water planning gallons per capita per day - The annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by the permanent resident population of the Municipal Water User Group in the regional water planning process divided by 365. Saline and reused/recycled water are not included in this volume.

Residential population **-** The permanent population residing in single-family or multi-family structures within an area. This population does **not** include group-quarters populations (jails, universities, campgrounds, etc.)

Residential sector - The water billed to single- and multi-family residences including indoor and outdoor uses. Single-family residential includes detached dwellings and duplexes. Structures with more than two dwellings such as triplexes, fourplexes, or apartment complexes are considered multi-family.

Single-family - A classification of housing where a single detached dwelling or separate house is a free-standing residential building, including duplexes.

Water loss - The difference between the input volume and the authorized consumption within a water system. Water loss consists of real losses and apparent losses.

Retail Water Providers

This section is intended to be used by retail water providers such as municipalities, water supply corporations, special utility districts, municipal utility districts, and water control improvement districts that are required to complete a water use survey, water conservation plan, conservation plan annual report or five-year implementation report. Wholesale water providers may also benefit from the guidance on water conservation plans and annual reports.

Chapter 4: Estimating Population

When developing population estimates it is best to keep in mind the end purpose, the level of accuracy required, and the resources available to water providers to calculate such estimates.

In water planning efforts, population is estimated to develop a per person water use volume (gallons per capita per day) used to

1. analyze a historical trend in the water-use efficiency of water customers,
2. establish a metric for developing and evaluating water conservation programs, or
3. develop water use projections for the system by multiplying the per-person water use times the projected populations.

Included in this guidance document are a number of basic population estimation methodologies that water systems can use. Due to the limited resources that most water utilities have at their disposal, these basic methods are suggested for the majority of the gallons per capita per day calculations. Other methods exist and can be found in the resources listed at the end of this chapter.

PERMANENT POPULATION

Population estimates are one of the greatest data challenges for water supply planners. It is critical to know how many people a utility serves and to project how many may be served in the future to ensure adequate water supply. Accurate and consistent estimates of population are a necessary component of calculating metrics such as gallons per capita per day. A number of basic methods are used for projecting and estimating current and future populations within communities. Some water systems may also be interested in taking a closer look at their temporary populations in addition to their permanent populations. Whichever method is used, it is important a utility continue to use that population estimation method as consistently as possible throughout their conservation reports.

Texas State Data Center annual population estimates

The Texas State Data Center and the Office of the State Demographer function as a distribution center of Census information, provide annual population estimates for counties and Census Places, and provide demographic-related information for Texas.

Annual population estimates for Census Places (cities and Census Designated Places) are calculated using an average of three estimation methods:

1) data on births, deaths, and elementary school enrollment,
2) counts of new housing units and demolitions, and
3) an estimate based upon the place's population ratio with the county's births, deaths, and housing units.[1]

When applicable, such annual population estimates are an excellent and easy-to-use resource.

[1] For a full description of the SDC population estimation methodology, see http://txsdc.utsa.edu/Resources/TPEPP/Estimates/2009/2009_txpopest_method.pdf

When to Use:

- When the service area boundary of the water utility corresponds closely to the political boundary of a Census Place (city or Census Designated Place).

How to Use:

- Access Texas State Data Center site at http://txsdc.utsa.edu/.
- The Texas State Data Center releases population estimates for both January 1 and July 1 dates. Generally, the July estimate is used in gallons per capita per day calculations as it is a midpoint in the year, acting as a proxy for the average population throughout the year.
- By looking at the annual estimates over a number of years, a growth trend can be established that can be compared with other methods of estimation.

Pros:

- Estimates are easy to obtain.
- Historical estimates are available for developing short, medium, and long-scale growth trends.
- High level of accuracy, particularly for up to seven years beyond the Census.

Cons:

- Water system service area must be contiguous with the political boundaries.
- In fast growing parts of the state, the strength of the Texas State Data Center estimates are in part based upon the municipality's response to an annual annexation survey[2]. The population of small cities can dramatically change with the annexation of a large subdivision; if annexation surveys are not returned, significant errors in estimation might occur.
- The opportunity for estimation errors may increase later in the decade as estimates are built upon the base Census year; the more years removed from the Census, the more opportunity for error.

Service-area boundaries and census block/tract data

When a water utility's service area does not readily conform to the political boundaries of a Census place, the estimation of population becomes more difficult. One method to estimate population served is to use the service area of the water system in conjunction with Census blocks or tracts.

When to Use:

- When the utility can utilize a geographic information system (GIS) application, such as Environmental Systems Research Institute's ArcGIS, to overlay the Census blocks and tracts with the service area boundary of the utility.

[2] Texas State Data Center Boundary and Annexation Survey

How to Use:

- The utility must first have a digital boundary of the water service area. This service area boundary may be a city boundary, district boundary, or a Certificate of Convenience and Necessity boundary from the Commission, or an area encompassing the distribution system and customers of the system.
- If the utility does not have a digital layer of their service area boundary, a number of sources exist from which it might be obtained. See section titled *Other Population Estimate Resources (page 26)* for possible sources.
- Geographic information system data for Census blocks and tracts in Texas can be obtained at the Census website[3]. Census blocks are a smaller geographic unit, so more precise data might be available at this level; however, the larger tracts may contain demographic information not collected at the block level.
- In the ArcGIS application, both the service area and the Census blocks/tracts should be activated, showing which blocks are partially or wholly within the service area. A number of methods exist for dealing with Census blocks that are only partially within the service area:
    a) For large areas with many split blocks, use a simple selection query of blocks whose centroid is inside of the service area. In this case, some split blocks will be wholly included and some wholly excluded, but in cases of many split-blocks, this is an efficient method of estimating.
    b) For staff with more geographic information system experience, the split blocks can be selected, merged, split, and remerged with the population of the area included being proportional to the area included.
    c) If the service area is relatively small or the particular Census blocks are large, then staff can utilize aerial imagery in ArcGIS via the Texas Natural Resources Information System map service[4] to determine an exact count of structures in the Census block that are within the service area.
- The sum of the Census blocks wholly within the service area boundary and that proportion of the population of blocks split by the boundary produce a population estimate for the water system.

Pros:

- Can provide a good baseline total population for an area.
- Can provide subtotals of the population served for water systems split by county, river basin, or other types of administrative boundaries.

Cons:

- Requires access to geographic information system software and knowledgeable staff.
- May not be applicable for rural water supply corporations with a Facility/Line Certificate of Convenience and Necessity service area consisting only of distribution lines down rural roads and the intermittent customers on those lines.

[3] www.census.gov
[4] www.tnris.org

Utility residential connections and people-per-household

While water systems may not know the number of people that they serve, nearly all water systems will know the number of customer accounts or meters they have. Basing the population estimates on the number of accounts gives a relatively accurate estimate of the population served and is particularly useful for years between the decennial Census. In addition, it is often useful for non-city water utilities and rural/suburban systems where significant numbers of households within the service area use private wells rather than the water system.

When to Use:

- When the utility retains a record of residential-type connections.
- When some type of base population year, such as Census, is available.

How to Use:

- A base year with a fairly reliable independent population estimate should be chosen. A Census year is often useful.
- Calculate the number of residential water connections for detached (single-family) housing units based on billing records or records of meter sizes.
- Calculate the number of attached (multi-family) housing units based on local knowledge, apartment surveys, or other methods. For the multi-family category, a count of *units* is more desirable than billing *connections* due to the fact that one connection may serve many apartments not metered individually.
- Vacancy rates for single-family houses or multi-family units could be applied to the base number of connections and units and subsequent estimates, particularly if the vacancy rates over different years have varied significantly.
- Divide the independent population estimate by the number of single-family connections and multi-family units. This ratio of people per housing unit can be used in subsequent years to estimate the population served if and when the number of connections change.
- A simplified variation of this method, particularly for systems with few multi-family complexes, is to divide the total base-year population by the single-family connections. Though this may over-estimate the people-per-single-family-household, it is an easy way to estimate the population over subsequent years using the single-family growth as a proxy for the general growth served by the utility.
- Re-calibrate the people-per-household between the decadal Census using the American Community Survey data[5] or other population estimation methods.

Pros:

- After the connection-population ratio is established in the base year, subsequent years are relatively simple to calculate.

Cons:

- A change in household size over time or a shift to relatively more multi-family units not accounted for in the count of connections may produce erroneous estimates, particularly as the estimates become more removed from the base year.

[5] www.census.gov/acs/

- The people-per-connection ratio and the resulting population estimate should be compared to other population estimates after four to five years to ensure that the calculated ratio is not deviating from the demographic trends.

Differentiating single-family population and multi-family population estimates

While a water utility may have a good estimate of total population served, the population may be split between those living in single-family houses and those living in multi-family units. Because the conservation strategies for these two populations are often quite different, it is sometimes important to be able to estimate the single- and multi-family populations.

