

CUSTOMER NOTICE OF SECOND VIOLATION AND PENALTY

DATE: _____

FROM: _____, Manager, Creekwood Ranches WSC

TO: _____, you are hereby notified that on _____ it was determined that you violated the restrictions on your water use that are required under the Corporation's Drought Contingency and Emergency Water Demand Management Plan. Specifically, [DESCRIBE VIOLATION].

This is the SECOND violation. You were notified of a previous violation on (see _____ attached [ATTACH COPY OF CUSTOMER NOTICE OF VIOLATION]). Accordingly, and as provided in the Corporation's Tariff, you are hereby directed to pay a penalty of _____, to be received in the Corporation's business office no later than _____ m., _____. **Failure to pay this penalty by this date and time will result in termination of your water service WITHOUT FURTHER NOTICE. Any further reconnection will require payment of the penalty and a charge for the service call to restore service.**

You are directed immediately to restrict your water use as directed in the Corporation's first , Notice of Violation. **Accordingly, you will be assessed an additional, and more severe, penalty for any violation following this Notice.** Continued violations may result in termination of your water service regardless of whether you pay the penalties assessed for these violations.

A complete copy of our approved Drought Contingency and Emergency Water demand Management Plan remains available for your review at our business office. A copy of the Plan may be obtained on payment of standard copying charges.

The conservation of our water resources is an important responsibility of all members and customers. Your cooperation is appreciated.

Corporation Official _____

CUSTOMER NOTICE OF SUBSEQUENT VIOLATION AND PENALTY

DATE: _____

FROM: _____, Manager, Creekwood Ranches WSC

TO: _____, you are hereby notified that on _____ it was determined that you violated the allocation restricting your water use which is required under the Corporation's Drought Contingency and Emergency Water Demand Plan. Specifically, [DESCRIBE VIOLATION].

You have been notified previously of the restrictions on your water use that must be followed, and you were assessed a penalty for your second violation which occurred on _____ (see attached [ATTACH A COPY OF CUSTOMER NOTICE OF SECOND VIOLATION AND PENALTY]).

The Corporation's previous notice advised you that you would be assessed an additional, and more severe, penalty if the violation continued. This is required under the Corporation's Tariff. Accordingly, you are hereby directed to pay a penalty of _____, to be received in the Corporation's business office no later than _____ m., _____. **Failure to pay this penalty by this date and time will result in termination of your water service WITHOUT FURTHER NOTICE.** Any reconnection will require payment of the penalty and a charge for the service call to restore service.

In addition, the Corporation may install a flow restricting device, which will limit the amount of water that will flow through your meter. The costs of this procedure will be for the actual work and equipment and shall be paid by the customer. Removal of this device will be considered Meter Tampering and will result in disconnection of service without further notice.

You are once again directed immediately to restrict your water use as directed in the Corporation's first notice to you. You have been directed to do so previously. **Additional penalties will be assessed for additional violations. In addition to these penalties, YOUR WATER SERVICE WILL BE TERMINATED FOR A PERIOD OF THREE (3) DAYS FOR ANY ADDITIONAL VIOLATIONS regardless of whether you pay the penalties assessed for these violations.**

Your prompt attention to this matter will be appreciated by the Creekwood Ranches Water Supply Corporation and its members.

Corporation Official _____

NOTICE OF TERMINATION

DATE: _____

FROM: _____, Manager, Creekwood Ranches WSC

TO: _____, you are hereby notified that on ____ it was determined that you violated the restrictions on your water use that are required under the Corporation's Drought Contingency and Emergency Water Demand Management Plan. Specifically, [DESCRIBE VIOLATION].

There have been repeated violations. You previously have been notified of violations on _____, _____, and _____. Because these violations have continued, and as provided under Section H of the Corporation's Tariff, your water service will be terminated on _____. Your service will not be restored until _____ and only after payment of a charge for the service call to restore your service. Additional violations thereafter will result in additional suspensions of your water service.

If any penalties or other charges, including monthly bills, are outstanding, you will be required to fully pay these as well before your service will be restored.

We regret that your continued violation of the water use restrictions required under the Corporation's Drought Contingency and Emergency Water Demand Plan have led to this action.

**CREEKWOOD RANCHES
WATER SUPPLY CORPORATION
SERVICE APPLICATION AND AGREEMENT**

| | |
|-----------------------------|-------|
| CORPORATION USE ONLY | |
| Date Approved: | _____ |
| Service Classification: | _____ |
| Cost: | _____ |
| Work Order Number: | _____ |
| Eng. Update: | _____ |
| Account Number: | _____ |
| Service Inspection Date: | _____ |

Please Print: DATE _____

APPLICANT'S NAME _____

CO APPLICANT'S NAME _____

CURRENT BILLING ADDRESS: _____
FUTURE BILLING ADDRESS: _____

PHONE NUMBER Home (____) _____ - _____ Work (____) _____ - _____

PROOF OF OWNERSHIP PROVIDED BY _____

DRIVER'S LICENSE NUMBER OF APPLICANT _____

LEGAL DESCRIPTION OF PROPERTY (Include name of road, subdivision with lot and block number)

PREVIOUS OWNER'S NAME AND ADDRESS (if transferring Membership)

ACREAGE _____ HOUSEHOLD SIZE _____

NUMBER IN FAMILY _____ LIVESTOCK & NUMBER _____

SPECIAL SERVICE NEEDS OF APPLICANT

NOTE: FORM MUST BE COMPLETED BY APPLICANT ONLY. A MAP OF SERVICE LOCATION REQUEST MUST BE ATTACHED.

The following information is requested by the Federal Government in order to monitor compliance with Federal laws prohibiting discrimination against applicants seeking to participate in this program. You are not required to furnish this information, but are encouraged to do so. This information will not be used in evaluating your application or to discriminate against you in any way. However, if you choose not to furnish it, we are required to note the race/national origin of individual applicants on the basis of visual observation or surname.

| | |
|---|---|
| Ethnicity: <input type="checkbox"/> Hispanic or Latino <input type="checkbox"/> Not of Hispanic or Latino | Race: <input type="checkbox"/> White <input type="checkbox"/> Black or African American <input type="checkbox"/> American Indian/Alaska Native <input type="checkbox"/> Asian <input type="checkbox"/> Native Hawaiian or Other Pacific Islander |
| Gender: Male <input type="checkbox"/> Female | |

AGREEMENT made this _____ day of _____,
between

Creekwood Ranches Water Supply Corporation,

a corporation organized under the laws of the State of Texas (hereinafter called the Corporation) and

_____ (hereinafter called the Applicant
and/or Member),

Witnesseth:

The Creekwood Ranches Water Supply Corporation (the "Corporation") shall sell and deliver water and/or wastewater service to the Applicant and the Applicant shall purchase, receive, and/or reserve service from the Corporation in accordance with the bylaws and tariff of the Corporation as amended from time to time by the Board of Directors of the Corporation. Upon compliance with said policies, and payment of a Membership fee, if required, the Applicant qualifies for Membership as a new applicant or continued Membership as a transferee and thereby may hereinafter be called a Member.

