# Water Conservation Program Development & Water Loss Report Training for Small Water Systems

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Texas Rural Water Association

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# Chapter 1

# Methods of Accounting for Water Loss

**Chapter Objectives**

**Introduce and explain:**

- **Best Management Practices in Methods of Accounting for Water Loss**
- **House Bill (HB) 3338 and role of the Texas Water Development Board (TWDB)**
- **Top-Down, Bottom-Up Audits and the required reports**
- **Information for Real Losses**
- **Information for Apparent Losses**

This Best Management Practice (BMP) is intended for all Municipal Water User Groups ("utility"). This BMP should be considered by a utility that:

1. Would like to analyze the benefits of reducing its unaccounted for water
2. Has not conducted a periodic water audit
3. Wants to determine if under-registering meters are impacting its revenues
4. Has not implemented a leak reduction program

To maximize the benefits of this BMP, the utility uses the information from the water audit to:

1. revise meter testing and repair practices
2. reduce unauthorized water use
3. improve accounting for authorized but unbilled water
4. implement effective water loss management strategies

Texas House Bill (HB) 3338 (copy provided at Appendix D) only requires a water utility to conduct a water audit every five years. By adopting this BMP, a utility will implement a more frequent program of water auditing and loss reduction techniques than required by HB 3338. Small utilities may want to use parts of this BMP, without following every step. Some small utilities may not have the equipment to obtain all the information needed to complete the report.

Compiling a water audit is a two-step approach, a top-down audit followed by a bottom-up audit. The first step, the top-down audit, is a desktop audit using existing records and some estimation to provide an overall picture of water losses. For those utilities that gather the information necessary to fill in the Texas Commission on Environmental Quality's Utility Profile (found on the internet at www.tceq.state.tx.us/assets/public/permitting/forms/10218.pdf), that information is the first step of a top-down audit.

## Introduction

The 78th Texas Legislature in 2003 also passed HB 3338 that amended Section 16.0121 of the Texas Water Code to require each retail public utility that provides potable water to conduct a water loss audit once every five years and to report the results of the audit to the Texas Water Development Board (TWDB). The water audit addresses four main points of water loss: loss

from distribution lines; inaccuracies in meters; deficiencies in accounting practices; and, theft of service.

The TWDB will compile the information from the water loss audit reports submitted by each retail public water utility for the Regional Water Planning Groups to use to identify appropriate water management strategies. The first water loss audit that is required will be conducted using data collected from 2005. A utility may choose to base the audit on either the 2005 calendar year or their 2005 fiscal year. The results of the water loss audit are due to the TWDB no later than March 31, 2006.

Retail Public Water Suppliers should have received a Water Audit Reporting Form through the mail in December 2005. If you have not received a copy of this form (copy provided at Appendix A), a printable version that can be submitted by mail will be found on the Texas Water Development Board's website at:
www.twdb.state.tx.us/assistance/conservation/Municipal/Water_Audit/HB3338ReportingForm.pdf.
A copy is provided at Appendix A of this manual.

## Water Audit Implementation

The term "water loss" is now broken down into two separate categories that enable the utility to put distribution loss into the **real loss** category and meter inaccuracies and theft into the **apparent loss** category. With the previous system of putting all types of loss into one category, the utility could not focus or direct its resources to the area of the loss. The utility was simply guessing as to the area needing assistance. Implementing audits into the business cycle will enable the utility's operation to become more efficient with each passing year. Utilities need to understand that it may take time before results can be expected from a meter replacement program and/or leak detection program. Initially, smaller utilities may see that the implementation of audits will warrant a few estimates. Over a several year period, these smaller systems will see that obtaining valid data assists them in lowering their losses.

## Top-Down Audits

Top-down audits are paper audits that utilize data the utility should already have without additional fieldwork. These are referred to as "desk top" exercises. Data is transferred from other reports to the water audit form, enabling the utility to see which areas warrant more fieldwork. This type of audit is typically less expensive than a more thorough bottom-up audit. Top-down audits are the method chosen for implementing the water loss reporting requirements of HB 3338.

## Bottom-Up Audits

This is the second part of the audit process. The utility confirms the data used in the top-down portion. Bottom-up audits are usually implemented only after the utility has a thorough understanding of the findings from the top-down audit. Bottom-up audits are more costly due to the amount of time, staff hours, and detailed work that is required. They include each aspect of the utility: billing records, distribution system, accounting principles, and all other programs within the utility. This audit will identify all internal issues that are preventing the utility from

achieving high efficiency. Utilities can implement this method once they have completed several top-down audits.

## Main Line Leaks, Service Line Leaks and Storage Tank Overflows

These are sub-categories within the Real Loss category and because the water does not go through a customer meter, the lost volume is associated with a production cost. Except for storage tank overflows, these sub categories are generally expensive and time consuming due to the difficulty in locating and repairing the leaks. They are considered real loss, because, as previously discussed, real loss is all the water that went through the master/source meters but has not gone through a customer's meter. Since this is "produced" water, it is calculated at a production rate. In order to more accurately track hydrant flushing, the utility could implement the use of a diffuser with a pressure gauge that measures flow by pressure.

When customer population growth occurs and the utility takes on more connections, the number of service line leaks also increases. A study done in Great Britain concluded that systems having more than 32 connections per mile had the majority of their leaks on the service lines and utilities with less than 32 connections per mile had the majority of their leaks on the main lines. This study occurred on systems that fully implemented this water loss methodology.

## Methods to locate and minimize water loss

This section shows how a utility can utilize several water loss techniques to locate loss within the system and conduct a bottom-up audit. As discussed earlier, this type of audit verifies that the data used is the most accurate and current possible. Bottom-up audits are the next step for utilities wanting to achieve a higher level of efficiency. They highlight issues within the utility that are preventing the utility from effective loss control. In performing the audit, billing procedures, maintenance costs and productivity levels can be reviewed. With time, financial rewards will be realized along with substantiated water savings.

## System Investigation

System investigation requires extensive knowledge of the utility's infrastructure. Therefore, appropriate staff should be chosen to conduct this study. Items that should be studied include, but are not limited to:

1. What are the types of storage tanks and stand pipes?
2. Is there an interconnect with another utility? Make sure they have properly installed check valves.
3. Is the utility aware of the location of all valves?
4. Does the same booster pump come on first every time? Equipment longevity can be extended if a different pump starts each time.
5. Is the utility implementing the use of forms for the fire department (Appendix A, page 8), line-flushing (Appendix A, page 9) and the leak repair summary report (Appendix A, page 10)? All three forms can be found in Appendix A of this manual.
6. What type of pipe is in the ground (e.g., PVC or iron)? Note the size of each. This information can be applied to the pin maps.

7. Are all meters the right size for each particular connection?
8. Residential meters should be 5/8 x 3/4 inch or similar. Are they installed correctly?
9. If the meters are close to reaching their operational limits, has their flow accuracy been tested? The accuracy level of any customer meter is just as important as that of the master meters. Water chemistry along with age can affect the accuracy of meters. Depending on water chemistry and customer use patterns, residential meters may need to be replaced when they "roll over" or when they reach 8 to 10 years old.
10. Does the entire field staff know the system thoroughly?

Meters should have check valves and/or backflow prevention devices. These will prevent household water from re-entering the utility's main lines. Pressure differences between the outside plumbing and inside plumbing can allow lawn and garden chemicals from a hose-end sprayer to enter the house plumbing if anti-siphon devices are not used on the outside faucets.

After this particular study, the utility should create a Utility Operations Manual that includes all the above information. The operations manual can be used by all staff during emergencies and when key personnel are out of the office for an extended period of time. Once the utility has done all the steps suggested here, the creation of pin maps will be the next step in minimizing water loss.

## Pin Maps

Pin maps show the entire infrastructure from the meters and valves to all service and main lines. Pin maps can be created using Geographic Information System (GIS) data, or otherwise by an engineer. By using GIS, the map may be periodically updated with relatively small cost. The map should be large enough to show the entire system, so that all staff members can refer to it at any time. Historically, they were referred to as pin maps because pins of various colors are placed on the map to depict various system losses. For example, red indicates service line leaks, blue for main leaks and other colors for each scenario that may arise. Each task should be represented by its own color. It is imperative that the map be updated frequently. Even if the utility has this map electronically, it is important that all leaks and repairs to the infrastructure are updated.

## Distribution Controls

These are factors controlling the overall distribution system. Is Supervisory Control and Data Acquisition (SCADA) installed on the system? SCADA systems can be used to manage many aspects in the utility's day-to-day operations. They also maintain pumping and pressure controls and will even monitor storage tanks. They can be programmed to control many operations that can give staff more time for other projects.

## Water Leak Survey

These surveys are part of the leak detection program. Have a staff meeting on water loss with all field personnel and gather input while prioritizing their ideas and/or locations of water loss in the order of importance. If the utility does not already use a form for the estimation of these leaks,

use the form located on page 10 of Appendix A in this manual for a template. Note all points of water loss on the pin maps, and refer to the map when fieldwork begins.

## Leak Detection and Repair

To be effective, leak detection and repair should be a continuous program. Even as recordkeeping is improved and meters are being installed, tested and replaced, the utility should be aggressively involved in leak detection and line repairs. The LEAK DETECTION AND REPAIR WORKSHEET (Appendix A, page 5-6), is a useful document to aid in maintaining a successful leak detection program.

In addition to saving the water lost through leakage, a leak detection program can pay for itself in reduced water production costs, reduced future repair costs, and deferred plant expansion. As each leak is being repaired, the repair crew can implement the LEAK DETECTION SURVEY DAILY LOG (Appendix A, page 7), to aid in prioritizing leaks.

Studies generally have shown that the life of a leak depends on the type of subsoil. In areas with sandy soil or limestone strata, water from a leak may not surface near its source or may not surface at all.

Clay soil is considered impermeable and will normally keep water from going deeper and into the next lower strata, but this may not always be the case. An ongoing leak detection program is essential. Leak detection methods include using a variety of flow measurement devices. Sonic and acoustic devices are used to detect leak sounds in mains or service lines.