When to Use

- When a utility serves a significant number of multi-family housing units and is capable of determining single- and multi-family gallons per capita per day values as metrics for conservation programs.
- When the utility can accurately estimate a total population and has an accurate occupancy rate and count of the number of single-family connections.

How to Use

- Two basic methods exist for differentiating single- and multi-family population estimates, depending upon the number of multi-family complexes served by the utility:
    a. Complex Survey – For utilities with a relatively small number or easily identifiable, apartment or condominium complexes, the best strategy may be to contact the complexes to obtain the number of units and average occupancy, and then multiply by the Census general number of persons-per-household or persons-per-household for renter-occupied housing units. The people per household figures can be found at the Census website www.census.gov.
    b. Population Calculation – For utilities that serve a large number of multi-family complexes, it might be easiest to estimate the multi-family population by subtracting from the total population an estimate of single-family population and group quarters population. The calculation is shown below.

Total Population
MINUS
Group Quarters Population
EQUALS
Residential Population

Residential Population
MINUS
Single-Family Population
# of Single-Family Connections * Person Per Household * Occupancy Rate
EQUALS
Multi-Family Population

Pros:

- Both methods are simple and can be used comparatively.

Cons:

- Surveys of apartment complexes may take a significant amount of time.
- In the Calculation method, if the single-family population estimate is incorrect (such as in areas with large number of vacation homes), then the multi-family estimate will be correspondingly incorrect.

TEMPORARY POPULATION

Temporary populations, or those individuals that do not reside in an area throughout the year such as tourists, commuters, and part-time residents, have generally not been included in gallons per capita per day calculations because their relative contribution to water use is difficult to quantify. However, an estimate of temporary populations may be useful to illustrate the significance of specific types of non-residential water use or in guiding the development of water conservation programs. A number of temporary populations are described below and a brief guidance for estimating such populations is provided.

Daily temporary populations

Individuals whose permanent residence is outside the water utility service area but come into the service area to work or to purchase/consume goods or services. Examples include workers, shoppers, visitors to parks, or offices. Such daytime populations can illustrate the impact of non-residents upon the utilities' resources during the day.

When to Use

- For water utilities that serve a significant amount of commercial, institutional, or industrial customers with a large labor force that commutes in from surrounding areas.

How to Use

Reference a number of federal websites that provide information on daytime populations:

- U.S. Census American Community Survey (http://www.census.gov/hhes/commuting/data/daytimepop.html)
- Census Transportation Planning Products, American Association of State Highway and Transportation Officials (http://ctpp.transportation.org)

Overnight temporary populations

This category includes individuals whose permanent residence is outside the utility service area but visit the utility service area for one or more nights. Examples include business travelers, vacation visitors (one or more nights in motel/hotels), visiting hunters, and so on.

When to Use

- When the utility serves a significant number of hotels or motels and a conservation program is being considered that needs a per-visitor metric.

How to Use

Reference a number of sources that may provide data regarding the number of overnight guests:

- Texas State Comptroller and Source Strategies, Incorporated: Texas Hotel Performance Reports (http://www.sourcestrategies.org/texas)
- Survey of hotels/motels (small service areas or non-city service areas)
- Local Chamber of Commerce

Seasonal temporary populations

Individuals whose permanent residence is outside the utility service area but reside in the utility service area for extended periods. An example is Winter Texans (four-five months in primarily recreational vehicle parks and mobile home parks).

When to Use

- For water utilities that serve a significant number of seasonal recreational vehicle parks or mobile home parks. In addition, a number of water utilities are seeing a significant amount of influx from oil and gas workers who establish recreational vehicle parks or mobile home parks when other types of housing are not available.

How to Use

- Survey of mobile home parks and recreational vehicle parks
- Local Chamber of Commerce
- Texas State Comptroller and Source Strategies, Incorporated: Texas Hotel Performance Reports (http://www.sourcestrategies.org/texas)
- Research organizations such as the Valley Markets and Tourism Research Center at the University of Texas–Pan American (www.utpa.edu/coba/tourism/)

OTHER POPULATION ESTIMATION RESOURCES

1. Texas Water Development Board, Water Use & Projections - http://www.twdb.texas.gov/waterplanning/data/projections/

2. Local Council of Government - see the Texas Association of Regional Councils (www.txregionalcouncil.org) for contact information for the appropriate council.

3. Texas State Data Center and the Office of the State Demographer - http://txsdc.utsa.edu/

4. State and Local Population Projections: Methodology and Analysis - a book by Stanley K. Smith, Jeff Tayman, and David A. Johnson (Springer, 2008).

5. Potential Sources of Service Area Boundaries in ArcGIS Format -
   - City boundaries are delineated as part of the decennial Census as shape files http://www.census.gov/geo/www/tiger/shp.html
   - Certificate of Convenience and Necessity boundaries are required for water supply corporations and investor-owned utilities but also held by many other types of utilities and are available for download at http://www.tceq.texas.gov/gis/boundary.html
   - District Boundaries are submitted to the Commission and can be downloaded at http://www.tceq.texas.gov/gis/boundary.html

- TWDB completed a statewide map of unofficial water service area boundaries in August 2011. View the technical documentation at http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1004831117_TexasWaterSystemMap.pdf. Please contact the Board's Water Use & Projections staff for a copy of the geodatabase.

For more information regarding the specifics of Population Estimation, please contact the Board's Water Use & Projections Section at 512-936-0829 or Kevin.kluge@twdb.texas.gov.

Chapter 5: Gallons Per Capita Per Day for Regional Water Planning

The Board uses a specific gallons per capita per day methodology for the regional and state water planning process. The purpose of this regional water planning gallons per capita per day is to provide a per-person water use volume based on the population-influenced residential, commercial, and institutional water use categories that can be used with projected population figures to estimate future water use. Because the regional water planning process includes separate water use categories for manufacturing, mining, and power generation, this method eliminates such identified industrial uses from the regional water planning gallons per capita per day.

DEFINITION

Regional water planning gallons per capita per day – the annual volume of water pumped, diverted, or purchased minus the volume exported (sold) to other water systems or large industrial facilities divided by 365 and divided by the permanent resident population of the Municipal Water User Group in the regional water planning process. Coastal saline and reused/recycled water is not included in this volume.

CALCULATION

Regional Water Planning Water User Group gallons per capita per day = (Net Water Use ÷ Permanent Population) ÷ 365

- Net Water Use = Total Intake minus Wholesale and Industrial Sales adjusted to match city limits or utility service-area boundaries.
    - Water User Group = cities with population greater than 500 and non-city water utilities that provide more than 280 acre-feet of water for municipal-type purposes.
    - Total Intake = total volume, whether pumped, diverted, or purchased, that is brought into a water system. Does not include saline or treated wastewater.
    - Wholesale = sales to other public water suppliers for further distribution.
    - Industrial Sales = sales with significant volumes to the city or utility for the purposes of mining, manufacturing, or power-generating activities.
- Permanent Population = Total permanent population within the water user group area: city limits for city water user groups or for non-city water user groups, the total permanent population within the service area, minus customer population within any city.

For more information regarding the specifics of how gallons per capita per day values in the regional water planning process are calculated, please contact the Board's Water Use & Projections Section at 512-936-0829 or Kevin.kluge@twdb.texas.gov.

Chapter 6: Total Gallons Per Capita Per Day

The Board and the Commission utilize a standardized methodology for determining total gallons per capita per day. Application of this methodology is intended to establish total gallons per capita per day water-use benchmarks for tracking purposes and to evaluate the effectiveness of conservation measures following their implementation.

The Board and the Commission recognize that a simple comparison of total gallons per capita per day among Texas municipal water providers may lead to inaccurate conclusions about comparative water use efficiencies among those municipal water providers. When examining the profiles of municipal water providers individually, significant differences may be found in climate, geography, source water characteristics, and service population profiles. As a metric, total gallons per capita per day has its limitations. Total gallons per capita per day takes into account all water use sectors that a system may have including residential, industrial, commercial, institutional, and agricultural water uses. This metric then divides the total use by a population number even though not all water use sectors may be population dependent. For this reason the Board and the Commission encourage water utilities to evaluate their system water use using a sector-based methodology.

Sector-based reporting can be highly beneficial to water providers by utilizing more specific detail on the water use sectors and their usage. With well-defined and consistent analysis of data and information per sector, water providers and user groups can develop effective conservation initiatives and programs.

When a utility only knows the total volume of water diverted and the population served, total gallons per capita per day is by default the single metric used to evaluate performance. However, it is important to keep in mind that the more detailed the information obtained per water use sector, the greater the understanding of how water is being used and where opportunities for conservation exist. Total gallons per capita per day can be used by a utility for internal evaluation purposes and as a planning tool in evaluating their own conservation programs and system needs. Total gallons per capita per day and population based sectors, targets, and goals should be considered by public water suppliers when developing utility profiles and water conservation plans, as required by the state.