The Member shall pay the Corporation for service hereunder as determined by the Corporation's tariff and upon the terms and conditions set forth therein, a copy of which has been provided as an information packet, for which Member acknowledges receipt hereof by execution of this agreement. A copy of this agreement shall be executed before service may be provided to the Applicant.

The Board of Directors shall have the authority to discontinue service and cancel the Membership of any Member not complying with any policy or not paying any utility fees or charges as required by the Corporation's published rates, fees, and conditions of service. At any time service is discontinued, terminated or suspended, the Corporation shall not re-establish service unless it has a current, signed copy of this agreement.

If this agreement is completed for the purpose of assigning utility service as a part of a rural domestic water and/or wastewater system loan project contemplated with the Rural Development, an Applicant shall pay an Indication of Interest Fee in lieu of a Membership Fee for the purposes of determining:

- a. The number of taps to be considered in the design and
- b. The number of potential ratepayers considered in determining the financial feasibility of constructing
 - 1) a new water system or
 - 2) expanding the facilities of an existing water system.

The Applicant hereby agrees to obtain, utilize, and/or reserve service as soon as it is available. Applicant, upon qualification for service under the terms of the Corporation's policies, shall further qualify as a Member and the Indication of Interest Fee shall then be converted by the Corporation to a Membership Fee. Applicant further agrees to pay, upon becoming a Member, the monthly charges for such service as prescribed in the Corporation's tariff. Any breach of this agreement shall give cause for the Corporation to liquidate, as damages, the fees previously paid as an indication of interest. In addition to any Indication of Interest Fees forfeited, the Corporation may assess a lump sum of \$300.00 as liquidated damages to defray any losses incurred by the Corporation. If delivery of service to said location is deemed infeasible by the Corporation as a part of this project, the Applicant shall be denied Membership in the Corporation and the Indication of Interest Fee, less expenses, shall be refunded. The Applicant may re-apply for service at a later date under the terms and conditions of the Corporation's policies. For the purposes of this agreement, an Indication of Interest Fee shall be of an amount equal to the Corporation's Membership Fees.

All water shall be metered by meters to be furnished and installed by the Corporation. The meter and/or wastewater connection is for the sole use of the Member or customer and is to provide service to only one (1) dwelling or one (1) business. Extension of pipe(s) to transfer utility service from one property to another, to share, resell, or submeter water to any other persons, dwellings, businesses, or property, etc., is prohibited.

The Corporation shall have the right to locate a water service meter and the pipe necessary to connect the meter on the Member's property at a point to be chosen by the Corporation, and shall have access to its property and equipment located upon Member's premises at all reasonable and necessary times for any purpose connected with or in the furtherance of its business operations, and upon discontinuance of service the Corporation shall have the right to remove any of its equipment from the Member's property. The Member shall install, at their own expense, any necessary service lines from the Corporation's facilities and equipment to the point of use, including any customer service isolation valves, backflow prevention devices, clean-outs, and other equipment as may be specified by the Corporation. The Corporation shall also have access to the Member's property for the purpose of inspecting for possible cross-connections, potential contamination hazards, illegal lead materials, and any other violations or possible violations of state and federal statutes and regulations relating to the federal Safe Drinking Water Act or Chapter 341 of the Texas Health & Safety Code or and the corporation's tariff and service policies.

The Corporation is responsible for protecting the drinking water supply from contamination or pollution which could result from improper practices. This service agreement serves as notice to each customer of the restrictions which are in place to provide this protection. The Corporation shall enforce these restrictions to ensure the public health and welfare. The following undesirable practices are prohibited by state regulations:

- a. No direct connection between the public drinking water supply and a potential source of contamination is permitted. Potential sources of contamination shall be isolated from the public water system by an airgap or an appropriate backflow prevention assembly in accordance with state regulations.

- b.No cross-connection between the public drinking water supply and a private water system is permitted. These potential threats to the public drinking water supply shall be eliminated at the service connection by the proper installation of an airgap or a reduced pressure-zone backflow prevention assembly and a service agreement must exist for annual inspection and testing by a certified backflow prevention device tester.
- c.No connection which allows condensing, cooling, or industrial process water to be returned to the public drinking water supply is permitted.
- d.No pipe or pipe fitting which contains more than 8.0 % lead may be used for the installation or repair of plumbing on or after July 1, 1988, at any connection which provides water for human consumption.
- e.No solder or flux which contains more than 0.2 % lead may be used for the installation or repair plumbing on or after July 1, 1988, at any connection which provides water for human consumption.

The Corporation shall maintain a copy of this agreement as long as the Member and/or premises is connected to the public water system. The Member shall allow their property to be inspected for possible cross-connections, potential contamination hazards, and illegal lead materials. These inspections shall be conducted by the Corporation or its designated agent prior to initiating service and periodically thereafter. The inspections shall be conducted during the Corporation's normal business hours.

The Corporation shall notify the Member in writing of any cross-connections or other undesirable practices which have been identified during the initial or subsequent inspection. The Member shall immediately correct any undesirable practice on their premises. The Member shall, at their expense, properly install, test, and maintain any backflow prevention device required by the Corporation. Copies of all testing and maintenance records shall be provided to the Corporation as required. Failure to comply with the terms of this service agreement shall cause the Corporation to either terminate service or properly install, test, and maintain an appropriate backflow prevention device at the service connection. Any expenses associated with the enforcement of this agreement shall be billed to the Member.

In the event the total water supply is insufficient to meet all of the Members, or in the event there is a shortage of water, the Corporation may initiate the Drought Contingency Plan as specified in the Corporation's tariff. By execution of this agreement, the Applicant hereby shall comply with the terms of said program.

By execution hereof, the Applicant shall hold the Corporation harmless from any and all claims for damages caused by service interruptions due to waterline breaks by utility or like contractors, tampering by other Member/users of the Corporation, normal failures of the system, or other events beyond the Corporation's control.

The Applicant shall grant to the Corporation permanent recorded easement(s) dedicated to the Corporation for the purpose of providing reasonable rights of access and use to allow the Corporation to construct, maintain, replace, upgrade, parallel, inspect, test and operate any facilities necessary to serve that Applicant as well as the Corporation's purposes in providing system-wide service for existing or future members.

By execution hereof, the Applicant shall guarantee payment of all other rates, fees, and charges due on any account for which said Applicant owns a Membership Certificate. Said guarantee shall pledge any and all Membership Fees against any balance due the Corporation. Liquidation of said Membership Fees shall give rise to discontinuance of service under the terms and conditions of the Corporation's tariff.

By execution hereof, the Applicant agrees that non-compliance with the terms of this agreement by said Applicant shall constitute denial or discontinuance of service until such time as the violation is corrected to the satisfaction of the Corporation.