Acoustical leak detectors consist of headphones and a ground microphone. They are practical, inexpensive and easy to use. Referred to as “leak finders”, they will find the leak within a range of several feet. As with most acoustical equipment, an estimate of the leak location is needed. This type of listening device tends to be lightweight and easier to use than others types of leak detectors.

## Correlators

Correlators are known in the industry as “leak pin pointers”, as they are able to locate a leak within several inches. This accuracy enables a utility to save money by only removing a small section of pavement.

Correlators use two transmitters to locate leaks. Once programmed with the correct parameters, the correlators will transmit information that indicates the leak location to the logger. Some utilities use acoustical detectors to find the leak, and then employ correlators to pinpoint it within inches. They will only be as accurate as the information programmed into the device. One method used by large municipalities to offset the expense of correlators, is to purchase them and then subcontract out to smaller systems.

## Accounting Errors

Accounting errors can present challenges for the utility. Examples of these challenges include; non-billing or accounting of every connection, data incorrectly transferred on meter readings, and customer water-usage data being altered during the billing cycle. A prime example is when the utility changes the amount billed or waives a portion of the water used due to a leak or some similar reason. Where in the billing records does the unbilled water show up? Even though the billing department chooses to waive the volume of water for customer satisfaction, follow the volume through the billing program to ensure that it does not become a real loss or the volume is not lost altogether. It is considered an apparent loss because the meter does record the volume of water.

## Theft of Service

This is the third sub-category of Apparent Loss. It is considered Apparent Loss because it was in the distribution system ready to sell. However, it was taken before the water had an opportunity to go through a meter and generate revenue. Theft of water can occur by construction companies tapping into fire hydrants, and/or unauthorized connections by residential customers. One opportunity for theft occurs by hooking up to the side of a hydrant that does not have a meter on it. Some utilities have begun to charge a rental fee for supplying meters that would cover the rental cost plus the cost of selling the water. The price needs to be set high enough to pay for an estimated amount but not too high to tempt users to take water from the non-metered side. Rental agreements can offset costs of others taking water without proper authorization. A utility can also create a program that entails labeling all fire hydrants and working with local law enforcement officials to notify them of unauthorized activity on fire hydrants. Some utilities attach a sign to the hydrant that states, “Unauthorized users will be prosecuted.”

Illegal taps are more likely to occur where a customer may be able to install a separate tap to irrigate a lawn or water livestock without being seen by neighbors. In order to eliminate theft when an account is closed, the utility could choose to remove the meter instead of turning the valve off or locking the valve closed.

Local law enforcement can assist you in criminal mischief cases under Section 28.03 of the Texas Penal Code. If a person causes any impairment or interruption of a potable water supply, including installation of any illegal taps or removal or circumvention of any metering device, that person commits a Class A misdemeanor (up to one year in jail, or $4,000 fine, or both) even if the water system cannot prove any particular value to the water. A good working relationship with your local law enforcement (sheriff, district and county attorneys, police) can be very helpful on many fronts.

Meters, record management and theft of service are all part of Apparent Loss. They all consist of accurate measurement and record of a loss so that the utility can be compensated. Since the loss of this water occurred at or after the customer’s meter it will have retail cost associated to it.

## Chapter 1 Review Questions

1. BMP stands for:
    a. Better Municipal Policies
    b. Back-up Master Plan
    c. Best Management Practice
    d. Better Meter Placement

2. The audit that requires the least amount of information to complete is:
    a. Front to Back Audit
    b. Bottom-Up Audit
    c. Complete Audit
    d. Top-Down Audit

3. Bottom-Up Audits require information that is obtained by the utility; which information?
    a. Billing Records
    b. Distribution System
    c. Accounting Principles
    d. All Listed

4. Which is not part of the sub-categories within Real Loss?
    a. SCADA
    b. Main Line Leaks
    c. Leak Detection and Repair
    d. Pin Maps

# Chapter 2

# Implement Accounting Process

**Chapter Objectives**

**Introduce and explain:**

- **Available information the small water system has for accounting for loss of water**
- **The importance of obtaining valid data**
- **Pin Maps will help to identify problem areas in system**
- **Water Loss Program**
- **Leak Detection**

Operators of small Public Water Systems (PWS) will take the information they have available to them to the class to complete the required reports. Benefits of master and sub-metering are identifiable but not always in place. System operators will be required to estimate some of the information required in the audits.

## Water Audit Implementation

The term "water loss" is now broken down into two separate categories that enable the utility to put distribution loss into the real loss category and meter inaccuracies and theft into apparent loss. With the current system of putting all types of loss into one category, the utility could not focus or direct its resources to the area of the loss. The utility was simply guessing as to the area needing assistance. Implementing audits into the business cycle will enable the utility's operation to become more efficient with each passing year. Utilities need to understand that it may take time before results can be expected from a meter replacement program and/or leak detection program.

Initially, smaller utilities may see that the implementation of audits will require them to rely on estimates. Over a period of several years, these smaller systems will see that obtaining actual data better assists them in lowering their losses.

The following items will help identify information in the implementation of a water audit for a small system.

1. Small Systems will find it easier to complete a top-down audit.
2. In Chapter 1, you will find a section for system investigation. Once a system completes as much of this investigation as their resources will allow, the system will begin to address the areas with the most needs.
3. Pin maps are an important asset to the utility and may help justify the expense of replacing sections of old, leaking pipe. Having a map with clusters of pins appearing on a particular section can indicate the need to replace the section rather than repair it with another clamp. The map may be used as a visual aid to justify expenses to the board of directors (and ultimately, ratepayers).
4. Develop a water loss program. Do not rely on customers to report leaks. Make an effort to discover the leaks before they cost the utility more money.

5. As the utility implements a leak detection program, the first leaks located will be the larger ones. The process should be repeated in order to locate the smaller leaks that were not initially detected with the acoustical equipment due to the background noise of the larger leaks.
6. Accounting errors result from making adjustments without investigating the claims.
7. Investigate all reports of illegal taps, service from the non-metered side of the meter, and any unauthorized persons working flush valves or fire hydrants.

Each of the items identified above will help in the accounting of water loss. Even if it moves from an unaccounted water-loss line item to an accounted loss, it will help the system improve on their ability to manage their system.

Managers have often stated that the small leaks should not be repaired until service is affected because the water is so cheap. However, such statements demonstrate a lack of customer service and a disregard for the diminishing water supplies. IT'S NEVER CHEAP IF IT'S GONE!

## Chapter 2 Review Questions

Water Loss is broken down into two separate categories, _____ and _____ Losses.

Utilities can take a proactive approach, not relying on customers to report leaks, by developing a _____ program.

A leak detection program will identify the _____ leaks first.

_____ should never be made without investigating the claims first.

# Chapter 3

# Enforcing Against Water Wasters

**Chapter Objectives**

**Introduce and explain:**

- **Enforcement-Water Wasters**
- **Using Ordinances**
- **Water Waste Programs**
- **Reasons for Conservation and Goals of these programs**

Municipal water conservation efforts in Texas have been motivated by diverse goals such as preventing land subsidence, addressing short-term or long-term water shortages, providing environmental protection, and avoiding or postponing the high costs of new water system improvements. Through years of experience in the implementation of water conservation programs, much has been learned about the most effective methods of encouraging public/customer participation. When addressing the water wasters, enforcement maybe necessary.

Customers that continue to waste water despite the effort of the utility may discourage other customers from participating. The utility's efforts in limiting water waste should find acceptance by the general public. The specific measures listed can be implemented individually or as a group. Upon review, a utility may find that it is already implementing one or more of these measures and it may want to adopt additional elements as outlined below.

1. For utilities with ordinance making powers (districts and cities)
    a. In the first twelve (12) months: Plan, develop, and pass an ordinance (example in Appendix E), including stakeholder meetings as needed. Develop a plan for educating customers, especially those directly affected by the requirements that are enforced as a result of the ordinance.
    b. After Ordinance Passage (in the 2nd year and thereafter): Continue implementation and an outreach program for customers. Continue compliance education and initiate enforcement programs. Enforcement can include citations with fines and service suspension or termination for repeat offenders.
2. For utilities with limited penalty authority (nonprofit water supply corporations): Amend tariff to provide for penalties assessed on customers that violate specified water waste prohibitions (such as allowing water to run off the property), as allowed by Section 67.011 of the Texas Water Code. (Example of tariff policy is provided at Appendix F.) Implement conservation rates charging higher unit costs for high volume water users (as discussed in Chapter 5). Develop and implement public awareness campaign (use mailers to accompany monthly bills; make presentations to school classes, civic organizations).
3. For utilities that lack ordinance-making powers (privately owned PWS): In the first twelve (12) months: Plan a program including stakeholder meetings as needed. Implement a water

waste program with recommendations. Implement conservation rates that charge higher unit costs for high-volume users.

Water waste prohibition measures are enforceable measures that prohibit specific wasteful activities. Under this BMP, the utility enacts and enforces ordinances to prohibit wasteful activities including:

1. water waste during irrigation
2. failure to fix outside faucet leaks
3. service line leaks (on the customer side of the meter)
4. sprinkler system leaks
5. once-through use of water in commercial equipment
6. non-recirculation systems in all new conveyer and in-bay automatic car washes and commercial laundry systems
7. non-recycling decorative water fountains
8. installation of water softeners that do not meet certain regeneration efficiency and waste discharge standards

Water waste during irrigation includes:

1. water running along the curb of the street
2. irrigation heads or sprinklers spraying directly on paved surfaces such as driveways, parking lots and sidewalks in public rights of way
3. operation of automatic irrigation systems without a functioning rain shut-off device or soil moisture sensor
4. a wind sensor and/or freeze sensors in some areas of the state
5. operation of an irrigation system with missing heads caused by water pressure higher than recommended design pressure for the heads, or broken head
6. spray irrigation during summer months between the hours of 10 a.m. and 6 p.m.

Summer months are generally considered June 1 through September 30, but utilities may select a longer or shorter timeframe. Utilities with enforcement power may want to consider not allowing spray irrigation until as late as 8 pm in summer months. An exemption for these watering hours should be included for newly installed landscapes for a limited period of time.