Normalizing Gallons Per Capita Per Day Outcomes for Weather

Water suppliers often experience fluctuations in customer demand as weather changes. The degree to which hot, dry weather results in greater demand varies greatly. Assessing this weather influence is important in evaluating annual gallons per capita per day relative to conservation targets and goals. Without this consideration, a water supplier might incorrectly infer great conservation progress during a wet year and failure to conserve during hotter and drier years.

Looking for Patterns in Gallons Per Capita Per Day Outcomes

The first step in analyzing whether gallons per capita per day values should be normalized for weather is to look at the variability in annual gallons per capita per day. Many parts of Texas have experienced both extreme dry years and wetter than normal years within the past decade. A comparison of gallons per capita per day outcomes should give an indication of how much the

gallons per capita per day changes with weather. Next, a water supplier should set criteria relating to water use expectations within the range of gallons per capita per day. Factors such as average temperature or average rainfall may not be the most accurate predictors of gallons per capita per day fluctuation. An isolated large rain event during a non-growing season could inflate average annual precipitation figures and diminish the effects of an otherwise dry year on gallons per capita per day. Other available data likely provide a more accurate predictor of annual gallons per capita per day outcomes.

FACTORS PREDICTING GALLONS PER CAPITA PER DAY FLUCTUATIONS

A detailed analysis of how to normalize annual gallons per capita per day with weather was completed by the California Urban Water Conservation Council. The full report on the analysis can be found at http://www.cuwcc.org/. The analysis concluded that reference evapotranspiration and rainfall were the strongest predictors of annual gallons per capita per day. The study also found that the strongest relationship can be identified by analyzing these factors for smaller time periods than an entire year.

While this may be the best approach, several other options for water suppliers exist that will yield predictive value and require less analysis if the utility has access to the required data. Four of these options are detailed below.

1. *Evapotranspiration annual totals against annual gallons per capita per day*
   Annual evapotranspiration correlates with gallons per capita per day for water suppliers that have a summer peaking factor due to landscape irrigation. A simple comparison of annual evapotranspiration against total gallons per capita per day for the past 5 to 10 years will show this relationship. This basic information can be used to define which years may be expected to show a swing up or down in total gallons per capita per day.

2. *Annual evapotranspiration adjusted for annual rainfall*
   Rainfall may have enormous influence on water use habits in many areas. When precipitation is plentiful, water users may reduce their consumption. The degree to which this is true may vary with each supply area. If there is a strong inverse relationship between daily pumping and rainfall, then adjusting evapotranspiration for rainfall will result in better data for predicting fluctuations in annual gallons per capita per day.

3. *Annual evapotranspiration adjusted for annual effective rainfall*
   Effective rainfall is a measure of how well rain events prevented the use of supplemental irrigation. The amount of rainfall needed to eliminate irrigation of vegetation varies greatly. It is not unusual for less than half of total precipitation to be “effective” for purposes of preventing an irrigation event. Effective rainfall can be estimated for a time period by analyzing how many distinct rain events fell at least three days apart. Only that amount of rain that can be held by soil and is available to be used by plants is counted as effective for each rain event.

5. *Monthly evapotranspiration adjusted for monthly effective rainfall*
   If a utility is able to access and analyze the data, calculating monthly evapotranspiration adjusted for monthly effective rainfall is the suggested method. While it may be simpler to analyze annual data, the use of monthly weather data is more accurate.

DEFINITION

Total gallons per capita per day - the total amount of water diverted and/or pumped for potable use divided by the total permanent population divided by the days of the year. Diversion volumes of reuse as defined in Texas Administrative Code Chapter 288.1 shall be credited against total diversion volumes for the purposes of calculating gallons per capita per day for targets and goals.

CALCULATION

Total gallons per capita per day = (Total System Input ÷ Permanent Population) ÷ 365

- Total System Input = Water Produced + Wholesale Water Imported – Wholesale Exported
  - *Water Produced = Volume produced from own sources*
  - *Wholesale Water Imported = wholesale water purchased or imported from other sources into the distribution system*
  - *Wholesale Exported = Wholesale water sold or transferred out of the distribution system*
- Permanent Population = Total permanent population of service area. Includes single- and multi-family and group quarter populations.

Determine 5- and 10-year goals for total gallons per capita per day

Once a utility has identified their current base use in the total municipal use sector and their current total gallons per capita per day, they should then determine appropriate 5- and 10-year goals for total gallons per capita per day for both water use and water loss. When setting goals the utility should take into account future population growth, future infrastructure improvements, and impacts that a newly implemented conservation program may have.

Create conservation programs for total water use

There are a number of best management practices that a utility can consider incorporating into their water conservation plan to target specific water use sector customers. The websites of the Board, Commission, and the Water Conservation Advisory Council contain detailed descriptions of current best management practices. These practices range from rebate and incentive programs to regulatory and policy related practices that a utility can administer. A utility should carefully evaluate their short- and long-term needs and determine which conservation programs and best management practices would have the most benefits.

High water users

If a system is able to identify their highest water users in specific sectors, they might consider establishing a conservation program that targets those high users such as a special outreach program to the top 5 to 10 percent. These programs could include informational direct mailings, water use audits in specific facilities, or landscape irrigation audits. Often customers are not aware of the large amounts of water they are using in specific areas of the facility. An audit can identify ways to modify water use behaviors and may improve water use efficiency.

Water Loss

Once the results of a water loss audit are known and water use data have been collected, a utility should design and implement a water conservation program to identify and reduce water loss.

For more information regarding the specifics of how total gallons per capita per day values are calculated, please contact the Board's Water Conservation Division at 512-463-7988 or wcpteam@twdb.texas.gov.

Chapter 7: Determining and Evaluating Water Use in the Residential Sector

Residential sector water use is described as that water billed to single- and multi-family residences including indoor and outdoor uses. Single-family residential includes detached dwellings and duplexes. Structures with more than two dwellings, such as triplexes, fourplexes, or apartment complexes are considered multi-family.

There are many advantages to evaluating residential water use separately from the total water use of a system. When utilities separately identify residential water use, removing the water use from other sectors such as industrial, institutional, commercial, and agricultural, this provides a number that depicts the indoor and outdoor water use patterns of a system's residential customers. Residential water use can be further analyzed by season or on a year-to-year basis which in turn allows a water utility to target its conservation programs and efforts in a more efficient manner.

Identify the total water use of the residential sector

One of the first steps in evaluating water use in the residential sector is to be able to accurately identify the number of residential customers that the utility serves, including both single- and multi-family residences. The next step is to identify the total water use of both the single- and multi-family residences as a whole. When a utility has a billing system that enables them to identify their customers by type, it becomes easier to identify the total water use of single- and multi-family customers. It is important to keep in mind that the water use of the residential sector includes both indoor and outdoor water uses.

Determine the residential gallons per capita per day

The Board and the Commission utilize a standardized methodology for determining residential gallons per capita per day. Residential gallons per capita per day is a measure of the average gallons per day used by a community's residential customers. Residential gallons per capita per day takes into account the use of both single- and multi-family residences. Application of this methodology is intended to establish residential gallons per capita per day water use benchmarks for tracking purposes and to evaluate effectiveness of conservation measures subsequent to their implementation. Residential gallons per capita per day should be used by a utility for internal evaluation purposes and as a planning tool in assessing conservation programs and system needs.

A utility should employ the following definition and calculation to identify the residential gallons per capita per day once water use for the residential sector has been determined.

DEFINITION

Residential gallons per capita per day - the total gallons sold for residential use by a public water supplier divided by the residential population served and then divided by the number of days in the year. (Texas Administrative Code Chapter 288.1)

CALCULATION

Residential gallons per capita per day = (Residential Use ÷ Residential Population) ÷ 365

- Residential Use = Single-Family Use + Multi-Family Use
- Residential Population = the residential population of the service area. Includes only single- and multi-family populations.

A utility should also consider calculating residential gallons per capita per day separately for both single- and multi-family customers in order to identify differences in water use patterns and to allow for design of specifically targeted outreach programs. A utility may consider determining the multi-family population by calculating water use per unit or door. Even such a simple calculation will help in long-term programming and evaluation.

Factors that may affect residential gallons per capita per day

Residential gallons per capita per day should be evaluated internally, and ongoing comparisons should be made annually or as frequently as possible. Many factors may impact the fluctuation of residential gallons per capita per day from year to year. Factors impacting residential water use include plumbing fixtures, income, water rates, resident's age, local aesthetics, landscape watering, and conservation attitudes and awareness.