Any misrepresentation of the facts by the Applicant on any of the four pages of this agreement shall result in discontinuance of service pursuant to the terms and conditions of the Corporation's tariff.

Witnesseth

Applicant Member

Approved and Accepted

Date Approved

**UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service**

RIGHT-OF-WAY EASEMENT (General Type Easement)

KNOW ALL MEN BY THESE PRESENTS, that _____ (hereinafter called "Grantors"), in consideration of one dollar (\$1.00) and other good and valuable consideration paid by _____ (hereinafter called "Grantee"), the receipt and sufficiency of which is hereby acknowledged, does hereby grant, bargain, sell, transfer, and convey to said Grantee, its successors, and assigns, a perpetual easement with the right to erect, construct, install and lay and thereafter access and use, operate, inspect, repair, maintain, replace, upgrade, parallel and remove water distribution and/or sewer collection lines and appurtenances, over and across _____ acres of land, more particularly described in instrument recorded in Vol. _____, Page _____, Deed Records, _____ County, Texas, together with the right of ingress and egress over Grantor's adjacent lands for the purpose for which the above mentioned rights are granted. The easement hereby granted shall not exceed 15' in width, and Grantee is hereby authorized to designate the course of the easement herein conveyed except that when the pipeline(s) is installed, the easement herein granted shall be limited to a strip of land 15' in width, the center line thereof being the pipeline as installed.

Grantee shall have such other rights and benefits necessary and/or convenient for the full enjoyment and use of the rights herein granted, including without limitation, (1) the reasonable right of ingress and egress over and across lands owned by Grantor which are contiguous to the easement; (2) the reasonable right from time to time to remove any and all paving, undergrowth and other obstructions that may injure Grantee's facilities and appurtenances or interfere with the construction, maintenance, inspection, operation, protection, repair, alteration, testing, replacement, upgrading, relocation (as above limited), substitution or removal thereof; and (3) the rights to abandon-in-place any and all water supply and/or sewer distribution lines, service lines and associated appurtenances, such that Grantee shall have no obligation or liability to Grantor, or their successors or assigns, to move or remove any such abandoned lines or appurtenances.

In the event the easement hereby granted abuts on a public road and the county or state hereafter widens or relocates the public road so as to require the relocation of this water and/or sewer line as installed, Grantor further grants to Grantee an additional easement over and across the land described above for the purpose of laterally relocating said water and/or sewer line as may be necessary to clear the road improvements, which easement hereby granted shall be limited to a strip of land 15' in width, the center line thereof being the pipeline as relocated.

The consideration recited herein shall constitute payment in full for all damages sustained by Grantors by reason of the installation of the structures referred to herein and the Grantee will maintain such easement in a state of good repair and efficiency so that no unreasonable damages will result from its use to Grantor's premises. This Agreement together with other provisions of this grant shall constitute a covenant running with the land for the benefit of the Grantee, its successors, and assigns. The Grantors covenant that they are the owners of the above described lands and that said lands are free and clear of all encumbrances and liens except the following:

Section I

Form RD-TX 442-9
(Rev. 6-06)

Grantor does hereby bind itself, its successors and assigns, to WARRANT AND FOREVER DEFEND, all and singular, the easement herein granted to Grantee, or Grantee's successors and assigns, against every person whomsoever claiming, or to claim, the same or any part thereof.

The easement conveyed herein was obtained or improved through Federal financial assistance. This easement is subject to the provisions of Title VI of the Civil Rights Act of 1964 and the regulations issued pursuant thereto for so long as the easement continues to be used for the same or similar purpose for which financial assistance was extended or for so long as the Grantee owns it, whichever is longer.

IN WITNESS WHEREOF the said Grantors have executed this instrument this _____ day of _____, 20_____.

ACKNOWLEDGEMENT

(Individual)

STATE OF TEXAS §
COUNTY OF _____ §

This instrument was acknowledged before me on _____ by _____
_____.

(SEAL)

Notary Public, State of Texas

**UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service**

**RIGHT-OF-WAY EASEMENT (Location of Easement
Required)**

KNOW ALL MEN BY THESE PRESENTS, That _____
(hereinafter called "Grantors"), in consideration of one dollar (\$1.00) and other good and valuable consideration paid by _____, (hereinafter called "Grantee"), the receipt and sufficiency of which is hereby acknowledged, does hereby grant, bargain, sell, transfer, and convey to said Grantee, its successors, and assigns, a perpetual easement with the right to erect, construct, install, and lay and thereafter access and use, operate, inspect, repair, maintain, replace, upgrade, parallel and remove water distribution and/or sewer collection lines and appurtenances, over and across _____ acres of land, more particularly described in instrument recorded in Vol. _____, Page _____, Deed Records,

_____ County, Texas, together with the right of ingress and egress over Grantors' adjacent lands for the purposes for which the above mentioned rights are granted. The easement hereby granted shall not exceed 15' in width, the center line thereof to be located across said land as follows:

Grantee shall have such other rights and benefits necessary and/or convenient for the full enjoyment and use of the rights herein granted, including without limitation, (1) the reasonable right of ingress and egress over and across lands owned by Grantor which are contiguous to the easement; (2) the reasonable right from time to time to remove any and all paving, undergrowth and other obstructions that may injure the Grantee's facilities and appurtenances or interfere with the construction, maintenance, inspection, operation, protection, repair, alteration, testing, replacement, upgrading, relocation (as above limited), substitution or removal thereof; and (3) the right to abandon-in-place any and all water supply and/or sewer distribution lines, service lines and associated appurtenances, such that Grantee shall have no obligation or liability to Grantor, or their successor or assigns, to move or remove any such abandoned lines or appurtenances.

In the event the county or state hereafter widens or relocates any public road so as to require the relocation of this water and/or sewer line as installed, Grantor further grants to Grantee an additional easement over and across the land described above for the purpose of laterally relocating said water and/or sewer lines as may be necessary to clear the road improvements, which easement hereby granted shall be limited to a strip of land 15' in width, the center line thereof being the pipeline as relocated.

The consideration recited herein shall constitute payment in full for all damages sustained by Grantors by reason of the installation of the structures referred to herein, and the Grantee will maintain such easement in a state of good repair and efficiency so that no unreasonable damages will result from its use to Grantors' premises. This agreement together with other provisions of this grant shall constitute a covenant running with the land for the benefit of the Grantee, its successors, and assigns. The Grantors covenant that they are the owners of the above described lands and that said lands are free and clear of all encumbrances and liens except the following:

Grantor does hereby bind itself, its successors and assigns, to WARRANT AND FOREVER DEFEND, all and singular, the easement herein granted to Grantee, or Grantee's successors and assigns, against every person whomsoever claiming, or to claim, the same or any part thereof.