## Chapter 3 Review Questions

1. Conservation efforts in Texas have been motivated by diverse goals such as:

    1. Land subsidence
    2. Short-term water shortages
    3. Long-term water shortages
    4. High cost of new water sources
    5. All the above

2. True /False: Only utilities with ordinance making powers can implement a water waste program?

3. True /False: A water waste program includes fixing leaks on the customer's side of the meter?

4. True /False: The best time to water landscape is during the day while we are at work?

# Chapter 4

# Assessing Meter Accuracy

**Chapter Objectives**

**Introduce and explain:**
- Meter Accuracy
- Meter Sizing-Residential
- Meter Testing
- Test Results
- Master and Sub-Meters
- Meter Sizing or Selection

The retail meters (⅝ by ¾) are referred as the cash registers of a system. Bills will be generated with the data from these meters. Accuracy is important for billing, revenue, and determining water loss in a system. A meter by design will begin to slow down with age and water quality, water pH, hardness and inorganic material found in the supply can effect the operations of a meter.

Though the following information may differ slightly from some meter manufacturers specifications, the parameters are considered the industry standard.

Residential meters usually are the ⅝ by ¾-inch meter. The accuracy standard for multi-jet meters will be plus or minus 3 gallons per minute, accurate when tested. Positive displacement type meters will be between plus or minus 1½ gallons per minute. In researching systems in Texas, many systems have adopted a plus or minus 2 gallons per minute accuracy.

You will find many brands of meters. Each system will find one works better than another. Customer complaints usually generate the need for testing meters, though some will be generated from data or lack of data during the monthly reading of meters.

Methods for testing meters include:

Removing the meter and completing a bench test for accuracy
Placing a meter that has been certified as accurate in-line with the meter in question, care must be made to assure that no water any where is being used by the residents
A volumetric test may be preformed with the meter in place. Care must be made to assure that no water anywhere is being used by the residents

## Testing Your ⅝ by ¾ Water Meter for Accuracy

### Supplies for testing

You will need:

- 5 gallon bucket
- Carpenter's level (longer than the bucket's diameter)
- Felt tip marker
- Garden hose

- Measuring container (which can measure quarts)

If you do not have the items listed, try to borrow them from a friend, or purchase them from a local hardware store.

## Meter testing procedure

**Step 1)** Level the bucket by placing a carpenter's level on top of the bucket. Level the bucket by digging or shimming until the air bubble on the level is between the two reference lines. Raise and lower each side of the bucket as needed. Repeat this procedure in a crisscross pattern, rotating the level 90 degrees between each adjustment until the bucket is level. The bucket should rest solidly on its surface. Unsteady buckets will invalidate the accuracy test.

**Step 2)** Using the measuring container, pour exactly 20 quarts of water inside the bucket.

**Step 3)** Mark the water level inside the bucket. Markings should be every 90 degrees.

**Step 4)** Empty the bucket. Check your marks on the bucket; and re-mark if necessary.

**Step 5)** Move the position of the register pointer on the water meter to a position that works best for you. You can do this by positioning a person at the meter and another person at the faucet. Turn water on and off until the .1 dial pointer, reaches an even gallon position.

**Step 6)** Place the five gallon bucket on level ground beneath an outdoor faucet. If there is not enough room, connect a garden hose to the faucet, and direct the hose to the bucket (on level ground) and remove all kinks from the hose. (NOTE: Stop all leaks prior to conducting test. Water leaks will cause inaccuracies and invalidate the test.)

**NOTE**: Prior to starting the test, make sure all air is bled from faucet and/or hose. Water must be visible at the end of the hose prior to test. Failure to do so will invalidate the test. Also, ensure that water will not be used on property during test. Any water not used for testing purposes will invalidate the test.

**Step 7)** Station a person at the meter, position the end of the hose over the bucket. Open the faucet to establish a medium flow rate of water. As soon as the .1 dial rotates to register (five) 5 gallons, immediately shut off the water. If the water was shut off too soon or too late, repeat the test.

## Evaluating the test results

If the water level is below the mark, the water meter is possibly over-registering:

- Ensure bucket is still level.

- Double check read on meter to ensure it rotated no more or no less than five gallons from the point from which you began your test. See step 6.

- Verify no water leaks on property and that the only water used during the test was for the test.
- Verify that the hose was full of water prior to test.

If the water level is above the mark, the water meter is possibly under-registering:

- Make sure the bucket is still level.
- Double check the reading on the meter to ensure five gallons no more or no less than was registered.

## Master and Sub-Meters

Meters that are located at the wellhead, interconnect(s), after treatment, and distribution sub-meters could be propeller, turbine, venturi or compound type meters. These meters will handle larger flow-rates and require testing once a year.

- Propeller meters have a fan-shaped rotor that spins with the flow of water.
- Turbine meters have a rotating element that turns with the flow of water. The volume of water is measured by number of revolutions by the rotor.
- Venturi meters *have* a section that has a smaller diameter than the pipe on the upstream side. Based on a principle of hydraulics, as water flows through the pipe, its velocity is increased as it flows through reduced cross-sectional area. Difference in pressure before water enters the smaller diameter section and at the smaller diameter "throat" is measured. The change in pressure is proportional to the square of velocity. Flow rate can be determined by measuring the difference in pressure. Venturi meters are suitable for large pipelines and do not require much maintenance.
- Compound Meters - In some cases, it is necessary to have a combination meter—both a positive displacement meter and velocity meter installed together—to be able to measure high and low flows. Low flows are measured through positive displacement while high flows are measured by velocity. A valve arrangement directs flows into each part of the meter.

## Selecting a Meter

In sizes of two and three inches, displacement, multi-jet, or turbine types of meters can be used. In the three- to four-inch size range, the meter type depends on the average flow rate. If the flow rate is between five and 35 percent of maximum flow rate, the positive displacement type is better. If the flow rates are going to be 10 to 15 percent of the maximum capacity, a turbine type should be used. If close accuracy at low flows is important, but large flows also have to be measured, a compound meter is best.

For large flows, velocity meters are more appropriate. Turbine meters are suitable for large flows where minimum flow rate is above 10 to 20 percent of the maximum rating. Turbine meters have

low pressure loss at high flow rates. Propeller meters are suitable for large mainlines or for pump station discharge.

## Selection of a Propeller Meter

The size of a propeller meter for irrigation depends primarily on the flow -- the rate the water is pumped. Table 1 indicates typical flow rate ranges for common sizes of propeller meters. It is not advisable to operate near either of the extreme values indicated in this table. For example, a 900 gpm system should use an 8-inch or 10-inch propeller meter rather than a 6-inch meter.

**Table 1: Common flow rate ranges for propeller meters.**

| Meter size | Minimum flow (gpm) | Maximum flow (gpm) |
|---|---|---|
| 4 inches | 50 | 400 |
| 6 inches | 90 | 900 |
| 8 inches | 100 | 1200 |
| 10 inches | 125 | 1500 |
| 12 inches | 150 | 2000 |

## Chapter 4 Review Questions

1. Residential meters usually are:
    a. 1 inch meters.
    b. 3/4 inch meters.
    c. 5/8 by ¾ inch meters.
    d. Customer will determine the size.

2. Which is not part of the testing procedure:
    a. Establish maximum flow
    b. Measure exactly 20 quarts in bucket, then mark level
    c. Bled air from hose
    d. Level bucket

3. The best meter suited for detecting low and high flows is the:
    a. Propeller meter
    b. Turbine meters
    c. Venture meter
    d. Compound meters

4. large flow velocity meters are suitable for flows where minimum flow rate is above:
    a. 20 to 30 percent of maximum flow
    b. 10 to 20 percent of maximum flow
    c. 40 to 50 percent of maximum flow
    d. 25 to 35 percent of maximum flow

# Chapter 5

# Encouraging Water Conservation

**Chapter Objectives**

**Introduce and explain:**

- **Water Conservation**
- **Pricing**
- **Prohibition on Water Wasting**
- **Plumbing Retrofits**
- **Fixture Replacement**
- **Education**
- **Incentives**

Despite the variety of water uses and numbers of water users, many patterns of water use, especially in domestic water use, are common. As a result, a number of conservation measures have been developed in municipal settings over the past several decades to reduce the total gallons consumed for daily activities without reducing the benefit of the water used.

1. Water Conservation Pricing
2. Prohibition on Water Wasting
3. Showerheads, Faucet Aerators and Toilet Flapper Retrofit
4. Residential Toilet Replacement Programs
5. Residential Clothes Washer Incentive Program
6. School Education
7. Landscape Irrigation Conservation and Incentives

## Water Conservation Pricing

Not all of the conservation measures listed in this chapter are readily available to small systems, either because of cost (including the cost of staff time for enforcement) or because the system does not have the police power of a city or a district. Water Conservation Pricing is the use of rate structures that discourage the inefficient use or waste of water. This is the single most effective method available to any utility, including the smallest. Conservation pricing structures include increasing unit prices with increased consumption such as inverted block rates, base rates, and excess use rates such as water budget rates, and seasonal rates. Seasonal rate structures may include additional charges for upper block (outdoor) usage or excess-use surcharges for commercial customers to reduce demand during summer months. The goal of conservation pricing is to develop long run consumption patterns consistent with cost. Utilities should consider establishing rates based on long-run marginal costs, or the cost of adding the next unit of capacity to the system. An established cost of service methodology should be followed whenever rates are developed or proposed for change.

Public involvement in the development and implementation of conservation rates can help assure that the goals of the conservation pricing initiatives will be met and accepted by local constituents. Some of the most common methods to generate public involvement are public meetings, advisory groups, and public announcements.

Development of conservation-based rate structures is more than just selection of arbitrary usage breaks. The process requires consideration of the effect on water demand and water utility finances. Basic rate structure considerations should include rates designed to recover the cost of providing service and billing for water and sewer service based on actual metered water use. Conservation pricing should provide incentives to customers to reduce average or peak use, or both. The conservation rate structure can be designed to bring in the same amount of revenue, often termed revenue neutral, as the previous rate structure.

Only one type of conservation pricing is required for this BMP. Conservation pricing is characterized by one or more of the following components:

- Seasonal rates are used to reduce peak demands during summer months. There is a variety of approaches including increasing block rates only during the summer months or implementing a year round block rate structure with higher block rates during the summer months.