Weather is perhaps the biggest factor impacting water use, especially on a seasonal basis. A year with more precipitation than usual may drive residential water use down, whereas a hot and dry year may drive residential water use up. *Water use during a drought may be higher or lower than normal depending on implementation of, and adherence to, drought restrictions.*

When reviewing residential water use it is important to look at both base use and seasonal use. Base use is typically winter time use (December, January, and February) and seasonal use, also known as peak use, is typically during the summer (June, July, and August).

Residential base use can be indicative of indoor water use with limited outdoor water use. Seasonal use can be indicative of outdoor water use, including landscape watering, swimming pool use, and water for cooling purposes. Because of possible fluctuations in seasonal use, it is best to look at several years and monitor trend lines over time.

Once base and seasonal use levels are determined, a utility can use this information to determine the effectiveness of current conservation programs or to implement new conservation efforts.

Time series analyses indicate that the economy can also have a direct impact on residential gallons per capita per day. Consumption decreases in a downturned economy and increases when the economy is doing well.

Determine 5- and 10-year goals for the residential sector

Once a utility has identified their current base use in the residential sector and their current residential gallons per capita per day, they should then determine appropriate 5- and 10-year goals. When setting goals the utility should consider potential future population growth and future infrastructure improvements as well as impacts that a newly implemented conservation program may have on the residential sector's water usage.

Create conservation programs for the residential sector

Numerous best management practices exist that a utility can consider incorporating into their water conservation plan to specifically target residential customers. The Board, Commission, and the Water Conservation Advisory Council publish information on best management practices online. These practices range from rebate and incentive programs to regulatory and policy-related practices that a utility can administer. A utility should carefully evaluate their short- and long-term needs and determine which conservation programs and best management practices would be most beneficial.

High water users

If a system is capable of identifying their highest water users in the residential sector, they could consider establishing a conservation program that targets those high users such as a special outreach program to the top 5 to 10
percent. These programs could include informational direct mailings, indoor water use audits, or landscape irrigation audits. Often customers are not aware of the large amounts of water they are using. An audit can identify ways to modify water use behaviors and may improve water use efficiency.

Seasonal use and landscape irrigation

Depending on seasonal use data and water management concerns such as reducing peak demand, the utility may wish to ensure efficient water use in the landscape. Potential programs could include time of day and day of week watering schedules, water waste prohibitions, landscape irrigation training, irrigation audits, and workshops on water efficient landscape practices.

Guidance on measuring savings

How a utility approaches measuring savings from associated residential conservation programs can differ depending on the type of activity and anticipated savings identified in the water conservation plan and the available data. Outdoor water savings might be measured as the difference between seasonal water use or peak day use from year to year. Weather conditions are the most important factor affecting outdoor water and should also be considered in determining the effectiveness of conservation programs.

Determining water savings from indoor programs such as improvements to plumbing fixtures can be easier because of studies showing potential savings on a per unit (toilet, faucet, and showerhead) basis. Knowing the number of users per fixture can further help in determining savings.

Comparing average residential use from one year to the next on a per person or on a per customer basis is another way to estimate savings. The impact of the conservation program might also be measured not in gallons saved but in the count of literature distributed, number of audits performed, etc.

Measuring savings in the single-family classification can be viewed on a per customer basis, but measuring savings in the multi-family classification may need to be viewed differently. If a population count is not possible, use a per unit or per door count.

However savings are measured, be consistent and use the methods deemed appropriate when developing the water conservation plan.

Chapter 8: Determining and Evaluating Water Use in the Industrial Sector

Industrial sector water use is defined as the use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value. This definition also includes the development of power by means other than hydroelectric but does not include agricultural use. Such facilities are included in the North American Industrial Classification System categories for mining, utilities, construction, and manufacturing. See *Appendix* for the North American Industrial Classification System coded activities.

For a utility, water use in the industrial sector can represent a significant portion of the system's demand and consumption. Water consumption by industries can be varied in amount of use, rate of use, and opportunities for efficiency. For many industrial water users in Texas, water is an integral part of a product or a process. A major use of water is for cooling by either removing heat from processes or by providing a comfortable safe environment through air conditioning. Some industries use water as a means of conveyance or for rinsing and cleaning products and containers. Numerous industrial facilities use water for landscape irrigation. The quality of water used by industries in different processes varies widely from ultra-pure treated water to water that does not meet potable water standards.

Industrial facilities vary in the types of water uses, the size of facilities, and the types of activities and processes that take place. For this reason it is difficult to compare one industrial customer to another; however, it may be possible to establish similar conservation programs and activities for a variety of industrial customers. In many industries, the water used to produce a product may be divided by the output to calculate the gallons per unit of production. Each industrial water user should evaluate water use and efficiency potential at its own facility.

Identify the total water use of the industrial sector

One of the first steps in evaluating water use in the industrial sector is to be able to accurately identify the amount of water used for processing. The next step would be to determine the amount of water used for cooling, irrigation, and other industry practices. When a utility has a billing system that enables identification of customers by type, it becomes easier to calculate the total water use of industrial customers as a whole. It is important to note that the water use of the industrial sector may include both indoor and outdoor water uses.

Consider appropriate metrics for evaluating water use in the industrial sector

Once a utility establishes industrial sector water use, work can begin with industrial water users to establish metrics that will best define the water use efficiencies for each water user. Industrial use is not population dependent and therefore a gallons per capita per day metric would not be appropriate nor would it provide any meaningful information.

One standard and useful industrial metric would be unit of production. Most industry is measured by the volume of material processed or produced. In some cases, the logical process measure is input. In the case of a refinery that processes crude oil to produce a variety of hydrocarbon-based products, the practical metric might be gallons of water used per barrel of oil

refined. In other cases, the process measure is output. The practical metric for a manufacturing plant that produces widgets might be gallons of water used per number of widgets produced. A company that produces paper products might logically use a metric of gallons of water per ton of paper produced.

Once the proper metric is designed and implemented by the utility and the industrial user, routine data collection can begin to track that metric. While it might seem practical to have a pre-defined metric for each North American Industrial Classification System code, the reality is that operations that share the same code will not necessarily have the same processes and equipment, so each user must determine the best metric for measuring use and efficiency.

Factors that may affect industrial use

The primary categories of industrial water use are cooling, process use, and steam generation. Not only do industries use a lot of water, but they use a lot of energy. Reducing energy usage will also reduce water usage. A thorough audit of energy and water consumption is needed to determine how the industry can be more efficient. An in-depth audit is no small feat and should be comprehensive. Technically experienced personnel should perform water budget and process analyses and oversee development of cost-effective strategies to reduce water and energy use.

Consider establishing 5- and 10-year goals for the industrial sector

Once a utility has identified their current base use in the industrial sector, they should determine appropriate 5- and 10-year goals. When setting these goals, the utility should consider future needs of the industry related to potential growth, innovative technologies for water use efficiency, and impacts that a conservation program may have on the industrial sector's water usage.

Identify high users in the industrial sector and conduct an audit

If a system is capable of identifying their highest water users in the industrial sector, they should consider establishing a conservation program to offer or even require industrial audits of those high users. Customers may be aware of the large amounts of water they are using for industry processes but may lack the knowledge of what conservation practices they could use to reduce their water use. Through an audit, a customer can learn important methods for modifying their water use behavior, using water more efficiently, utilizing alternate sources of water, or even identifying alternatives to using water. The industrial user might solicit help from the utility or an outside source to help conduct a survey and identify opportunities for water conservation. From this survey or audit, internal metrics and controls might be established that will monitor use and identify waste.

Create conservation programs for the industrial sector

There are a number of best management practices that a utility can consider incorporating into their water conservation plan to specifically target industrial customers. The Board, Commission, and the Water Conservation Advisory Council publish information on best management practices online. The best management practices range from rebate and incentive programs to regulatory and policy related practices that a utility can administer. A utility should carefully evaluate their short- and long-term needs to determine which conservation program(s) and best management practices would have the most positive impacts. A utility interested in developing a

conservation program with their industrial customers may wish to consider available resources, if any, such as staff, time, and expertise, as well as the volume of water use and potential benefits. Any program and activities developed could vary depending on those factors.

A few examples of conservation programs for industrial customers are listed below.

1. Perform an indoor audit/evaluation of each building to determine water use efficiency.
2. Perform an irrigation audit/evaluation to determine watering efficiency.
3. Provide free or low-cost upgrades to existing fixtures and appliances when a need is determined after performing the evaluations.

Guidance on measuring savings

The utility should determine if implementation of a particular best management practice to achieve water savings will be cost effective. The analysis should determine the cost effectiveness for the industrial water user including any cost savings that might accrue in addition to reduced direct costs associated with reduced water use. Many operating procedures and controls that improve water use efficiency should be implemented simply as a matter of good practice. In other cases the industrial user may decide to implement best management practices based on non-cost factors such as public goodwill. In evaluating equipment and process additions or changes, the utility should evaluate making capital improvement decisions based on industry specific criteria.