The easement conveyed herein was obtained or improved through Federal financial assistance. This easement is subject to the provisions of Title VI of the Civil Rights Act of 1964 and the regulations issued pursuant thereto for so long as the easement continues to be used for the same or similar purpose for which financial assistance was extended or for so long as the Grantee owns it, whichever is longer.

IN WITNESS WHEREOF the said Grantors have executed this instrument this _____ day of _____, 20_____.

ACKNOWLEDGEMENT

(Individual)

STATE OF TEXAS §
COUNTY OF _____ §

This instrument was acknowledged before me on _____ by _____
_____.

(SEAL)

Notary Public, State
of Texas

**CREEKWOOD RANCHES WATER SUPPLY
CORPORATION LINE EXTENSION REFUND
AGREEMENT**

The Creekwood Ranches Water Supply Corporation Board affirms that _____ will be compensated as provided in this Refund agreement approved at the regular board meeting on the _____ day of _____, 20____, on a prorated basis for construction costs for the _____ feet of inch line extension which have been paid by _____. This will be collected from all approved applicants requesting service from said line extension, to a maximum of _____ connections for a period not to exceed _____ years from the _____ day of _____ in the year of _____ (date the line extension was completed and/or approved for service) after which time the Refund Agreement will expire and the Corporation shall be under no further obligation to _____. The Corporation shall transfer said compensation within _____ days of receipt.

It is to understand that the Corporation will secure this compensation through new customer service fees from applicants for service from said line extension, and from no other sources. Accordingly, the compensation provided by this Refund Agreement will be modified automatically in the event any applicant requesting service from said line extension obtains a final administrative or Judicial Determination limiting the amount the Corporation may charge applicants for service from said line extension.

This agreement entered into on the _____ day _____ in the year of _____ by:

Creekwood Ranches Water Supply Corporation

Signed by Applicant

Signed by President

address

address

city

zip

city

zip

Witness

Date filed: _____ / _____ / _____

THE STATE OF TEXAS, COUNTY OF _____
IN WITNESS WHEREOF the said Member/Applicant and President of Creekwood Ranches WSC has executed this instrument this _____ day of _____, 20____.
BEFORE ME, the undersigned, a Notary Public in and for County and State of Texas, on this day personally appeared _____ and _____ known to me to be the persons whose names are subscribed to the foregoing instrument, and acknowledged to me that he/she/they executed the same for the purpose and consideration therein expressed.
GIVEN UNDER MY HAND AND SEAL OF OFFICE THIS _____ day of _____, 20____.

Commission Expires

(Notary Public Signature)

**CREEKWOOD RANCHES WATER SUPPLY
CORPORATION REQUEST FOR SERVICE
DISCONTINUANCE**

I/Business Name _____, hereby request that my water or sewer service account number _____ located at _____, be disconnected from Creekwood Ranches Water Supply Corporation service and that my membership fee is be refunded. I understand that if I should ever want my service reinstated I may have to reapply for service as a new member and I may have to pay all costs as indicated in the re-service provisions in the current copy of the Creekwood Ranches Water Supply Corporation Tariff.

Charges for water or sewer service will terminate when this signed statement is received by the Creekwood Ranches WSC office. I understand and agree that a fee will be incurred for the processing of this transaction and will be deducted from the membership fee in addition to final water, sewer and service trip charges.(Residential account)

If applicable, I further represent to the Corporation that my spouse joins me in this request and I am authorized to execute this Request for Service Discontinuance on behalf of my spouse as a joint owner of the aforementioned property.

(Commercial account)

I further represent to the Corporation that I am the duly authorized representative of _____ and have full authority to execute this Request for Service Discontinuance on behalf of said business.

Signature

Date of Signature

**CREEKWOOD RANCHES WATER SUPPLY
CORPORATION MEMBERSHIP MORTGAGE
AGREEMENT**

This agreement hereby verifies that the Creekwood Ranches WSC provides or is able to provide utility service under the terms and conditions of its Tariff to the property so designated in this agreement.

The Creekwood Ranches WSC does meet the service requirements of the Texas Commission on Environmental Quality and currently holds all authorization or certification required.

The Membership available/assigned to this property is transferable to all legally qualifying interests upon compliance with the terms and conditions of the Creekwood Ranches WSC's Tariff, including but not limited to completion of all required forms and applications, payment of all fees, and payment of final account balances.

The Creekwood Ranches WSC shall notify any Loan/Membership guarantor and/or mortgagee by certified mail at least thirty (60) days prior to Membership/Service termination and guarantor/mortgagee hereby guarantees payment of any account balances required to prevent termination of Membership by the Creekwood Ranches WSC.

A guarantor and/or mortgagee shall qualify as a bona fide lien-holder to the Membership by providing a Deed of Trust*, to be hereto affixed, for the real property in question and designated below which clearly defines the guarantor and/or mortgagee as the lien-holder of the Membership and the real property for which Membership was issued. Creekwood Ranches WSC shall notify the entity so designated in the Deed of Trust*.

Legal Description of Property:

Mortgagee (Lien-Holder)

Guarantor (If Applicable)

Creekwood Ranches WSC Representative

Date

Note: * Please attach Deed of Trust or other proof of ownership for permanent record.

ALTERNATE BILLING AGREEMENT FOR RENTAL ACCOUNTS

NAME: _____

METER #: _____

ADDRESS: _____

ACCT #: _____

I hereby authorize Creekwood Ranches Water Supply Corporation to send all billings on my account to the person(s) and address below until further written notice:

I understand that under this agreement that I will be given notice by the Corporation of all delinquencies on this account prior to disconnection of service. A notification fee shall be charged to the account in accordance with the provisions of the Corporation's Tariff.

I understand that if I request that my membership be canceled at this location, thereby discontinuing service to an occupied rental property, that the Corporation will provide the above listed person with written notice of disconnection five (5) days prior to the scheduled disconnection date.

I also understand that I am responsible to see that this account balance is kept current, as is any other account in the Corporation. This account shall not be reinstated until all debt on the account has been retired.

Signature _____

Date _____

**CREEKWOOD RANCHES WSC
NOTICE OF RETURNED CHECK**

TO:

DATE:

CHECK NUMBER:

AMOUNT OF CHECK:

Your check has been returned to us by your bank for the following reasons:

You have ten days from the date of this notice in which to redeem the returned check and pay an additional \$____.00 Returned Check Fee. Redemption of the returned check and payment of additional fees may be made by cash, money order, or certified check. If you have not redeemed the returned check and paid the additional service fees within ten (10) days, your utility service will be disconnected unless other arrangements have been made with management.

CREEKWOOD RANCHES WSC
MANAGEMENT

**CREEKWOOD RANCHES WSC
DEFERRED PAYMENT AGREEMENT**

By execution of this Agreement, the undersigned Member agrees to payment of outstanding debt for water utility service as set forth below:

Member agrees to pay \$_____per month, in addition to current monthly water utility service rates, fees, and charges, as set forth in the Corporation's Tariff, until the account is paid in full. Any fees normally assessed by the corporation on any unpaid balance shall apply to the declining unpaid balance.