- Rates in which the unit rate increases as the quantity used increases are called increasing block rates. For block rate structures, the rate blocks should be set so that they impact discretionary use. A utility should analyze historical records for consumption patterns of its customers. The first block should typically cover the amount of water for normal household health and sanitary needs. To increase the effectiveness of this rate structure type, the additional revenue from the higher blocks should be associated with discretionary and seasonal outdoor water use.

    - Rates for single family residential and other customer classes may be set differently to reflect the different demand patterns of the residents.

    - The price difference between blocks is very important in influencing the customer's usage behavior. Price increases between blocks should be no less than 25 percent of the previous block. For maximum effectiveness, the price difference going from one block to the next highest block is recommended to be at least 50 percent of the lower block. For example if the third block of a four-block rate structure is $4.00 per 1000 gallons, the fourth and final block should have a rate of at least $6.00 (50 percent higher) per 1000 gallons. Any surcharge based on water usage should be included when calculating these percentages.

- Other rate structures are based on individual customer water budgets in which the unit cost increases above the water budget. Water budget rate structures are based on the philosophy that a certain amount of water is adequate for all normal necessary uses, and uses above that amount are considered excessive and charged as excessive. For example, Irvine Ranch Water District in California sets the excess use charges at 200 percent of the base rate. Typically, there should be an indoor and an outdoor component to a water budget.

        - For residential rates, the indoor component should be based on estimates of average family use. The outdoor component is based on landscape area. For

business customers, water budgets will often be based on historical average for indoor water use, and outdoor component based upon landscape area.
    - To qualify as a conservation rate, utilities that implement water budget based rate structures typically begin excess rate charges for landscaped areas at no more than 80 percent of average annual reference evapotranspiration replacement rates.
- There are also rates based on the long-run marginal cost or the cost of adding the next unit of capacity to the system.

Conservation pricing should use a consumption charge based upon actual gallons metered. The minimum bill for service should be based on fixed costs of providing that service which generally includes service and meter charges. Including an allotment for water consumption in the minimum bill does not promote conservation and it is recommended that if a minimum is included, it not exceed 2000 gallons per month. Utilities including a water allotment in the minimum bill should consider eliminating that allotment within five years of implementing this BMP.

Adoption of lifeline rates neither qualifies nor disqualifies a rate structure as meeting the requirements of this BMP except that the minimum bill guidelines should be followed. Lifeline rates are intended to make a minimum level of water service affordable to all customers.

The utility should educate customers about the rate structure and use billing software that allows the customer to compare water use on their bill with average water use for their customer class as well as their individual water use for the last 12 months. The rate structure should be clearly indicated on the water bill. The utility may want to consider implementing the Public Information BMP in conjunction with this BMP in order to provide customers with information on how to reduce their water bill under a conservation rate structure.

In order to be able to set up an effective irrigation rate, the utility should consider adopting rules or ordinances requiring new commercial and industrial customers to install separate irrigation meters and consider retrofitting current commercial and industrial customers with irrigation meters. It is important for commercial and industrial customers to have a separate irrigation meter so they can better understand how much water they are using for irrigation. This provision is optional for this BMP. It is important that water utilities focus on the efficiency of their supply operations while promoting water efficiency to their customers. A utility can reduce water loss through careful and regular monitoring of its water delivery systems through the System Water Audit and Water Loss. In addition, the Water Conservation Pricing can provide an effective method of encouraging water efficiency by the customer through feedback from the cost of the water to the user. The Prohibition on Water Wasting can help send a message to users about the value of water as well as educate the general populace about simple steps to save water.

## Prohibition on Water Wasting

Water waste prohibition measures are enforceable actions that prohibit specific wasteful activities. A utility enacts and enforces ordinances to prohibit wasteful activities including:

- water waste during irrigation
- failure to fix outside faucet leaks
- service line leaks (on the customer side of the meter)
- sprinkler system leaks

Water waste during irrigation includes:

- water running along the curb of the street
- irrigation heads or sprinklers spraying directly on paved surfaces such as driveways, parking lots and sidewalks in public right of ways
- operation of automatic irrigation systems without a functioning rain shut off device or soil moisture sensor or a wind sensor and/or freeze sensors in some areas of the state
- operation of an irrigation system with misting heads caused by water pressure higher than recommended design pressure for the heads, or broken heads
- spray irrigation during summer months between the hours of 10 a.m. and 6 p.m.

Summer months are generally considered June 1 through September 30, but utilities may select a longer or shorter timeframe. Utilities may want to consider not allowing spray irrigation until as late as 8 pm in summer months. An exemption for these watering hours should be included for newly installed landscapes for a limited period of time.

## Residential Toilet Replacement Programs

For small utilities, this replacement program could cause a finical hardship. Education that demonstrates to the customer the benefits and potential savings to both the utility and the customer, may be the best approach.

Toilets can be purchased from wholesalers by the truckload for $50 to $70 each. There may be additional costs for storage and distribution of the toilets. A small system might survey its customers, make a bulk order based on the survey results and include the cost on the customers' next billing statement

## School Education

School education programs may result in both short and long-term water savings. Behavioral changes by the students based on greater knowledge are often shared with parents and implemented at home. To be effective, a school education program should provide curriculum material appropriate to the grade level of the student, increasing in complexity from elementary school through high school. If such a curriculum does not already exist, local curriculum experts may be willing to help develop the desired materials.

## Landscape Irrigation Conservation and Incentives

Landscape irrigation conservation practices are an effective method of accounting for and reducing outdoor water usage while maintaining healthy landscapes and avoiding run-off. The utility provides non-residential and residential customers with customer support, education, incentives, and assistance in improving their landscape water-use efficiency.

Irrigation system design, maintenance components, and landscape design may be systematically upgraded through the use of municipal ordinance-making powers where possible, or generally encouraged as part of a public awareness program.

Water Wise Landscape programs follow the seven principles of Xeriscape$_{TM}$, from the Texas A&M Horticulture Website, listed below:

- Planning and design
- Soil analysis and improvement
- Appropriate plant selection
- Practical turf areas
- Efficient irrigation
- Use of mulches
- Appropriate maintenance

In conclusion, education, planning, and even the use of ordinances where available, can effectively be utilized in the conservation of water resources.

http://aggie-horticulture.tamu.edu/

## Chapter 5 Review Questions

1. List four of the daily activities that customers can help in conservation of water.

   _____

   _____

   _____

   _____

2. Public involvement can assist utilities in conservation efforts; choose from the list below.
   a. Public meetings
   b. Advisory groups
   c. Public announcements
   d. All listed

3. If allowing a certain amount of water consumption in minimum monthly billing, the amount should not exceed:
   a. 1000 gallons
   b. 5000 gallons
   c. 3000 gallons
   d. 2000 gallons

# Chapter 6

# Reporting and Record Retention

## Chapter Objectives

**Class Exercise:**

- Form as seen on TWDB website
- Enter student data or prepared information
- Familiarize each student with reporting procedures

This chapter will include viewing the form, as you would find it on the Texas Water Development Board website. Students that bring their system information can use system-specific information; otherwise, the instructor will provide data. We will fill out the audit form from Appendix B as if we were submitting it. This will be accomplished by use of PowerPoint. A handout will be provided to each student, to allow everyone to follow along as we fill it out.

# Appendix A – TWDB Water Audit Reporting Forms

**TEXAS WATER DEVELOPMENT BOARD**
P.O. BOX 13231, CAPITOL STATION AUSTIN, TX 78711-3231
**WATER AUDIT REPORTING FORM**

Texas Water Development Board
Mark Mathis, Conservation Division
P.O. Box 13231
Austin, TX 78711
(512.463.0987)
Email: Mark.Mathis@twdb.state.tx.us

Utility Name: _____

Type of Utility: WSC MUD WCID SUD CITY Other _____

Regional Water Planning Group(s) in which this system operates:_
http://www.twdb.state.tx.us/mapping/maps/pdf/sb1_groups_8x11.pdf

Name of person competing form: _____

Phone number of person completing form: _____

Mailing address of Utility: _____

Reporting Period: From _____To_____

Percentage of water used: Surface_____% Groundwater _____%
(must equal 100%)

Mean household income of population served: _____
http://factfinder.census.gov/servlet/SAFFPeople?

Population served: _____

Note: unit of measure (Acre-feet or Million gallons(MG) or Thousand gallons(KG) or gallons(G)/year) must stay consistent throughout report.