Chapter 9: Determining and Evaluating Water Use in the Commercial Sector

Commercial sector water use is described as the use of water by a place of business such as a hotel, restaurant, or office building. Such facilities are included in the North American Industrial Classification System categories for construction, trade, transportation, information, and professional activities. See *Appendix* for coded activities. Commercial water use does not include water used by multi-family residences or agricultural, industrial, or institutional users. The commercial sector is an integral part of the local economy, and for a utility, great opportunity exists for improving water efficiency in the commercial business sector.

Identify the total water use of the commercial sector

One of the first steps in evaluating water use in the commercial sector is to accurately identify the commercial customers currently served by the utility. The North American Industry Classification System codes are a good resource to begin with and should be used to identify the businesses that are considered commercial. The next step would be to determine the amount of water used by each commercial customer. Such water use may include cooling, irrigation, kitchen, bathroom, and other uses. When a utility has a billing system that enables identifying commercial customers by type, it becomes easier to identify the total water use of commercial customers as a whole. It is important to remember that the water use of the commercial sector may include both indoor and outdoor water uses.

Consider appropriate metrics for evaluating water use in the commercial sector

The water use of commercial businesses may be indirectly related to population of an area, but gallons per capita per day is likely not the best indicator of how efficiently water is used by the businesses. Because of the wide variety of types of businesses that fall within this sector, it can be challenging to identify a metric for measuring water use and efficiency in the commercial sector. The time required for this effort depends on the size of your utility and your type of billing system. It should be possible to work with similar groups of businesses or business associations to develop the best metrics.

The metrics for hotels and motels might be gallons of water used per occupied room per day. Restaurants might decide to use gallons per customer metric where average daily water use is divided by the average number of customers served during a single day. Retail shops might use gallons of water used per employee per day.

Factors that may affect commercial use

Factors that may affect commercial water use are those typically associated with the type of business being operated. Businesses that provide water to the public via plumbing fixtures such as restaurants and hotels would be subject to factors similar to those affecting residential customers; weather, income, watering restrictions, and types of plumbing fixtures installed in the building will affect the amount of water used. Businesses such as golf courses and nurseries will mainly be affected by weather conditions. Seasonal fluctuations and watering restrictions can have a huge impact on water use as well.

In new developments, temporary construction water use can be a significant percentage of total water use and the uses that fall in that category can include temporary irrigation, road construction, and building construction. The temporary irrigation can be substantial if there are strict pollution prevention ordinances that require establishment of vegetation within a few weeks of the completion of construction at a disturbed site.

Consider establishing 5- and 10-year goals for the commercial sector

Once a utility has identified their current base use in the commercial sector, they should determine appropriate 5- and 10-year goals. When setting goals, the utility should take into account the future population growth, future infrastructure improvements, and impacts that a conservation program may have on the commercial sector's water usage.

Identify high users in the commercial sector and conduct an audit

If a system is capable of identifying their highest water users in the commercial sector, they should consider establishing a conservation program to offer or even require commercial audits of those high users. Customers may be aware of the large amounts of water they are using for commercial businesses, but may lack the knowledge of what conservation practices they can use to reduce their water use. Through an audit, a customer can learn important methods for modifying their water use behavior, using water more efficiently, or utilizing alternative sources of water. The business might solicit help from the utility or some outside source to help conduct a survey and identify opportunities for water conservation. From this survey or audit, internal metrics and controls might be established that serve to monitor use and identify waste.

Create conservation programs for the commercial sector

A utility can consider incorporating a number of best management practices into their water conservation plan to specifically target commercial customers. Those best management practices can be found online through the Board, Commission, or the Water Conservation Advisory Council. The best management practices range from rebate and incentive programs to regulatory and policy type practices that a utility can administer. A utility should carefully evaluate their short- and long-term needs to determine which conservation programs and best management practices have the most positive impacts. A utility interested in developing a conservation program with their commercial customers may wish to consider available resources, if any, such as staff, time and expertise, as well as the volume of water use and potential benefits. Any program and activities developed could vary depending on those factors. Examples of conservation program practices for commercial customers are listed below:

1. Perform an indoor audit/evaluation to determine water use efficiency
2. Perform an irrigation audit/evaluation to determine watering efficiency
3. Provide free or low cost upgrades to existing fixtures and appliances when a need is determined after performing the evaluations

Guidance on measuring savings

The utility should determine if implementation of a particular best management practice to achieve water savings will be cost effective. The underlying concept is a comparison, usually expressed in dollars, of the inputs of any action with the outcomes. In evaluating water conservation efforts, the decisions center on comparing the costs of implementing a program

against the “costs of conserved water” or the “avoided costs” of acquiring new sources of water. In the strictest sense, if the analysis shows that the water user will gain positive value (benefit cost) or that the costs of one option are less than the costs of another (cost effectiveness), then the conservation program should be implemented.

The challenge is to conduct an analysis that reflects real life situations and is thorough but still understandable and usable. It is important for the analysis to consistently address the costs of implementing a conservation program to the costs of water saved or deferred. Detailed guidance on measuring water savings can be found online at *http://www.twdb.texas.gov/conservation/municipal/plans/doc/WCITFBMPGuide.pdf*.

Chapter 10: Determining and Evaluating Water Use in the Institutional Sector

Institutional sector water use is described as the use of water by an establishment dedicated to public service such as a school, university, church, hospital, nursing home, prison, or government facility. All facilities dedicated to public service are considered institutional regardless of ownership. Such facilities are included in the North American Industrial Classification System categories for educational services, health care, recreation, and public administration. See *Appendix* for coded activities. Within a municipality, water use in the institutional sector can often be difficult to measure and can represent a significant portion of a utility's water usage.

Identify the total water use of the institutional sector

One of the first steps in evaluating water use in the institutional sector is to accurately identify the institutional customers currently served by the utility. The North American Industry Classification System codes are a good resource to begin with and should be used to identify businesses that are considered institutional. Another resource to reference is the U.S. Census which provides a city's residential institutions population (dormitories, prisons, military bases, etc.) in the U.S. Census "Group Quarters" section. Institutions such as churches and hospitals generally have no resident population. The next step would be to determine the amount of water used by each customer for cooling, irrigation, kitchen, bathroom, and other uses. When a utility has a billing system that enables identification of customers by type, it becomes easier to identify the total water use of institutional customers as a whole. It is important to note that the water use of the institutional sector may include both indoor and outdoor water uses.

Consider appropriate metrics for evaluating water use in the institutional sector

Institutions may be directly or indirectly related to the population of an area so gallons per capita per day is not likely to be the best indicator of how efficiently water is used. However, those institutions providing long-term housing may find use of gallons per capita per day to be the best indicator of efficiency.

Because of the wide variety of the types of institutions that fall within this sector, it can be challenging to identify a metric for measuring water use and efficiency. The time required for this effort depends on the size of the utility and the type of billing system.

The metric for hospitals might be gallons of water used per occupied room per day. Universities and schools might decide to use a gallons of water per student metric where the average daily water use is divided by the average number of students served during a single day. Prisons might consider using a residential gallons per capita per day metric to account for their long-term housing.

Factors that may affect institutional use

Factors that affect institutional water use will usually be associated with the number of people living in or attending the facility. When an institution is at full capacity, indoor water use will be higher than when the institution is not fully occupied. Evaluating indoor water use will help the institution determine the efficiency of the plumbing fixtures, laundry appliances, kitchen appliances, and other equipment to determine where upgrades might be needed. Outdoor use should be evaluated as to its significance within total water use.

Consider establishing 5- and 10-year goals for the institutional sector

Once a utility has identified their current base use in the institutional sector they should determine appropriate 5- and 10-year goals. When setting goals the utility should take into account potential future population growth and infrastructure improvements as well as impacts that a conservation program may have on the institutional sector's water usage.

Identify high users in the institutional sector and conduct an audit

If a system is capable of identifying their highest water users in the institutional sector, they should consider establishing a conservation program to offer or even require audits of those high users. Often customers are not aware of the large amounts of water they use. An audit can identify important methods for modifying water use behavior or for using water more efficiently. The survey or audit should enable the institution to first evaluate important water uses and then to define water conservation opportunities. Establishing a water conservation program outlines the steps to be taken and the identification of targets and goals that can be established to improve water use efficiencies.

Create conservation programs for the institutional sector

There are a number of best management practices that a utility can consider incorporating into their water conservation plan to specifically target institutional customers. Those best management practices can be found online through the Board, Commission, or the Water Conservation Advisory Council. The best management practices range from rebate and incentive programs to regulatory and policy type practices that a utility can administer. A utility should carefully evaluate their short- and long-term needs to determine which conservation programs and best management practices have the most benefits to the system. A utility interested in developing a conservation program with their institutional customers may wish to consider available resources, if any, such as staff, time and expertise, as well as the volume of water use and potential benefits.