Failure to fulfill the terms of this Agreement shall institute the Corporation's disconnection procedures as set forth in the Corporation's Tariff unless other satisfactory arrangements are made by the Member and approved by the Corporation's authorized representative.

Member

Date

Creekwood Ranches WSC Authorized Representative

**NOTICE OF PROHIBITION OF MULTIPLE CONNECTIONS TO A SINGLE
TAP**

DATE: _____

FROM: _____, Manager, Creekwood Ranches WSC

TO: _____, you are hereby notified that Creekwood Ranches Water Supply Corporation ("Corporation") has sufficient reason to believe a Multiple Connection exists on your property at _____ in violation of the Corporation's tariff, Section E Prohibition of Multiple Connections. Pursuant to the tariff, no more than one (1) residential, commercial, or industrial service connection is allowed per meter or sewer tap.

The Corporation shall discontinue service under the Disconnection with Notice provisions of the Corporation's tariff if the Multiple Connection is not rectified within _____ (days or date).

See also 30 Texas Administrative Code 290.38(15) and 290.44(d)(4) and Texas Commission on Environmental Quality's Regulatory Guidance document number RG-219 attached.

(page 1 of 2)



TCEQ REGULATORY GUIDANCE

Water Supply Division

RG-219 • May 2008

One Meter per Residence Requirements

It is important for water customers to receive a continuous and adequate supply of water. It is equally important for retail public utilities to have adequate measures in place to help ensure that each water customer receives an adequate supply of water that is protected from contamination from external sources. To help achieve this, rules have been written for the protection of both the customer and the utilities that call for one meter per residence or per commercial connection. The following are excerpts from TCEQ rules. The numbers and letters in brackets indicate where these rules can be found in the Texas Administrative Code (30 TAC).

These rules apply to public water utilities:

One meter is required for each residential, commercial, or industrial service connection. An apartment building or mobile home park may be considered by the utility to be a single commercial facility for the purpose of these sections. The executive director may grant an exception to the individual meter requirement if the plumbing of an existing multiple use or multiple occupant building would prohibit the installation of individual meters at a reasonable cost or would result in unreasonable disruption of

the customary use of the property.

[291.89(a)(4)]

Use of meter. All charges for water service shall be based on meter measurements, except where otherwise authorized in the utility's approved tariff. [291.89(a)(1)]

These rules apply to retail public utilities and public water systems:

Each community public water system shall provide accurate metering devices at each service connection for the accumulation of water usage data. [290.44(d)(4)]

Connection - A single family residential unit or each commercial or industrial establishment to which drinking water is supplied from the system. [290.38]

Questions? Contact the Consumer Assistance group, Water Supply Division, at 512-239-4691 (*fax*, 512-239-6145) or by mail at this address: Consumer Assistance MC 153
TCEQ
PO Box 13087
Austin TX 78711-3087

CUSTOMER REQUEST THAT PERSONAL INFORMATION CONTAINED IN UTILITY RECORDS NOT BE RELEASED TO UNAUTHORIZED PERSONS

Chapter 182, Subchapter B of the Texas Utilities Code allows water utilities to give their customers the option of making the customer's address, telephone number, account records, and social security number confidential. A customer also may make confidential information relating to the volume or units of utility usage or the amounts billed to or collected from the individual for utility usage, unless the primary source of water for the utility is a sole-source designated aquifer.

IS THERE A CHARGE FOR THIS SERVICE?

Yes. There is a one-time charge of \$.00 to cover the cost of postage and implementation which must be paid at the time of request.

HOW CAN YOU REQUEST THIS?

Simply complete the form at the bottom of this page and return it with your check or money order for \$____.00 to:
Creekwood Ranches Water Supply Utility
Address
City, State Zip

Your response is not necessary if you do not want this service.

WE MUST STILL PROVIDE THIS INFORMATION UNDER LAW TO CERTAIN PERSONS.

We must still provide this information to (1) an official or employee of the state or a political subdivision of the state, or the federal government acting in an official capacity; (2) an employee of a utility acting in connection with the employee's duties; (3) a consumer reporting agency; (4) a contractor or subcontractor approved by and providing services to the utility or to the state, a political subdivision of the state, the federal government, or an agency of the state or federal government; (5) a person for whom the customer has contractually waived confidentiality for personal information; or (6) another entity that provides water, wastewater, sewer, gas, garbage, electricity, or drainage service for compensation.

Detach and Return This Section

I want you to make my personal information, including my address, telephone number, usage and billing records, and social security number confidential. I have enclosed my payment of \$.00 for this service.

Name of Account Holder

Account Number

Address

Area Code/Telephone Number

City, State, Zip Code

Signature

**CREEKWOOD RANCHES
WSC TERMINATION
NOTICE**

TO:

ACCOUNT NUMBER:

DATE:

DATE OF SCHEDULED TERMINATION:

You are hereby advised that the delinquent status of your account is jeopardizing your Membership with the Corporation. If our office does not receive payment within ten days of the date of this notice, your utility service will be terminated. To regain service after termination, you must re-apply for a new Membership and pay all costs applicable to purchasing a new Membership under the terms of the Corporation's Tariff. If you have no intentions of retaining our service, make sure the service line is capped. We will not cap your line for you, but will remove the meter regardless of the circumstances.

CREEKWOOD RANCHES WSC
MANAGEMENT

CUSTOMER SERVICE INSPECTION CERTIFICATION

Name of PWS _____ PWS I.D.# _____

Location of Service _____

Reason for Inspection: New construction
 Existing service where contaminant hazards are suspected
 Major renovation or expansion of distribution facilities

I _____, upon inspection of the private water distribution facilities connected to the aforementioned public water supply do hereby certify that, to the best of my knowledge:

| | Compliance | Non-Compliance |
|---|--------------------------|--------------------------|
| (1) No direct connection between the public drinking water supply and a potential source of contamination exists. Potential sources of contamination are isolated from the public water system by an air gap or an appropriate backflow prevention assembly in accordance with commission regulations. | <input type="checkbox"/> | <input type="checkbox"/> |
| (2) No cross-connection between the public drinking water supply and a private water system exists. Where an actual air gap is not maintained between the public water supply and a private water supply, an approved reduced pressure-zone backflow prevention assembly is properly installed and a service agreement exists for annual inspection and testing by a certified backflow prevention device tester. | <input type="checkbox"/> | <input type="checkbox"/> |
| (3) No connection exists which would allow the return of water used for condensing, cooling or industrial processes back to the public water supply. | <input type="checkbox"/> | <input type="checkbox"/> |
| (4) No pipe or pipe fitting which contains more than 8.0% lead exists in private water distribution facilities in on or after July 1, 1988. | <input type="checkbox"/> | <input type="checkbox"/> |
| (5) No solder or flux which contains more than 0.2% lead exists in private water distribution facilities installed on or after July 1, 1988. | <input type="checkbox"/> | <input type="checkbox"/> |

Water service shall not be provided or restored to the private water distribution facilities until the above conditions are determined to be in compliance.