**1. SYSTEM INPUT VOLUME** ACRE-FT MG KG G

**Water Delivery -** Amount of water put into delivery system:_____

**Production Meter Accuracy** (enter percentage): _____%

**Production Meter Adjustment -** Corrected Input Volume - Water delivery: _____

**Corrected Input Volume -** Water Delivery/ Production Meter Accuracy:_____

## 2. AUTHORIZED CONSUMPTION

**Billed Metered -** All water sold and metered: _____

**Billed Unmetered -** All water sold but not metered: _____

**Unbilled Metered -** City and local government use, metered line flushing: _____

**Unbilled Unmetered -** Line flushing/fire dept use: _____

**Authorized Consumption -** The Total of all authorized water: _____

## 3. WATER LOSS

**Apparent Loss**

**Customer Meter Accuracy** (enter percentage) _____

**Customer Meter Under Registering -** Total Water Sold / Customer Meter Accuracy

_____

**Billing Adjustment/Waivers** (Unbilled Consumption) _____

**Unauthorized Consumption** _____

**Total of Apparent Loss** _____

**Real Loss**

**Main break/leaks** _____

**Customer service line leaks/breaks** _____

**Storage Tank Overflows** _____

**Total of Real Loss** _____

**Total of Water Loss** (Apparent Loss + Real Loss)

_____

**Total of Water Loss + Authorized Consumption**

_____

**Balancing Error** _____
(See 3B "Note" on instruction sheet)

## 4. TECHNICAL PERFORMANCE INDICATORS

**Performance Indicators for Real Losses**

Your utility's number of service connections _____

Your utility's number of miles of main lines _____

Service connections per mile of main_____

**Total Real Loss/Miles of Main/365** *(in gallons)*

_____

**Total Real Loss/No. of Service Connections/365** *(in gallons)*

_____

## 5. FINANCIAL PERFORMANCE INDICATORS

**Total Real Loss** _____

**Production cost of water** *(make sure correct unit of measure is used to determine the cost)* _____

**Total Real Loss multiplied by production cost of water**

_____

**Total Apparent Loss** _____

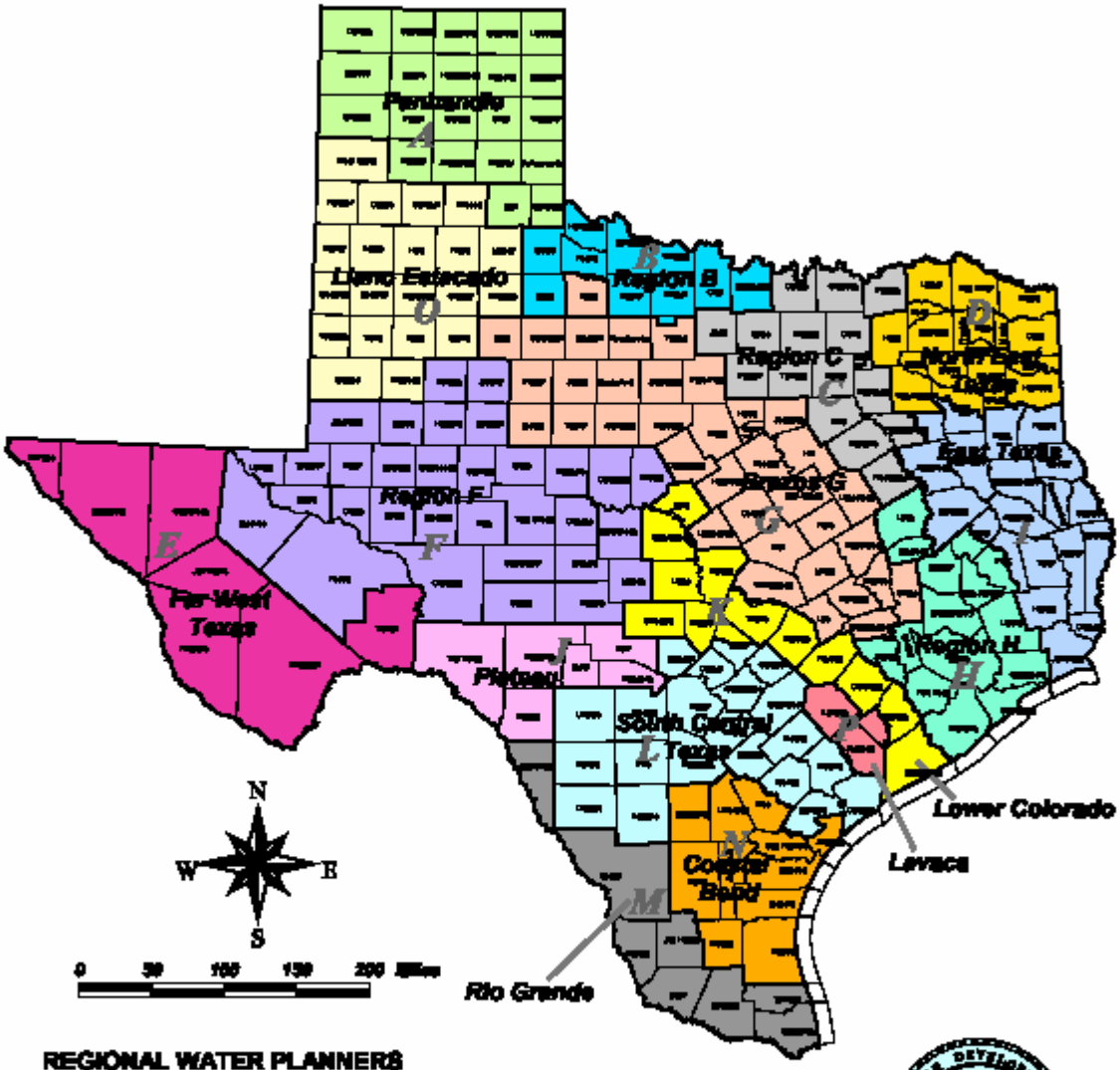
**Retail cost of water** *(make sure correct unit of measure is used to determine the cost)*

_____

**Total Apparent Loss multiplied by retail cost of water**

_____

# *Regional Water Planning Groups*




**REGIONAL WATER PLANNERS**

*Robert Flores (512) 463 - 8061 - Regions E & M*
*Sherry Cordry (512) 936 - 0824 - Region F*
*Temple McKinnon (512) 475 - 2057 - Regions A, B & O*
*Virginia Sable (512) 475 - 2056 - Regions C & D*
*Bill Roberts (512) 936 - 0863 - Regions H & I*
*Matt Nelson (512) 936 - 3500 - Regions L & N*
*David Messey (512) 936 - 0852 - Regions K & P*
*Kevin Kluge (512) 936 - 0829 - Regions G & J*

**Form A**
**LEAK DETECTION AND REPAIR PLAN WORKSHEET**

Utility Name: _____Date:_____

A. AREA TO BE SURVEYED

1. The area in the distribution system to be surveyed should be mapped using the results of the water audit. Higher priority should be given to areas with high leak potential. (Items to consider include records of previous leaks, type of pipe, age of pipe, soil conditions, pressures, ground settlement and installation procedures.)
2. Estimate the total miles of main to be surveyed (excluding service lines).
3. Estimate the average number of miles of main to be surveyed per day.
4. Describe the equipment and procedures that will be used to detect leaks.
5. Estimate the number of working days needed to complete the survey.

B. PROCEDURES AND EQUIPMENT

**1.** Experience has shown that the best results have been obtained by listening for leak sat all system contact points such as water meters, valves, hydrants and blow-offs.

**2.** The average two-person survey crew can survey about two miles of main per day if the main is located in a city or subdivision and all valves, hydrants and meters are checked.

**3.** Items to consider include distances between services, traffic and conditions and total number of listening points.

**4.** If not to listening for leaks at all available listening points, what plans will be made for checking missed points later? A portable listening device, field notebook, hammer, screwdriver, flashlight and cover key are essential items. The leak surveyor should note broken valves, hydrants, meters or other unserviceable equipment in addition to location, size and type of leak or other water loss condition observed.

**5.** Describe how the leak detection team and the leak repair crew will work together. A leak is normally reported by a citizen or utility employee who sees the water leaking out of the ground or building. The leak detection team should be called in first or at the same time as the repair crew to pinpoint the leak. In other cases, the leak detection crew might discover a leak, pinpoint it and initiate the work order.

**6.** What measures will be used to minimize the chance of digging “dry holes”?

**7.** Describe the methods that will be used to determine the flow rates for excavated leaks. Formulas for calculating approximate flow rates for typical leaks are presented in Figure 1.

C. LEAK DETECTION SURVEY BUDGET

| | Number of days | | $/day | | Cost |
|---|---|---|---|---|---|
| Utility Crew Cost | | | | | |
| Consultant Crew Cost | | | | | |
| Vehicle Cost | | | | | |
| Cost of Leak Detection Equipment | | | | | |
| Supervision and Administration | | | | | |
| Other Costs | | | | | |
| Total Estimated Costs | | | | | |

D. LEAK SURVEY AND REPAIR SCHEDULE
Indicate realistic, practical dates.

| | | Start Dates | | | | Completion Dates |
|---|---|---|---|---|---|---|
| Phase 1 | | | | | | |
| Area 1 | | | | Area 1 | | |
| Area 2 | | | | Area 2 | | |
| Area 3 | | | | Area 3 | | |
| Phase 2 | | | | | | |
| Area 1 | | | | Area 1 | | |
| Area 2 | | | | Area 2 | | |
| Area 3 | | | | Area 3 | | |

Prepared by _____ Date _____/_____/_____
Title _____

**Form B**

**LEAK DETECTION SURVEY DAILY LOG**

Date:_____ Crew:_____ Survey Time:_____

Area:_____ Vehicle:_____

Weather:_____

Starting Address:_____Ending Address: _____

Route:_____

Miles Surveyed:_____

Brief Description of Each Leak Discovered / Suspected (Size and Location):

1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

Notes:_____

_____

_____

_____

_____

Signed (Crew Chief):_____

**Form C**
**WATER FOR FIRE FIGHTING AND TRAINING**

FIRE DEPARTMENT NAME:_____

CITY OR SYSTEM NAME:_____

MONTH: _____ TANK SIZE: _____(gal)

| | |
|---|---|
| 1 _____ | 16 _____ |
| 2 _____ | 17 _____ |
| 3 _____ | 18 _____ |
| 4 _____ | 19 _____ |
| 5 _____ | 20 _____ |
| 6 _____ | 21 _____ |
| 7 _____ | 22 _____ |
| 8 _____ | 23 _____ |
| 9 _____ | 24 _____ |
| 10 _____ | 25 _____ |
| 11 _____ | 26 _____ |
| 12 _____ | 27 _____ |
| 13 _____ | 28 _____ |
| 14 _____ | 29 _____ |
| 15 _____ | 30 _____ |
| 31 _____ | |

MONTHLY TOTAL:_____

**Form D**
**LINE FLUSHING REPORT**

| Date | Location | GPM | | Time | Gallons |
|---|---|---|---|---|---|
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | | X | | |
| | | Total Gallons | | | |

Remarks: _____

_____

_____

_____

Signature: _____

**Form E**
**LEAK REPAIR SUMMARY REPORT**

By: _____ Date: _____

Work Order #: _____ Crew: _____ Date Completed: _____

Area/Location: _____

Found per Leak Detection Survey (Attached)? _____

| LEAK TYPE | | | | PIPE MATERIAL | | | |
|---|---|---|---|---|---|---|---|
| ____ | Meter Leak | _____ | Fire Hydrant | _____ | Galvanized Iron | _____ | A.C.P. |
| ____ | Meter Spud | _____ | Meter Yoke | _____ | Black Iron | _____ | Steel |
| ____ | Valve Joint | _____ | Ductile | _____ | Iron | _____ | PVC |
| ____ | Curb Stop | _____ | Main | _____ | Cast Iron | _____ | Copper |
| ____ | Service | _____ | Other | _____ | Polybutylene | _____ | Transite |