Examples of types of conservation programs for institutional customers are listed below.

1) Perform an indoor audit/evaluation of each building to determine water use efficiency
2) Perform an irrigation audit/evaluation to determine watering efficiency
3) Provide free or low cost upgrades to existing fixtures and appliances when a need is determined after performing the evaluations

Guidance on measuring savings

The utility should determine if implementation of a particular best management practice to achieve water savings will be cost effective. The underlying concept is a comparison of the inputs of any action with the outcomes, usually expressed in dollars. In evaluating water conservation efforts, the decisions center on comparing the costs of implementing a program against the "costs of conserved water" or the "avoided costs" of acquiring new sources of water. In the strictest sense, if the analysis shows that the water user will gain positive value (benefit-cost) or that the costs of one option are less than the costs of another (cost effectiveness), then the conservation program should be implemented.

The challenge is to make an analysis that reflects real life situations and is thorough but still understandable and usable. It is important for the analysis to consistently address the costs of implementing a conservation program to the costs of water saved or deferred. Detailed guidance on measuring water savings can be found online at the Board's *Best Management Practices Guide: Cost-Effectiveness Analysis for Municipal Water Users at* *http://www.twdb.texas.gov/conservation/municipal/plans/doc/WCITFBMPGuide.pdf*.

Chapter 11: Determining and Evaluating Water Use in the Agricultural Sector

Agricultural sector water use is described as any use or activity involving agriculture, including irrigation. Such activities are defined in the Commission's Chapter 288 definitions found in Chapter 3 of this document. Another resource describing these activities is the North American Industry Classification System codes for Agriculture, Forestry, Fishing, and Hunting (Code 11). See *Appendix* for coded activities. Within a utility's customer base, the agricultural sector can prove to be a distinctive water using group where unique opportunities exist to develop water conservation programs for improving water use efficiency.

Identify the total water use of the agricultural sector

By identifying agricultural water use, a municipal provider will often be able to identify the largest volume customers. Programs can then be tailored to assist these entities in reducing their use and/or curtailing non-essential use during times of water shortages or mainline breaks. One of the first steps in evaluating water use in the agricultural sector is to be able to accurately identify the number of agricultural customers that the utility serves, which may include nursery growers, irrigation customers, livestock producers, and others. Agricultural water customers may utilize multiple sources of water including potable, raw, reuse, or groundwater. A utility may need to survey agricultural water users to determine estimates of alternate water source use.

Consider appropriate metrics for evaluating water use in the agricultural sector

Once the water use for the agricultural sector is determined, a utility might calculate the volume of water used per unit of production, if available, for each entity.

Examples

Livestock: Gallons per head of cattle
Nursery: Gallons per square foot of nursery space, or gallons per container size
Crops: Acre-inches per acre, or acre-feet per acre

Sample Calculations

Livestock Use (gallons/head) = Annual Use (Gallons) ÷ Size of Herd (Head)
Nursery Use (gallons/container) = Annual Use (Gallons) ÷ Number of 1 gallon containers[6]
Crop Use (acre-inches/acre) = Annual Use (Gallons) ÷ 27,154 (gallons/Acre-Inch) ÷ Acres

Factors that may affect agricultural water use

Many factors may impact the fluctuation of agricultural use by entity from year to year including the economy, market prices, and water rates among others. Seasonal weather conditions are perhaps the biggest factor that will impact water use. A wet year with more precipitation than usual may drive agricultural water use down, whereas a hot and dry year may necessarily drive agricultural water use up. Water use during a drought may be higher or lower than normal

[6] Due to the differences in size of containers used in greenhouse and nursery horticultural operations, separate metrics may be necessary to evaluate water use per 1 gallon container versus 2, 3, 5, or 10 gallon containers unless the metric used is gallons per square foot of nursery space. The crop use metric could alternatively be used, inches per acre, for nursery operations.

depending on implementation of, and adherence to, drought restrictions. Because of possible fluctuations in seasonal use it is best to look at several years and monitor trend lines over time. Comparisons between agricultural water users should be avoided. Instead, entities should be compared against themselves over time from year to year or month to month. Evaluating changes in seasonal water use may improve implementation and effectiveness of conservation programs and efforts as well.

When reviewing agricultural water use it is important to look at all sources of water and water rates. Entities receiving potable water may be better served by raw water or reclaimed water, if available, depending on the dynamics and location of their operation.

Consider establishing 5- and 10-year goals for the agricultural sector

Once a utility has identified their current agricultural sector use, they should determine appropriate 5- and 10-years goals for the sector. When setting goals the utility should take into account potential future land-use changes, population growth, and infrastructure improvements, as well as impacts that a newly implemented conservation program may have on the agricultural sector's water usage.

Identify high users in the agricultural sector and conduct a survey or audit

If a system is capable of identifying their highest water users in the agricultural sector, they should consider establishing a conservation program to offer audits or educational programs to those high users. Through an educational program or a water use audit, a customer may learn new water conserving technologies or identify money-saving methods by using water more efficiently.

Create conservation programs for the agricultural sector

There are a number of best management practices that a utility can consider incorporating into their water conservation plan to specifically target agricultural customers. Those best management practices can be found online through the Board, Commission, or the Water Conservation Advisory Council. The best management practices range from rebate and incentive programs to regulatory and policy related practices that a utility can promote. A utility should carefully evaluate their short- and long-term needs to determine which conservation programs and best management practices would have the most positive impacts. A utility interested in developing a conservation program with their agricultural customers may wish to consider available resources, if any, such as staff, time, and expertise as well as the volume of water use and potential benefits. Any program and activities developed could vary depending on those factors.

Guidance on measuring savings

Each agricultural best management practice includes a method for determining water savings. Utilities can work with irrigators and agricultural operations to estimate the water saved through the implementation a specific best management practice. These savings can form the basis for continuous development of 5- and 10-year water conservation goals.

Chapter 12: Determining and Evaluating Water Loss

System water loss refers to the difference between how much water is put into a water distribution system and how much water is verified to be used for consumption. Water loss includes theft, under-registering meters, billing adjustments and waivers, main breaks and leaks, storage tank overflows, and customer service line breaks and leaks. High volumes of water loss impact utility revenues and increase the use of water resources, especially during drought.

Identify total water loss in a municipal water system

The purpose of a water loss audit is to enable an entity to identify significant losses in their system. This allows the entity to determine long-term infrastructure needs and save money by establishing an efficient repair and maintenance program. Water loss audits conserve the state's water resources by reducing water loss occurring in the systems of drinking water utilities. Most utilities are required to submit a water loss audit to the Board every five years; however, Board loan recipients are now required to submit a water loss audit annually. It is advisable for all utilities to conduct annual water loss audits to facilitate tracking water loss and identifying areas of potential improvement or concern. With correct data a utility can identify if their water loss is "real" (leaks and breaks) or "apparent" (meter inaccuracy, etc.). This information can be used to identify proper activities to reduce loss that should be included in the entity's water conservation plan.

Determine 5- and 10-year goals for total water loss

Once a utility has identified their base water loss in the utility profile, they should determine appropriate 5- and 10-years goals for reducing water loss from both gallons per capita per day and percent of water loss based on identified water loss activities. When designing goals, the utility should consider potential future population growth and infrastructure improvements, as well as impacts that a newly implemented conservation program may have on municipal water usage.

Create conservation programs for total water loss

A number of best management practices exist that a utility can consider incorporating into their water conservation plan to specifically target water loss. Those best management practices can be found online through the Board, Commission, or the Water Conservation Advisory Council. Practices include improvements in customer billing and accounting, testing and replacement of customer meters, and proactive location and repair of leaks. A utility should carefully evaluate their short- and long-term needs and determine which water loss programs and best management practices would have the most positive impacts.

Guidance on measuring savings

A utility should determine if implementation of a specific best management practice to reduce water loss will be cost effective. The underlying concept is a comparison of the inputs of any action with the outcomes, usually expressed in dollars. In evaluating water loss efforts, the decisions center on comparing the costs of implementing a program against the "costs of conserved water" or the "avoided costs" of acquiring new sources of water. For water loss, a utility may wish to compare the value of that water at the retail cost for apparent loss and at the

production cost for real loss. Many times a meter replacement program is advisable because it can increase revenue, pay for itself in a short period of time, and help fund other water loss and conservation programs. In the strictest sense, if the analysis shows that the water user will gain positive value (benefit cost) or that the costs of one option are less than the costs of another (cost effectiveness), then the program should be implemented.

Self-Supplied Agricultural Entities

This section is intended to be used by self-supplied agricultural entities such as irrigation districts that are required to complete a water conservation plan, conservation plan annual report, or five-year implementation report.