I further certify that the following materials were used in the installation of the water distribution facilities:

| | | | | | | | | |
|---------------|------|--------------------------|-----------|--------------------------|--------------|--------------------------|-------|--------------------------|
| Service lines | Lead | <input type="checkbox"/> | Copper | <input type="checkbox"/> | PVC | <input type="checkbox"/> | Other | <input type="checkbox"/> |
| Solder | Lead | <input type="checkbox"/> | Lead Free | <input type="checkbox"/> | Solvent Weld | <input type="checkbox"/> | Other | <input type="checkbox"/> |

I recognize that this document shall become a permanent record of the aforementioned Public Water System and that I am legally responsible for the validity of the information I have provided.

Signature of Inspector

Registration Number

Title

Type of Registration

Date

NOTICE OF RATE INCREASE

The Creekwood Ranches Water Supply Corporation ("Corporation") Board of Directors held a public meeting on _____ (date) and voted to increase the monthly rates for water/sewer service for all members. (Insert reason for rate increase including measures the Corporation took to justify the increase such as rate analysis, etc.)

The new rates will take effect 30 days after this board decision, on _____ (date) and the new monthly rates will begin starting with the _____ (month) billing. The rate changes are as follows:

| METER SIZE | 5/8" X 3/4" METER EQUIVALENTS | NEW MONTHLY BASE RATE | CURRENT MONTHLY BASE RATE |
|--|----------------------------------|--------------------------|------------------------------|
| 5/8" X 3/4" | 1.0 | \$_____.00 | \$_____.00 |
| 3/4" | 1.5 | \$_____.00 | \$_____.00 |
| " | 2.5 | \$_____.00 | \$_____.00 |
| 1 1/2" | 5.0 | \$_____.00 | \$_____.00 |
| 2" | 8.0 | \$_____.00 | \$_____.00 |
| 3" DISP. | 9.0 | \$_____.00 | \$_____.00 |
| 3" CMPD. | 16.0 | \$_____.00 | \$_____.00 |
| 3" TURB. | 17.5 | \$_____.00 | \$_____.00 |
| 4" CMPD. | 25.0 | \$_____.00 | \$_____.00 |
| 4" TURB. | 30.0 | \$_____.00 | \$_____.00 |
| 6" CMPD. | 50.0 | \$_____.00 | \$_____.00 |
| 6" TURB. | 62.5 | \$_____.00 | \$_____.00 |
| 8" CMPD. | 80.0 | \$_____.00 | \$_____.00 |
| | | | |
| Water Gallonage charge | | NEW MONTHLY | CURRENT MONTHLY |
| \$ _____.00 per _____,000 gallons for 0 to _____,000 gallons | | \$_____.00 | \$_____.00 |
| \$ _____.00 per _____,000 gallons for _____,000 gallons to _____,000 gallons | | \$_____.00 | \$_____.00 |
| \$ _____.00 per _____,000 gallons for _____,000 gallons and over | | \$_____.00 | \$_____.00 |
| | | | |
| Sewer rate | NEW MONTHLY | CURRENT MONTHLY | |
| | \$_____.00 | \$_____.00 | |

For more information about the rate increase, please contact the Corporation at _____ or person at our main office located at _____

Guidance Matrix for Assigning Scores to Components of the Water Audit

| COMPONENT | ASSESSMENT TABLE | | | | |
|---|--|---|---|---|--|
| SYSTEM DATA | 1 | 2 | 3 | 4 | 5 |
| <i>Length of mains</i> | Estimates only | Paper records in poor condition (no totals from year to year) | Good annual paper records | Electronic records and asset management system in good condition; includes system backup | GIS data and asset management database in agreement; random field checks validate databases |
| <i>Improvements in quantifying the length of mains</i> | Research and collect paper records for a number of years prior to audit year | Improve to include all totals for at least five years prior to audit year | Convert to electronic databases with backup | Link GIS and asset management databases; conduct field verification of data | Continue with standardization and random field validation to improve knowledge of system |
| <i>Average operating pressure</i> | Estimates only | Random pressure testing and averaging | Pressure testing through system standardized on annual basis | Combine pressure testing to calibrate hydraulic model to develop average system pressure | District testing and averaging matching data from hydraulic model |
| <i>Improvements in quantifying the average operating pressure</i> | Develop total system pressure by averaging known pressure from hydrant and random pressure tests | Improve standardization of pressure testing and recording | Analyze SCADA pressure data and assess average system pressure through hydraulic network modeling | Conduct standardized pressure testing as part of calibration process for developing hydraulic model | Continue with standardization and random field validation to improve knowledge of system; refine hydraulic model |
| System Data | | | | | 10 |
| WATER SUPPLIED | 1 | 2 | 3 | 4 | 5 |
| <i>Volume from own sources</i> | No meters; volume quantified by estimates only | Partially metered; several supply sources metered but not all | Fully metered; no regular testing or calibration of meters | Fully metered; partial testing or electronic calibration; no meters greater than 15 years old | Fully metered; annual electronic calibration and flow testing; no meters greater than 15 years old |
| <i>Improvements in quantifying volume from own sources</i> | Install meters | Complete 100% metering | Initiate testing of meters | Reduce age of meters unless able to prove accuracy of all old meters through flow testing | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |

Appendix 1.3 continued

| | | | | | |
|---|--|---|--|---|--|
| <i>Production meter accuracy</i> | No testing of production meters; estimated adjustment used only as needed | Testing of production meters only where problems suspected | Systematic testing of meters; underperforming meters not always replaced | Systematic testing of all meters within at least a five-year cycle; all meters over standards replaced or repaired and retested | Testing of all production meters conducted in year of audit; replacement of all meters outside standard accuracy range |
| <i>Improvements to master meter error adjustment</i> | Start testing program | Develop systematic testing program | Replace or repair all non-standard meters | Test all production meters annually; repair or replace all underperforming meters | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |
| <i>Water imported</i> | No meters; volume quantified by estimates only | Partially metered; several supply sources metered but not all | Fully metered; no regular testing or calibration of meters | Fully metered; partial testing or electronic calibration; no meters greater than 15 years old | Fully metered; annual electronic calibration and flow testing; no meters greater than 15 years old |
| <i>Improvements in quantifying volume of water imported</i> | Install meters | Complete 100% metering | Initiate testing of meters | Reduce age of meters unless able to prove accuracy of all old meters through flow testing | No new work; standardize calibration, testing, and replacement to maintain this high level of service |
| <i>Water exported</i> | No meters; volume quantified by estimates only | Partially metered; several interconnections metered but not all | Fully metered; no regular testing or calibration | Fully metered; partial testing or electronic calibration; no meters greater than 15 years old | Fully metered; annual electronic calibration and flow testing; no meters greater than 15 years old |
| <i>Improvements in quantifying volume of water exported</i> | Install meters | Complete 100% metering | Initiate testing of meters | Reduce age of meters unless able to prove accuracy of all old meters through flow testing | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |
| Water Supplied | | | | | 20 |
| AUTHORIZED CONSUMPTION | 1 | 2 | 3 | 4 | 5 |
| <i>Billed metered</i> | No consumption data gathered; flat or fixed rate in use only | Manual meter reads and billings; no regular audits of customer billing data | Automated billing system; no annual checks of data | Automated meter reading and billing system; internally checked or checked by third party on less than annual basis | Automated meter reading and billing system audited by third party on annual basis |
| <i>Improvements in quantifying volume of billed metered consumption</i> | Start meter reading and volume-based billing; plan computerized billing system | Develop computerized billing system; consider automatic meter reading | Conduct internal checks of billing data; install automatic meter reading | Conduct third-party audit of billed data | Continue and standardize program |