**OTHER INFORMATION**

Depth to top of pipe _____(ft) Type of bedding _____ Type of backfill _____

Leakage Rate _____(gpm) (___Measured ____Estimated) Estimated age of leak _____

Estimated water lost _____(gal) Previous repairs? _____

How was leak repaired (previous/this time)? _____

_____(Attach "Before" and "After" Photos)

Shape and dimensions _____ Original wall thickness of pipe _____(in)

System Pressure Measured _____? Corrosion _____? Outside _____ Inside _____

**COST OF REPAIRS**

Labor Costs:

Total hours worked _____ x Average hourly rate $ _____ = $_____

Equipment Cost:

| Equipment Used | Hours Used | X | Cost of Equipment | = | Total Equipment Cost |
|---|---|---|---|---|---|
| 1) | | X | $ | = | $ |
| 2) | | X | $ | = | $ |
| 3) | | X | $ | = | $ |
| 4) | | X | $ | = | $ |

Material used _____ Cost $_____

Administrative/Supervisory/Other Cost _____ $_____

**Total Cost of Repairs $**_____

Follow-up listing test? _____(date) OK? _____

Supervisor's Signature _____

**Table No. 1 Leak Rates from Holes of Known Size**

| Gallons per Minute (gpm) | | | | | | |
|---|---|---|---|---|---|---|
| Area of Leak | | Pressure Pounds per Square Inch (psi) | | | | |
| Square Inches | 10 | 20 | 40 | 60 | 80 | 100 |
| 0.005 | 0.5 | 0.8 | 1.1 | 1.3 | 1.5 | 1.7 |
| 0.010 | 1.1 | 1.5 | 2.2 | 2.6 | 3.1 | 3.4 |
| 0.025 | 2.7 | 3.8 | 5.4 | 6.6 | 7.5 | 8.5 |
| 0.050 | 5.4 | 7.6 | 11 | 13 | 15 | 17 |
| 0.075 | 8.1 | 11 | 16 | 20 | 23 | 26 |
| 0.100 | 11 | 15 | 22 | 26 | 31 | 34 |
| 0.200 | 22 | 31 | 43 | 53 | 61 | 68 |
| 0.300 | 32 | 46 | 65 | 79 | 92 | 102 |
| 0.400 | 43 | 61 | 86 | 106 | 122 | 136 |
| 0.500 | 54 | 76 | 108 | 132 | 153 | 171 |
| 0.600 | 65 | 92 | 129 | 159 | 183 | 205 |
| 0.700 | 76 | 107 | 151 | 185 | 214 | 293 |
| 0.800 | 86 | 122 | 173 | 211 | 244 | 273 |
| 0.900 | 97 | 137 | 194 | 238 | 275 | 307 |
| 1.000 | 108 | 153 | 216 | 264 | 305 | 341 |
| 1.100 | 119 | 168 | 237 | 291 | 336 | 375 |
| 1.200 | 129 | 183 | 259 | 317 | 366 | 409 |
| 1.300 | 140 | 198 | 280 | 343 | 397 | 443 |
| 1.400 | 151 | 214 | 302 | 370 | 427 | 443 |
| 1.500 | 162 | 229 | 324 | 396 | 458 | 512 |
| 1.600 | 173 | 244 | 356 | 423 | 488 | 546 |
| 1.700 | 183 | 259 | 367 | 449 | 519 | 580 |
| 1.800 | 194 | 275 | 388 | 476 | 549 | 614 |
| 1.900 | 205 | 290 | 410 | 502 | 580 | 648 |
| 2.000 | 216 | 305 | 431 | 528 | 610 | 682 |
| 2.500 | 270 | 381 | 539 | 661 | 763 | 853 |
| 3.000 | 324 | 458 | 647 | 793 | 915 | 1,023 |
| 4.000 | 431 | 610 | 863 | 1,057 | 1,220 | 1,364 |

The above table is based on the following formula:

Flow = 2.8 x Area x Square Root of (148 x Pressure)

Flow – gpm, Area – Square Inches, Pressure – psi

Example use of TABLE 1.
A hole 1/8 inch by 1 ¼ inch in size at 50 psi
First calculate the area:
1/8 inch = 0.125 inches, 1 ¼ inch = 1.25 inches, Area = 0.125 x 1.25 = 0.156 square inc
From the table, the size that is closest is 0.1 and 0.2 square inches, and the pressure is between 40 and 60 psi. The flow rate is going to be about 36 gpm.

**TEXAS WATER DEVELOPMENT BOARD'S**
**BROCHURES, LEAK DETECTION EQUIPMENT**
**AND**
**SERVICES HANDOUT**

The Texas Water Development Board is a non-regulatory state agency that is set out to provide many services to Water Utilities around the state. Several of these services are: providing brochures, conducting Water Audit/Leak Detector Workshops, and loaning Leak Detectors and master meter verification equipment free for 30-days.

The brochures we provide range in numerous topics including lawn watering, information about your utility, water wise plants. Most of these are also available in Spanish. A complete list of brochures can be found on our website, http://www.twdb.state.tx.us/assistance/conservation/pubs.asp. We are able to send up to 500 brochures per year at no charge, to water utilities, river authorities and other types of governmental agencies.

Water Audit/Leak Detector Workshops are available anytime of the year. This is a TCEQ approved workshop which entitles each operator 4 hours of credit towards the renewal of their operator's license. This workshop discusses how a system can achieve maximum efficiency by implementing a leak detection program and conducting a comprehensive water audit. The Texas Water Development Board presenter will travel to your system and conduct the workshop; all training materials necessary will be provided. The sponsoring system is responsible for providing a training room and scheduling with other systems to ensure a class size of no less than 10 attendees to be eligible for this workshop. An agenda for the workshop and other relevant information is available by contacting Mark Mathis, 512.463.0987 or by accessing our website, http://www.twdb.state.tx.us/assistance/conservation/Municipal/Water_Audit/Leak_Detection/LeakDetection_Workshop.asp.

Our **free** equipment, an Aquascope and Panametrics are both available for loan for 30-days. The Aquascope is an acoustical sounding device that will help you determine where your leaks are within your system. The device has headphones and a ground microphone; together they work quite well in pinpointing your leaks and ruptured pipes. The Panametrics (an ultrasonic device) works with transducers that are placed onto the pipe near your master meter. This equipment will verify the flow rates going through your master or source meters.

Once again, all of this information is provided to you without cost to your utility. To implement one or all of these services, call Mark Mathis at 512.463.0987 or access our website at www.twdb.state.tx.us/assistance/conservation/consindex.asp.

# Appendix B – Water Audit Reporting Form Calculation

**TEXAS WATER DEVELOPMENT BOARD**
P.O. BOX 13231, CAPITOL STATION AUSTIN, TX 78711-3231
**WATER AUDIT REPORTING FORM**

Texas Water Development Board
Mark Mathis, Conservation Division
P.O. Box 13231
Austin, TX 78711
(512.463.0987)
Email: Mark.Mathis@twdb.state.tx.us

Utility Name: Test Utility 02

Type of Utility: WSC MUD WCID SUD CITY Other: WSC

Regional Water Planning Group(s) in which this system operates: Brazos G
http://www.twdb.state.tx.us/mapping/maps/pdf/sb1_groups_8x11.pdf

Name of person competing form: Test Contract

Phone number of person completing form: (512)123-4567

Mailing address of Utility: 123 Test Drive
Austin, TX 78711

Reporting Period: From 01/01/2005 To 12/31/2005

Percentage of water used: Surface 10.00 % Groundwater 90.00 %
(must equal 100%)

Mean household income of population served: $50,000.00
http://factfinder.census.gov/servlet/SAFFPeople?

Population served: 80,000

Note: unit of measure (Acre-feet or Million gallons(MG) or Thousand gallons(KG) or gallons(G)/year) must stay consistent throughout report.

**1. SYSTEM INPUT VOLUME** ACRE-FT MG KG **G**

**Water Delivery -** Amount of water put into delivery system: 4.00

**Production Meter Accuracy** (enter percentage): 90.00 %

**Production Meter Adjustment -** Corrected Input Volume - Water delivery: 0.000

**Corrected Input Volume -** Water Delivery/ Production Meter Accuracy: 0.00

## 2. AUTHORIZED CONSUMPTION

**Billed Metered -** All water sold and metered: 0.000

**Billed Unmetered -** All water sold but not metered: 0.000

**Unbilled Metered -** City and local government use, metered line flushing: 0.00

**Unbilled Unmetered -** Line flushing/fire dept use: 0.00

**Authorized Consumption -** The Total of all authorized water: 0.00

## 3. WATER LOSS

### Apparent Loss

**Customer Meter Accuracy** (enter percentage) 100.00

**Customer Meter Under Registering -** Total Water Sold / Customer Meter Accuracy
0.00

**Billing Adjustment/Waivers** (Unbilled Consumption) 0.00

**Unauthorized Consumption** 0.00

**Total of Apparent Loss** 0.00

### Real Loss

**Main break/leaks** 0.00

**Customer service line leaks/breaks** 0.00

**Storage Tank Overflows** 0.00

**Total of Real Loss** 0.00

**Total of Water Loss** (Apparent Loss + Real Loss)
0.00

**Total of Water Loss + Authorized Consumption**

0.00

**Balancing Error** 0.00
(See 3B "Note" on instruction sheet)

## 4. TECHNICAL PERFORMANCE INDICATORS

**Performance Indicators for Real Losses**

Your utility's number of service connections 0

Your utility's number of miles of main lines 0.00

Service connections per mile of main 0.000

**Total Real Loss/Miles of Main/365** *(in gallons)*
0.000

**Total Real Loss/No. of Service Connections/365** *(in gallons)*
0.000

## 5. FINANCIAL PERFORMANCE INDICATORS

**Total Real Loss** 0.00

**Production cost of water** *(make sure correct unit of measure is used to determine the cost)* $0.00

**Total Real Loss multiplied by production cost of water**
$0.00

**Total Apparent Loss** 0.00

**Retail cost of water** *(make sure correct unit of measure is used to determine the cost)*
$0.00

**Total Apparent Loss multiplied by retail cost of water**
$0.00

# Appendix C – 30 TAC Chapter 288 Subchapter A

# Texas Administrative Code

| | |
|---|---|
| **TITLE 30** | ENVIRONMENTAL QUALITY |
| **PART 1** | TEXAS COMMISSION ON ENVIRONMENTAL QUALITY |
| **CHAPTER 288** | WATER CONSERVATION PLANS, DROUGHT CONTINGENCY PLANS, GUIDELINES AND REQUIREMENTS |
| **SUBCHAPTER A** | WATER CONSERVATION PLANS |
| **RULE §288.2** | **Water Conservation Plans for Municipal Uses by Public Water Suppliers** |

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(a) A water conservation plan for municipal water use by public water suppliers must provide information in response to the following. If the plan does not provide information for each requirement, the public water supplier shall include in the plan an explanation of why the requirement is not applicable.