Chapter 13: Determining and Evaluating Water Use in a Self-Supplied Agricultural Operation

Agricultural sector water use is described as any use or activity involving agriculture, including irrigation.

DEVELOPING A WATER CONSERVATION PLAN

Texas Administrative Code Chapter 288 requires the holder of an existing permit, certified filing, or certificate of adjudication for the appropriation of surface water in the amount of 10,000 acre-feet or more for agricultural use to develop and submit a water conservation plan every five years. Additionally, water rights applicants for agricultural use may be required to submit a water conservation plan with their application.

There are three categories of agricultural water conservation plans:

1. For an individual agricultural user other than irrigation (livestock operations, aquaculture, other), the water conservation plan must include a description of the use of the water in the production process including how the water is diverted and transported from the supply source(s), how the water is utilized in the production process, and the estimated quantity of water consumed in the production process and therefore unavailable for reuse, discharge, or other means of disposal. The plan also must include specific, quantified 5- and 10-year targets for water savings and the basis for the development of such goals. Additional requirements include:

    - a description of the device(s) and/or method(s) within an accuracy of ±5.0 percent to be used to measure and account for the amount of water diverted from the source of supply,
    - leak detection, repair, and accounting for water loss in the water distribution system,
    - application of state-of-the-art equipment and/or process modifications to improve water use efficiency, and
    - any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

2. For an individual irrigation user, the water conservation plan must include a description of the irrigation production process which shall include but is not limited to the type of crops and acreage of each crop to be irrigated, monthly irrigation diversions, any seasonal or annual crop rotation, and soil types of the land to be irrigated as well as a description of the irrigation method or system and equipment including pumps, flow rates, plans, and/or sketches of the system layout. The plan also must include specific, quantified 5- and 10-year targets for water savings including, where appropriate, quantitative goals for irrigation water use efficiency and a pollution abatement and prevention plan. Additional requirements include:

    - a description of the device(s) and/or methods within an accuracy of ±5.0 percent, to be used to measure and account for the amount of water diverted from the source of supply,

- water-conserving irrigation equipment and application system or method including, but not limited to, surge irrigation, low pressure sprinkler, drip irrigation, and non-leaking pipe,
- leak-detection, repair, and water-loss control,
- scheduling the 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 including, but not limited to, land leveling, furrow diking, terracing, and weed control,
- tailwater recovery and reuse, and
- any other water conservation practice, method, or technique which the user shows to be appropriate for preventing waste and achieving conservation.

3. For a system providing agricultural water to more than one user, the water conservation plan must include a system inventory for the supplier's:

    - structural facilities including the supplier's water storage, conveyance, and delivery structures,
    - management practices including the supplier's operating rules and regulations, water pricing policy, and a description of practices and/or devices used to account for water deliveries, and
    - a user profile including size of the service area in square miles, the number of customers taking delivery of water by the system, the types of crops, the types of irrigation systems, the types of drainage systems, and total acreage under irrigation, both historical and projected.

The plan also must include specific, quantified 5- and 10-year targets for water savings including maximum allowable losses for the storage and distribution system. Additional requirements include:

- a description of the practice(s) and/or device(s) which will be utilized to measure and account for the amount of water diverted from the source(s) of supply,
- a monitoring and record management program of water deliveries, sales, and losses,
- a leak-detection, repair, and water loss control program,
- a program to assist customers in the development of on-farm water conservation and pollution prevention plans and/or measures,
- a requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan (by either ordinance, resolution, or tariff) and including any contract extension that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements in this chapter. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with applicable provisions of this chapter,

- official adoption of the water conservation plan and goals, by ordinance, rule, resolution, or tariff, indicating that the plan reflects official policy of the supplier,
- any other water conservation practice, method, or technique which the supplier shows to be appropriate for achieving conservation, and
- documentation of coordination with the regional water planning groups to ensure consistency with appropriate approved regional water plans.

DETERMINING AND EVALUATING WATER USE

One of the first steps in evaluating water use in the agricultural sector is to measure the total volume of water being applied within the aforementioned ±5.0 percent accuracy guidelines.

Once the total water use for the agricultural sector is determined, the agricultural water user should calculate the volume of water used per unit of production for each entity.

Examples

Livestock: Gallons per head of cattle
Nursery: Gallons per square foot of nursery space or gallons per container size
Crops: Acre-inches per acre or Acre-feet per acre

Sample Calculations

Livestock Use (gallons/head) = Annual Use (Gallons) ÷ Size of Herd (Head)
Nursery Use (gallons/container) = Annual Use (Gallons) ÷ Number of 1 gallon containers[7]
Crop Use (acre-inch/acre) = Annual Use (Gallons) ÷ 27,154 (gallons/Acre-Inch) ÷ Acres

Many factors may impact the fluctuation of agricultural use by entity from year to year such as the economy, market prices, and water rates, among others. Seasonal weather conditions are perhaps the biggest factor impacting water use. A wet year with more precipitation than usual may drive agricultural water use down, whereas a hot and dry year may necessarily drive agricultural water use up. Water use during a drought may be higher or lower than normal depending on implementation of, and adherence to, drought restrictions. Because of possible fluctuations in seasonal use it is best to look at several years and monitor trend lines over time. Evaluating changes in seasonal water use may improve implementation and effectiveness of conservation programs and efforts.

When reviewing agricultural water use it is important to look at all sources of water and water rates. Some entities receiving potable water may be better served by raw water or reclaimed water, if available, depending on the dynamics and location of their operation.

[7] Due to the differences in size of containers used in greenhouse and nursery horticultural operations, separate metrics may be necessary to evaluate water use per 1 gallon container versus 2, 3, 5, or 10 gallon containers unless the metric used is gallons per square foot of nursery space. The crop use metric could alternatively be used, inches per acre, for nursery operations.

Developing Conservation Activities and Implementing Best Management Practices

Crop irrigation accounts for the majority of agricultural water use in Texas. According to the 2012 State Water Plan, irrigated agriculture uses over half of the water in Texas; however, irrigation demand is expected to decline largely due to anticipated natural improvements in irrigation efficiency, the loss of irrigated farmland to urban development in some regions, and the economics of pumping water from increasingly greater depths. The amount of water used in irrigation of a specific crop or in an agricultural practice varies with the location, climate, crop types, local cropping practices, types of irrigation systems, and institutional constraints. Likewise, the amount of water saved by implementing a best management practice for a particular crop or practice will also vary. Best management practices for agricultural water users are combinations of site-specific management, educational, and physical practices that have proven to be effective, are economical, and conserve water. Best management practices provide a means for measuring the success of water conservation programs, their costs, and schedules of implementation.

Best management practices have been developed for:

- agricultural water use management,
- land management systems,
- on-farm water delivery systems,
- water district delivery systems, and
- tailwater recovery and reuse systems.

The Best Management Practices Guide can be found by visiting the websites of the Board, the Commission, or the Water Conservation Advisory Council.

Submitting Five-Year Implementation Reports

Texas Administrative Code Chapter 288 requires the holder of an existing permit, certified filing or certificate of adjudication for the appropriation of surface water in the amount of 10,000 acre-feet or more for irrigation uses to submit a water conservation implementation report every five years. The implementation report is a way for an entity to track and measure the effectiveness in their water conservation program and activities.

The five-year implementation report must contain:

1) the list of dates and descriptions of the conservation measures implemented,
2) data about whether or not targets in the plans are being met,
3) the actual amount of water saved, and
4) an explanation, if needed, as to why any of the targets are not being met, including any progress made on that particular target.

SUBMITTING CONSERVATION ANNUAL REPORTS

Texas Water Code: 16.402(b)
Texas Administrative Code: 31 Texas Administrative Code Chapter 363, Subchapter A, Rule 363.15
Who is required to submit: Entities who are currently required to have a water conservation plan on file with the Board or Commission are required to submit a conservation annual report.
Report goes to: The conservation annual report should be submitted to the Board.
When to submit: The conservation annual report should be submitted annually by May 1.
Purpose and Function: The purpose of a conservation annual report is for the agricultural water user to internally collect and track key water use data as well as measure and evaluate their conservation program and activities. The conservation annual report shall report annual progress in implementing each of the minimum requirements in the water conservation plan. As the report form is completed, an entity should review their water conservation plan to determine if they are making progress towards meeting stated goals.

Self-Supplied Industrial Entities

This section is intended to be used by self-supplied industries that are required to complete a water use survey, water conservation plan, conservation plan annual report, or five-year implementation report.

Chapter 14: Determining and Evaluating Water Use in a Self-Supplied Industrial Operation

Developing a Water Conservation Plan

Texas Administrative Code Chapter 288 requires the holder of an existing permit, certified filing, or certificate of adjudication for the appropriation of surface water in the amount of 1,000 acre-feet or more for industrial uses to submit a water conservation plan to the Commission every five years. Additionally, water rights applicants for industrial use may be required to submit a water conservation plan with their application.