Appendix 1.3 continued

| | | | | | |
|---|---|--|--|---|--|
| <i>Billed unmetered</i> | Estimates of consumption used | Production meters used to determine consumption; all areas not monitored | Production meters used to determine consumption; all areas monitored | District meters (each 3,000 or fewer connections) used to determine consumption; No total coverage; rest use production meters | District meters (each covers 3,000 connections or less) throughout system used to determine consumption |
| <i>Improvements in quantifying volume of billed unmetered consumption</i> | Develop methods to meter at a higher level (production or district level) | Improve level of monitoring to all areas or consider metering any unmetered accounts | Reduce size of monitored areas or meter unmetered accounts | Reduce size of monitored areas and standardize system analysis, or meter unmetered accounts | Continue and standardize program; all customers who can feasibly be metered are metered |
| <i>Unbilled metered</i> | No testing; estimates only | Testing only where problems suspected | Systematic testing of all meters; underperforming meters not always replaced | Systematic testing of all meters within at least a five-year cycle; all meters over standards replaced or repaired and retested | Testing of all production meters conducted in year of audit; replacement of all meters outside standard accuracy range |
| <i>Improvements in quantifying volume of unbilled metered consumption</i> | Start testing program and regular meter readings | Develop systematic testing program; consider automatic meter reading | Replace or repair all non-standard meters; install automatic meter reading | Test all meters annually; repair or replace all underperforming meters | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |
| <i>Unbilled unmetered</i> | Overall estimates throughout system | Partial estimates for some of variables; basic estimates for others | Estimates using formulae (for example, time x gallons per flush) for known events | Partial estimates using test data; other estimates using formulae from known number of events | Estimates using previous metered testing to determine overall estimated values |
| <i>Improvements in quantifying volume of unbilled unmetered consumption</i> | Develop estimates for various unbilled metered events; use default of 1.25% of input volume; change to metered values | Record number of events and develop standard formula for calculating volume, or change to metered values | Conduct test studies of defined duration to determine actual versus estimated volumes, or change to metered values | Conduct test studies on all variables to determine actual versus estimated volumes, or change to metered values | Change to metered values; use of diffuser to accurately determine flushing volume |
| Authorized Consumption | | | | | 20 |

Appendix 1.3 continued

| APPARENT LOSSES | 1 | 2 | 3 | 4 | 5 |
|---|--|---|---|---|---|
| <i>Average customer meter accuracy</i> | No testing or replacement; estimates only | Testing or replacement of 1 to 5% of meters in year of audit | Analysis of test data finds meters meeting specs, or testing or replacement of 5 to 10% of meters per year | Previous test data analyzed and all meters in specifications, or testing or replacement of 10 to 50% of meters in year of audit | Previous test data analyzed and all meters in specifications, or testing or replacement of over 50% of meters in year of audit |
| <i>Improvements in quantifying loss due to customer meter inaccuracies</i> | Conduct testing regime on small number of meters targeted to suspected problem areas such as meter age or type | Standardize testing and test or replace 5 to 10% of meters; consider increasing number of meters tested or replaced after review of test data | Consider increasing number of meters tested or replaced after review of test data | Consider increasing number of meters tested or replaced after review of test data | Consider increasing number of meters tested or replaced after review of test data |
| <i>Systematic data handling discrepancy</i> | No review of billing system | Automated system but no checks of data validity | Automated system; less than annual checks of data | Automated system; internally checked on at least annual basis | Assessment of data handling errors conducted internally and audited by third party on annual basis |
| <i>Improvements in quantifying losses due to systematic data handling error</i> | Conduct internal review of meter reading and billing systems | Conduct internal checks on data validity and meter reading procedures | Conduct annual internal checks of billing data | Conduct third party audit of billed data with specific review of possible data handling and meter reading errors | Continue and standardize program |
| <i>Unauthorized consumption</i> | Arbitrary volume estimates | Default of 0.25% of input volume | Number of events of each type evaluated; multiply by estimated gallons lost per event | Number of occurrences evaluated; monitoring and enforcement program started | Monitoring and enforcement program well established with analyzed losses less than 0.25% and declining from previous years |
| <i>Improvements in quantifying volume of unauthorized consumption</i> | Develop estimates for likely major incidents of unauthorized consumption; use default of 0.25% of input volume | Evaluate number of occurrences of each of major incidents of unauthorized consumption | Identify losses and aim to reduce; audit areas of suspected losses; examine policy and procedures for gaps allowing fraud | Put in place a monitoring and enforcement plan to show reductions in water lost; implement improved policy and procedures for better policing | Continue with monitoring and enforcement program; review at least annually; consider new regulations to thwart specific incidents of unauthorized consumption |
| Apparent Losses | | | | | |