(1) Minimum requirements. All water conservation plans for municipal uses by public drinking water suppliers must include the following elements:

(A) a utility profile including, but not limited to, information regarding population and customer data, water use data, water supply system data, and wastewater system data;

(B) until May 1, 2005, specification of conservation goals including, but not limited to, municipal per capita water use goals, the basis for the development of such goals, and a time frame for achieving the specified goals;

(C) beginning May 1, 2005, specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for municipal use, in gallons per capita per day. The goals established by a public water supplier under this subparagraph are not enforceable;

(D) metering device(s), within an accuracy of plus or minus 5.0% in order to measure and account for the amount of water diverted from the source of supply;

(E) a program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement;

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

(G) a program of continuing public education and information regarding water conservation;

(H) a water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water;

(I) a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies; and

(J) a means of implementation and enforcement which shall be evidenced by:

(i) a copy of the ordinance, resolution, or tariff indicating official adoption of the water conservation plan by the water supplier; and

(ii) a description of the authority by which the water supplier will implement and enforce the conservation plan; and

(K) documentation of coordination with the regional water planning groups for the service area of the public water supplier in order to ensure consistency with the appropriate approved regional water plans.

(2) Additional content requirements. Water conservation plans for municipal uses by public drinking water suppliers serving a current population of 5,000 or more and/or a projected population of 5,000 or more within the next ten years subsequent to the effective date of the plan must include the following elements:

(A) a program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water;

(B) a record management system to record water pumped, water deliveries, water sales, and water losses which allows for the desegregation of water sales and uses into the following user classes:

(i) residential;
(ii) commercial;
(iii) public and institutional; and
(iv) industrial;

(C) 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 the provisions of this chapter.

(3) Additional conservation strategies. Any combination of the following strategies shall be selected by the water supplier, in addition to the minimum requirements in paragraphs (1) and (2)

of this subsection, if they are necessary to achieve the stated water conservation goals of the plan. The commission may require that any of the following strategies be implemented by the water supplier if the commission determines that the strategy is necessary to achieve the goals of the water conservation plan:

(A) conservation-oriented water rates and water rate structures such as uniform or increasing block rate schedules, and/or seasonal rates, but not flat rate or decreasing block rates;

(B) adoption of ordinances, plumbing codes, and/or rules requiring water-conserving plumbing fixtures to be installed in new structures and existing structures undergoing substantial modification or addition;

(C) a program for the replacement or retrofit of water-conserving plumbing fixtures in existing structures;

(D) reuse and/or recycling of wastewater and/or graywater;

(E) a program for pressure control and/or reduction in the distribution system and/or for customer connections;

(F) a program and/or ordinance(s) for landscape water management;

(G) a method for monitoring the effectiveness and efficiency of the water conservation plan; and

(H) any other water conservation practice, method, or technique which the water supplier shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

(b) A water conservation plan prepared in accordance with 31 TAC §363.15 (relating to Required Water Conservation Plan) of the Texas Water Development Board and substantially meeting the requirements of this section and other applicable commission rules may be submitted to meet application requirements in accordance with a memorandum of understanding between the commission and the Texas Water Development Board.

(c) Beginning May 1, 2005, a public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group.

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**Source Note:** The provisions of this §288.2 adopted to be effective May 3, 1993, 18 TexReg 2558; amended to be effective February 21, 1999, 24 TexReg 949; amended to be effective April 27, 2000, 25 TexReg 3544; amended to be effective October 7, 2004, 29 TexReg 9384

# Appendix D – House Bill 3338, 78th Legislature

H.B. No. 3338

AN ACT

relating to the performance of a water audit by a retail public utility providing potable water.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. Subchapter B, Chapter 16, Water Code, is amended by adding Section 16.0121 to read as follows:

Sec. 16.0121. WATER AUDITS. (a) In this section, "retail public utility" has the meaning assigned by Section 13.002.

(b) Every five years, a retail public utility providing potable water shall perform and file with the board a water audit computing the utility's most recent annual system water loss.

(c) The board shall develop appropriate methodologies and submission dates for a water audit required under Subsection (b) for the following categories of retail public utilities:

(1) retail public utilities serving populations of 100,000 or more;

(2) retail public utilities serving populations of 50,000 or more but less than 100,000;

(3) retail public utilities serving populations of more than 3,300 but less than 50,000; and

(4) retail public utilities serving populations of 3,300 or less.

(d) In developing the methodologies required by Subsection (c), the board shall ensure that each methodology:

(1) is financially feasible for the category of retail public utility for which it is developed; and

(2) considers differences in population density, source of water supply, the mean income of the service population, and other factors determined by the board.

(e) The methodologies required by Subsection (c) shall account for various components of system water loss, including loss from distribution lines, inaccuracies in meters or accounting practices, and theft.

(f) The board shall compile the information included in the water audits required by Subsection (b) according to category of retail public utility and according to regional water planning area. The regional planning group for a regional planning area shall use the

information to identify appropriate water management strategies in the development of a regional water plan under Section 16.053.

SECTION 2. Section 16.053(j), Water Code, is amended to read as follows:

(j) The board may provide financial assistance to political subdivisions under Subchapters E and F of this chapter, Subchapters C, D, E, F, J, O, and P, Chapter 15, and Subchapters D, I, K, and L, Chapter 17, for water supply projects only if:

(1) the board determines that the needs to be addressed by the project will be addressed in a manner that is consistent with the state water plan; [~~and~~]

(2) beginning January 5, 2002, the board:

(A) has approved a regional water plan as provided by Subsection (i), and any required updates of the plan, for the region of the state that includes the area benefiting from the proposed project; and

(B) determines that the needs to be addressed by the project will be addressed in a manner that is consistent with that regional water plan; and

(3) the board finds that the water audit required under Section 16.0121 has been completed and filed.

SECTION 3. This Act takes effect September 1, 2003.

_____ _____

President of the Senate Speaker of the House

I certify that H.B. No. 3338 was passed by the House on May 10, 2003, by a non-record vote.

_____

Chief Clerk of the House

I certify that H.B. No. 3338 was passed by the Senate on May 28, 2003, by the following vote: Yeas 31, Nays 0.

_____

Secretary of the Senate

APPROVED: _____

Date

_____

Governor

# Appendix E – Water Conservation Example

## ARTICLE II. WATER CONSERVATION

### Sec. 90-31. Water conservation plan adopted.

The city council hereby adopts a water conservation plan similar to Edwards Underground Water District's four-stage plan.

(Ord. No. 62A, § 1, 7-17-1990)

### Sec. 90-32. Violations; penalty.

It shall be unlawful for any person, individual, corporation or partnership to intentionally, knowingly, recklessly or negligently use water or allow or cause the use of water in violation of any of the provisions of the water conservation plan. Any person, individual, corporation or partnership who shall violate any provision of this article shall be deemed upon conviction to be guilty of a misdemeanor and shall be punished by a fine of not less than $25.00 nor more than $200.00, and each day such violation continues shall be a separate offense and punishable as such.

(Ord. No. 62A, § 2, 7-17-1990)

### Sec. 90-33. Mandatory conservation measures.

(a) The following conservation measures will become mandatory at each stage as measured at the Dodd Field Test Well AY-68-37-203 (J-17):

(1) *Stage I: 644 feet.*

a. Watering for existing landscaping, new landscaping and vegetable gardens is recommended only between the hours of 8:00 p.m. and 8:00 a.m., or any time with a hand-held hose, a bucket or drip irrigation.

b. Filling of existing private swimming pools and hot tubs is permitted.

c. Filling of new private swimming pools and hot tubs is discouraged.

d. All water waste is prohibited.

e. Washing of sidewalks, driveways and other such impervious surfaces is discouraged.

f. Washing of vehicles is permitted only with a hand-held hose or a bucket, or a commercial car wash with a water recycling capability.

g. Industrial, commercial, agricultural and livestock use should be reduced by any means available.

h. Indoor use of water should be reduced by any means available.

(2) *Stage II: 628 feet.*

a. Watering for new or existing landscaping and vegetable gardens is permitted with sprinklers or sprinkler systems. Residential landscape watering will be allocated by odd vs. even building numbers. Residential landscape watering will be Sundays and Thursdays for odd numbers and Tuesdays and Saturdays for even numbers. Commercial/business landscape watering will be completed on Mondays and Fridays. Watering, whether residential or commercial, is permitted between 8:00 p.m. and 8:00 a.m. If the water pressure is less than 45 psi, and is provided by a water purveyor, those individuals will be allowed one additional day for watering. The day for odd-numbered homes will be Tuesday and even-numbered homes will be Mondays.

b. Watering for new or existing landscaping and vegetable gardens is permitted at any time with a hand-held hose, bucket, drip irrigation system, or reused water.

c. Filling and make-up for new and existing swimming pools and hot tubs is prohibited.

d. All water waste is prohibited.

e. Washing of sidewalks, driveways, and other such impervious surfaces is prohibited.

f. Washing of vehicles is permitted only on Mondays and Wednesdays and only with a handheld hose or a bucket. Commercial car washes using a water recycling system is permitted Monday through Friday only.

g. No water use restrictions are imposed on such utility and essential uses as firefighting, medical use, and health care facilities.