A water conservation plan for industrial use must include a description of the use of the water in the production process, including how the water is diverted and transported from the supply source(s), how the water is utilized in the production process, and the estimated quantity of water consumed in the production process and therefore unavailable for reuse, discharge, or other means of disposal. The plans also must include specific, quantified 5- and 10-year targets for water savings and the basis for the development of such goals. Additional requirements include:

- a description of the device(s) and/or method(s) within an accuracy of ±5.0 percent to be used to measure and account for the amount of water diverted from the source of supply,
- leak detection, repair, and accounting for water loss in the water distribution system,
- application of state-of-the-art equipment and/or process modifications to improve water use efficiency, and
- any other water conservation practice, method, or technique that the user shows to be appropriate for achieving the stated goal(s) of the water conservation plan.

Determining and Evaluating Water Use

One of the first steps in evaluating water use in the industrial sector is to accurately identify the amount of water used for processing. The next step is to determine the amount of water used for cooling, irrigation, and other industry processes. It is important to remember that water use may include both indoor and outdoor water uses. Once total water use is established, an entity can begin to establish metrics to best define the water use efficiencies for the industrial operation.

One standard and useful industrial metric would be unit of production. Most industry is measured by the volume of material processed or produced. In some cases, the logical process measure is input. In the case of a refinery that processes crude oil to produce a variety of hydrocarbon-based products, the practical metric might be gallons of water used per barrel of oil refined. In other cases, the process measure is output. The practical metric for a manufacturing plant that produces widgets might be gallons of water used per number of widgets produced. A company that produces paper products might logically use a metric of gallons of water per ton of paper produced.

Once a metric is established, routine data collection can begin to track that metric. While it might seem practical to have a pre-defined metric for each North American Industry Classification System code, the reality is that operations that share the same code will not necessarily have the

same processes and equipment, so each user must determine the best metric for measuring use and efficiency.

The biggest factors that affect industrial water use are cooling, process use, and steam generation. Not only do industries use lots of water, but they use lots of energy. Reducing energy usage will also reduce water usage. A thorough audit of energy and water consumption is needed to determine how the industry can be more efficient. An indepth audit is not a small task and should be comprehensive. Technically experienced personnel should perform water budget and process analyses and oversee development of cost-effective strategies to reduce water and energy use.

Developing Conservation Activities and Implementing Best Management Practices

For many industrial water users in Texas, water is an integral part of a product or process. However, wide variation exists in the types and amounts of water uses, the size of facilities, and the types of activities at different industrial facilities. Each industrial water user should evaluate water use and efficiency potential at its facility. Industrial water audits should be thought of as the initial best management practice for industrial water users to expedite identification of opportunities to improve water use efficiency at their facility. Facility water audits include accurate measurement of all water entering the facility, the inventory and calculation of all onsite water uses, and any unused water sources, calculation of water related costs, and identification of potential water efficiency measures. The information from the water audit should then form the basis for a comprehensive conservation program to implement specific best management practices. The Best Management Practices Guide can be found online through the Board, Commission, or the Water Conservation Advisory Council.

Submitting Five-Year Implementation Reports

Texas Administrative Code Chapter 288 requires the holder of an existing permit, certified filing or certificate of adjudication for the appropriation of surface water in the amount of 1,000 acre-feet or more for industrial uses to submit a water conservation implementation report every five years. The implementation report is a way for an entity to track and measure the effectiveness in their water conservation program and activities. The report must contain:

1. the list of dates and descriptions of the conservation measures implemented,
2. data about whether or not targets in the plans are being met,
3. the actual amount of water saved, and
4. if the targets are not being met, an explanation as to why any of the targets are not being met, including any progress on that particular target.

Submitting Conservation Annual Reports

Texas Water Code: 16.402(b)

Texas Administrative Code: 31 Texas Administrative Code Chapter 363, Subchapter A, Rule 363.15

Who is required to submit: Entities who are currently required to have a water conservation plan on file with the Board or Commission are therefore required to submit a conservation annual report.

Report goes to: The conservation annual report should be submitted to the Board.
When to submit: The report should be submitted annually by May 1.
Purpose and Function: The purpose of a conservation annual report is for the industrial water user to internally collect and track key water use data as well as measure and evaluate their conservation program and activities. The conservation annual report shall report annual progress in implementing each of the minimum requirements in the water conservation plan. As the report form is completed, an entity should review their water conservation plan to see if they are making progress towards meeting stated goals.

WATER USE SURVEY

Texas Water Code: 16.012
Texas Administrative Code: 31 Texas Administrative Code Chapter 358, Subchapter B, Rule 358.5
Who is required to submit: Entities using surface water or groundwater for industrial, power generation, or mining purposes are required by Texas Water Code Section 16.012(m) to submit a water use survey.
Report goes to: The water use survey should be submitted to the Board.
When to submit: The water use survey should be submitted every year by March 1.
Purpose and Function: The Board is legislatively directed to plan for, and to assist financially, the development and management of the water resources of Texas. The usefulness of the Board's water planning and funding activities is dependent upon the accuracy and completeness of the information that water users provide. To this end, the Board annually collects and maintains accurate information concerning the current use of water for industrial purposes.

Appendix

North American Industry Classification System Codes

(http://www.census.gov/eos/www/naics/)

AGRICULTURAL WATER USE: NAICS Code 11

Select Examples

1111 Oilseed and Grain Farming
1112 Vegetable and Melon Farming
1113 Fruit and Tree Nut Farming
1114 Greenhouse, Nursery, and Floriculture Production
1119 Other Crop Farming
1121 Cattle Ranching and Farming
1122 Hog and Pig Farming
1123 Poultry and Egg Production
1124 Sheep and Goat Farming
1125 Aquaculture
1129 Other Animal Production
1151 Support Activities for Crop Production

INDUSTRIAL WATER USE: NAICS Codes 21, 22, 23, 31-33

Select Examples

2111 Oil and Gas Extraction
2123 Nonmetallic Mineral Mining and Quarrying
2131 Support Activities for Mining
2211 Electric Power Generation, Transmission and Distribution
2212 Natural Gas Distribution
2213 Water, Sewage and Other Systems
2361 Residential Building Construction
2362 Nonresidential Building Construction
2371 Utility System Construction
2373 Highway, Street, and Bridge Construction
2379 Other Heavy and Civil Engineering Construction

COMMERCIAL WATER USE: NAICS Codes 23, 42, 44, 45, 48, 51 – 56, 62, 72, 81

Select Examples

2382 Building Equipment Contractors
2383 Building Finishing Contractors
2389 Other Specialty Trade Contractors
423 Merchant Wholesalers, Durable Goods
424 Merchant Wholesalers, Nondurable Goods
425 Wholesale Electronic Markets and Agents and Brokers
441 Motor Vehicle and Parts Dealers
442 Furniture and Home Furnishings Stores
443 Electronics and Appliance Stores
444 Building Material and Garden Equipment and Supplies Dealers
445 Food and Beverage Stores
446 Health and Personal Care Stores
447 Gasoline Stations
448 Clothing and Clothing Accessories Stores
451 Sporting Goods, Hobby, Musical Instrument, and Book Stores
452 General Merchandise Stores
453 Miscellaneous Store Retailers
454 Non-store Retailers
481 Air Transportation
482 Rail Transportation
484 Truck Transportation
486 Pipeline Transportation
487 Scenic and Sightseeing Transportation
488 Support Activities for Transportation
493 Warehousing and Storage
511 Publishing Industries (except Internet)
512 Motion Picture and Sound Recording Industries
515 Broadcasting (except Internet)
517 Telecommunications
518 Data Processing, Hosting, and Related Services
519 Other Information Services
52 Finance and Insurance
53 Real Estate and Rental and Leasing
54 Professional, Scientific, and Technical Services
55 Management of Companies and Enterprises
56 Administrative and Support and Waste Management and Remediation Services
621 Ambulatory Health Care Services (Offices of Health Practitioners)
6243 Vocational Rehabilitation Services
6244 Child Day Care Services
721 Accommodation

811 Repair and Maintenance
812 Personal and Laundry Services

INSTITUTIONAL WATER USE: NAICS Codes 61, 62(partial), 71, 81(partial) and 92

Select Examples

61 Educational Services
622 Hospitals
623 Nursing and Residential Care Facilities
712 Museums, Historical Sites, and Similar Institutions
713110 Amusement and Theme Parks
713910 Golf Courses and Country Clubs
8131 Religious Organizations
921 Executive, Legislative, and Other General Government Support
922 Justice, Public Order, and Safety Activities
924 Administration of Environmental Quality Programs
925 Administration of Housing Programs, Urban Planning, and Community Development
927 Space Research and Technology
928 National Security and International Affairs