(3) *Stage III: 612 feet.*

a. Watering of new or existing landscapes is permitted with reused water only.

b. Watering of vegetable gardens is permitted with a hand-held hose, bucket, or drip system on any day between 8:00 p.m. and 8:00 a.m.

c. Filling of new or existing private or public swimming pools and hot tubs is prohibited. Makeup for new or existing public or private pools and hot tubs is prohibited.

d. For indoor water use reduction measures, see Stage I

e. For agricultural use reduction measures, see Stage I.

f. For livestock uses, see Stage I.

g. For industrial and commercial water use reduction measures, see Stage I.

h. For water use reduction measures for washing and washing of impervious surface areas, such as sidewalks and driveways, see Stage II. All waste is prohibited.

i. Vehicle washing by commercial facilities is prohibited.

j. No water use restrictions are imposed on such utility and essential uses as firefighting, medical use, and health care facilities. Water use for fire fighting training is strongly discouraged.

k. The city council will be the approval authority for all building permits and certificates of occupancy.

(4) *Stage IV: Determined by water quality.* Additional measures to be determined by the city council.

(b) Water use restrictions become more stringent as stages advance I through IV. All restrictions in initial stages will apply if not specifically altered in a later stage.

(Ord. No. 62A, § 3, 7-17-1990)

# Appendix F – Sample WSC Penalty Policy

**DROUGHT CONTINGENCY**
**AND**
**EMERGENCY WATER DEMAND MANAGEMENT PLAN**

## 1. INTRODUCTION

The goal of this plan is to cause a reduction in water use in response to drought or emergency conditions so that the water availability can be preserved. Since emergency conditions can occur rapidly, responses must also be enacted quickly. This plan has been prepared in advance considering conditions that will initiate and terminate the rationing program.

A Drought/Emergency Management Committee consisting of two Board Members and the System Manager will monitor usage patterns and public education efforts and will make recommendations to the Board on future conservation efforts, demand management procedures or any changes to this plan. The Committee will develop public awareness notices, bill stuffers, and other methods that will begin and continue as a constant type of reminder that water should be conserved at all times, not just during a drought or emergency. This Committee will also review and evaluate any needed amendments or major changes due to changes in the WSC service area population, distribution system or supply. This review and evaluation will be done on a regular basis of five years unless conditions necessitate more frequent amendments.

The plan will be implemented according to the three stages of rationing as imposed by the Board. Section D describes the conditions that will trigger these stages.

## 2. PUBLIC INVOLVEMENT

Opportunity for the public to provide input into the preparation of the Plan was provided by the Board by scheduling and providing public notice of a public meeting to accept input on the Plan. Notice of the meeting was provided to all customers. In the adoption of this plan, the Board considered all comments from customers.

## 3. Coordination with Regional Water Planning Group

Being located within the _____ (name of regional water planning area or areas), a copy of this Plan has been provided to that Regional Water Planning Group.

## 4. TRIGGER CONDITIONS

The Drought Emergency Management Committee is responsible for monitoring water supply and demand conditions on a monthly basis (or more frequently if conditions warrant) and shall determine when conditions warrant initiation or termination of each stage of the plan, that is, when the specified triggers are reached. The Committee will monitor monthly operating reports, water supply or storage tank levels and/or rainfall as needed to determine when trigger conditions are reached. The triggering conditions described below take into consideration: the vulnerability of the water source under drought of record conditions; the production, treatment and distribution capacities of the system, and member usage based

upon historical patterns.

**a. Stage I - Mild Condition:** Stage I water allocation measures may be implemented when one or more of the following conditions exist:

1) Water consumption has reached 80 percent of daily maximum supply for three (3) consecutive days.
2) Water supply is reduced to a level that is only 20 percent greater than the average consumption for the previous month.
3) There is an extended period (at least eight (8) weeks) of low rainfall and daily use has risen 20 percent above the use for the same period during the previous year.

**b. Stage II - Moderate Conditions:** Stage II water allocation measures may be implemented when one of the following conditions exist:

1) Water consumption has reached 90 percent of the amount available for three consecutive days.
2) The water level in any of the water storage tanks cannot be replenished for three (3) consecutive days. Example: The highest recorded water level drops _____ (___) feet or more for _____ (___) consecutive days.

**c. Stage III - Severe Conditions:** Stage III water allocation measures may be implemented when one of the following five conditions exist:

1) Failure of a major component of the system or an event which reduces the minimum residual pressure in the system below 20 psi for a period of 24 hours or longer.
2) Water consumption of 95 percent or more of the maximum available for three (3) consecutive days.
3) Water consumption of 100 percent of the maximum available and the water storage levels in the system drop during one 24-hour period.
4) Natural or man-made contamination of the water supply source(s).
5) The declaration of a state of disaster due to drought conditions in a county or counties served by the Corporation.
6) Reduction of wholesale water supply due to drought conditions.
7) Other unforeseen events which could cause imminent health or safety risks to the public.

## 5. STAGE LEVELS OF WATER ALOCATIONS

The stage levels of water allocations are to be placed in effect by the triggers in Section D. The System shall institute monitoring and enforce penalties for violations of the Drought Plan for each of the Stages listed below. The water allocation measures are summarized below.

**a. Stage I - Mild Conditions**

1) Alternate day, time of day, or duration restrictions for outside water usage allowed. (System will notify Customers which restriction is in effect)
2) The system will reduce flushing operations.
3) Reduction of customers' water use will be encouraged through notices on bills or other method.

**b. Stage II - Moderate Conditions**

1) All outside water use is prohibited (except for a livestock or other exemption or variance granted under this section).
2) Make public service announcements as conditions change via local media (TV, radio, newspapers, etc.).

**c. Stage III - Severe Conditions**

1) All outside watering prohibited.
2) Water use will be restricted to a percentage of each member's prior month usage. This percentage may be adjusted as needed according to demand on the system. Notice of this amount will be sent to each customer.
3) Corporation shall continue enforcement and educational efforts.

**NOTE:**

- Refer to your water purchase contract for additional restrictions/requirements that may be imposed by stipulations from the wholesale supplier.
- There may be additional restrictions imposed by Governmental Entities.
- Meters will be read as often as necessary to insure compliance with this program for the benefit of all the customers.

## 6. INITIATION AND TERMINATION PROCEDURES

Once a trigger condition occurs, the Corporation, or its designated responsible representative, shall, based on recommendation from the Chairperson of the Drought/Emergency Management Committee, decide if the appropriate stage of rationing shall be initiated. The initiation may be delayed if there is a reasonable possibility the water system performance will not be compromised by the condition. If water allocation is to be instituted, written notice to the customers shall be given.

Written notice of the proposed water allocation measure shall be mailed or delivered to each affected customer upon the initiation of each stage. In addition, upon adoption of Stage II or Stage III, a notice will be placed in a local newspaper or announced on a local radio or television station. The customer notice shall contain the following information:

a. The date water allocation shall begin,
b. The expected duration,
c. The stage (level) of water allocations to be employed,
d. Penalty for violations of the water allocation program, and
e. Affected area or areas.

A sample Customer Notice of water allocation conditions is included in Miscellaneous Transaction Forms of this tariff.

If the water allocation program extends 30 days then the Chairperson of the Drought/Emergency Management Committee or manager shall present the reasons for the allocations at the next scheduled Board Meeting and shall request the concurrence of the Board to extend the allocation period.

When the trigger condition no longer exists then the responsible official may terminate the water allocations provided that such an action is based on sound judgment. Written notice of the end of allocations shall be given to customers. A water allocation period may not exceed 60 days without

extension by action of the Board.

## 7. PENALTIES FOR VIOLATIONS

**a. First Violation** – The customer/member will be notified by a written notice of their specific violation and their need to comply with the tariff rules. The notice will show the amount of penalty * to be assessed for continued violations.

**b. Second Violation** - The Corporation will assess a penalty * of $ _____.

**c. Subsequent Violations** - The Corporation will assess an additional penalty * of $_____ for violations continuing after the Second Violation. The Corporation may also install a flow restricting device in the customer's meter service to limit the amount of water that will pass through the meter in a 24 hour period. The costs of this procedure will be for the actual work and equipment and shall be paid by the customer.

**d. Termination** – The Corporation will terminate service for up to 7 days for continuing violations under this section. Service will remain off until any delinquent penalty * or other assessment is fully paid including a charge for the service call to restore service.

**These provisions apply to all customers of the Corporation.**

**NOTE: PENALTY * --** A WSC is allowed to charge a reasonable penalty to customers that fail to comply with the Rationing Procedures in accordance with TAC 291.41 (j) if:

(1) the penalty is clearly stated in the tariff;
(2) the penalty is reasonable and does not exceed six (6) times the minimum monthly bill stated in the water supply corporation's current tariff; and
(3) the water supply corporation has deposited the penalty in a separate account dedicated to enhancing water supply for the benefit of all the water supply corporation's customers.

## 8. EXEMPTIONS OR WAIVERS

The Drought/Emergency Management Committee may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health or sanitation for the public or the person requesting such variance and if one or more of the following conditions are met:

**a.** Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.

**b.** Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the Drought/Emergency Management Committee within 5 days after the Plan or a particular drought response stage has been invoked or after a condition justifying the variance first occurs. All petitions for variances shall be reviewed by the Committee and shall include the following:

- Name and address of the petitioner(s).
- Purpose of water use.
- Specific provision(s) of the Plan from which the petitioner is requesting relief.
- Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Plan.
- Description of the relief requested.

- Period of time for which the variance is sought.
- Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
- Other pertinent information, as requested by the Committee.

Variances granted by the Committee shall be subject to the following conditions, unless specifically waived or modified by the Committee or Board of Directors:

- Variances granted shall include a timetable for compliance.
- Variances granted shall expire when the water allocation is no longer in effect, unless the petitioner has failed to meet specified requirements. No variance allowed for a condition requiring water allocation will continue beyond the termination of water allocation under Section F. Any variance for a subsequent water allocation must be petitioned again. The fact that a variance has been granted in response to a petition will have no relevance to the Committee's decision on any subsequent petition.

No variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

## 9. IMPLEMENTATION

The Board establishes a Drought/Emergency Management Committee by Resolution, the chairperson of which will be the responsible representative to make Drought and Emergency Water Management actions. This Committee will review the procedures in this plan annually or more frequently. Modifications may be required to accommodate system growth, changes in water use demand, available water supply and/or other circumstances.

This Plan was adopted by the Board at a properly noticed meeting held on _____.