Appendix 1.3 continued

| REAL LOSSES | 1 | 2 | 3 | 4 | 5 |
|--|--|---|---|---|---|
| <i>Reported leaks</i> | Arbitrary estimates; repairs of reported leaks and breaks not documented | Only visual leaks and breaks from customer calls fixed; no known duration before fixing; cursory records | Visual leaks and breaks reported by customers and city staff; call-to-repair times known (greater than one week average); good records | Visual leaks and breaks reported by customers and city staff; call-to-repair times average less than one week; computerized maintenance management system used to document leak repair trends | Visual leaks and breaks reported by customers and city staff; call-to-repair times average less than two days; outstanding computer maintenance records track system deficiencies and repair crew performance |
| <i>Improvements in quantifying reported leaks</i> | Report leaks and breaks and develop standards to find, repair, and document leaks and breaks | Standardize recording of leak location and repair data | Continue to standardize recordkeeping process; plan computerized maintenance management system; cut average leak run time to less than one week | Implement computerized maintenance management system to document repairs; reduce leak run time average to less than two days; plan proactive leak detection | Use capabilities of computerized maintenance management system to track failure trends in distribution system and repair crew activity costs; conduct proactive leak detection |
| <i>Unreported loss</i> | If no active leakage control activities exist, unreported leaks are undetected and quantity is zero | Limited leak detection using basic sounding performed for a portion of the distribution system; no detailed records/database | Proactive leak detection using basic sounding, correlation, and detailed leak detection records; one or more District Metered Areas in use | Proactive leak detection using basic sounding, correlation, flow monitoring, and detailed leak detection and asset condition records; detailed component analysis results | Fully integrated flow monitoring and leak detection program with continuous reporting and analysis of system leakage; integration with asset management, GIS, and economic level of leakage |
| <i>Improvements in quantifying unreported loss</i> | Plan proactive leak detection, and/or evaluate the feasibility of continuous flow monitoring in one or more District Metered Areas | Upgrade leak detection capabilities using electronic correlation; set structured leak survey schedule; improve detail of records/database | Improve sonic leak detection and flow monitoring capabilities; improve records to include analysis of asset condition; conduct a component analysis by estimating leak run times and repair times | Fully integrate all leak detection and asset management functions; continue to install District Metered Areas as economically feasible; start to analyze economic level of leakage | Continue to standardize and audit on regular basis |
| Real Losses | | | | | 10 |

Appendix 1.3 continued

| COST DATA | 1 | 2 | 3 | 4 | 5 |
|--|--------------------------|---|--|--|--|
| <i>Customer retail unit cost (applied to apparent losses)</i> | Estimates only | Residential rate only | Weighted average residential rate using volumes in each rate block | Weighted average combination usage rate (includes residential, commercial, and industrial) | Third-party reviewed; weighted average combination usage rate (includes residential, commercial, and industrial) |
| <i>Improvements in quantifying the annual retail unit costs</i> | Conduct structured audit | Evaluate volume of water used in each usage block by residential users; multiply volumes by full rate structure | Evaluate volume of water used in each usage block by all classifications of users; multiply volumes by full rate structure | Conduct a third-party audit of water used in each usage block by all classifications of users; multiply volumes by full rate structure | Continue with this program |
| <i>Variable production cost (applied to real losses)</i> | Estimates only | Extrapolated from evaluation of partial system electric and chemicals costs | Non-audited evaluation of total system electric and chemical costs | Internally audited wholesale, electric, and chemical costs | Third party audited wholesale, electric, chemical, and detailed support costs annually |
| <i>Improvements in quantifying the variable production costs</i> | Conduct structured audit | Conduct cost evaluation of total system electric and chemical costs | Conduct an annual internal audit | Conduct a third-party audit | Continue with this program |
| Cost Data | | | | | 10 |
| Total Score | | | | | 85 |

American Water Works Association General Guidelines for Setting a Target Infrastructure Leakage Index

(without a full economic analysis of leakage control options*)

Once data has been entered into the Water Audit Worksheet, the performance indicators are automatically calculated. The Water Loss Control Committee of the American Water Works Association provided the following table to assist water utilities in gauging an approximate infrastructure leakage index that is appropriate for their water system and local conditions. The lower the amount of leakage and real losses that exist in the system, the lower the infrastructure leakage index will be.

| Target Infrastructure Leakage Index Range | Financial Considerations | Operational Considerations | Water Resources Considerations |
|---|--|---|--|
| 1.0 - 3.0 | Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability. | Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand. | Available resources are greatly limited and are very difficult and/or environmentally unsound to develop. |
| >3.0 - 5.0 | Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population. | Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place. | Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management and water conservation) are included in the long-term plan. |
| >5.0 - 8.0 | Cost to purchase or obtain/treat water is low, as are rates charge to customers. | Superior reliability, capacity, and integrity of the water supply infrastructure make it relatively immune to supply shortages. | Water resources are plentiful, reliable, and easily extracted. |
| Greater than 8.0 | Although operational and financial considerations may allow a long-term infrastructure leakage index greater than 8.0, such a level of leakage is not an effective use of water as a resource. Setting a target level greater than 8.0 other than as an incremental goal to a smaller long-term target is discouraged. | | |
| Less than 1.0 | If the value of the infrastructure leakage index for your system is 1.0 or less, two possibilities exist: 1) You are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control; or 2) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low value but do not employ extensive leakage control practices in your operations. In such cases, it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters or to identify any other potential sources of error in the data. | | |

*Note: This table offers an approximate guideline for setting leakage reduction targets. The best means of setting such targets include performing economic assessments of various loss control methods. However, this table is useful if such assessments are not possible or a preliminary target is desired.

Water Loss Audit FAQs from the Texas Water Development Board:

1. I have registered to access the water loss audit worksheet, but now it does not allow me to access, and is sending an error message. What can I do?

You may be having a problem with your user name and/or password. Contact us at 512-463-7955 so we can help you.

2. Help - I forgot my user name and/or password!

Utilizing your email and username you should be able to go in as a registered user and request a new password. Contact us at 512-463-7955 so we can help you.

3. How come the data that I have entered into the water loss audit worksheet is no longer there?

Well as we all know sometimes the electronic fairies come in and gather all the numbers up. Call us, 512-463-7955, we will see that we can do. It is important as you are filling out the report form that you frequently save your data.

4. How do I save my completed worksheet to my computer?

After you complete your worksheet hit the save button on the top of that page, and then the submit button., Then click on the water report tab, once at the report page, select a format under the Select Format Box (we recommend as a PDF file) and then click on export. You can then save the file to your computer.

5. My worksheet is showing negative numbers, what does that mean?

Negative numbers show that you sold and lost more water than you produced (not likely)! You may need to adjust the percentages for your production meter accuracy and possibly your customer meter accuracy.

6. How can I review an earlier water loss audit?

After you access the name of your utility in database you can select the year that you want to review in the drop down box at the top of the page and then select view.

7. Is it possible to use the water loss worksheet for a non-reporting year?

We encourage you to do so. After you access the name of your utility in database you can select the year that you want to complete in the drop down box at the top of the page and then select fill out.



Water Quality Monitoring Program

by Mark McPherson, George Kinnel, and Andrew G. Smith-Hawley

Report 367
March 2008

Texas Water Development Board
www.twdb.state.tx.us





Texas Water Development Board
Report 367

Water Loss Audit Manual for Texas Utilities

by
Mark Mathis
Texas Water Development Board

George Kunkel, P.E.
American Water Works Association
Water Loss Control Committee, Active Member

Andrew Chastain Howley
American Water Works Association
Water Loss Control Committee, Active Member

March 2008

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Cover photo courtesy of City of Austin Water Utility

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Executive Summary

In 2003, the 78th Texas Legislature, Regular Session, enacted House Bill 3338 to help conserve the state's water resources by reducing water loss occurring in the systems of drinking water utilities. This statute requires that retail public utilities providing water within Texas file a standardized water audit once every five years with the Texas Water Development Board (TWDB). In response to the mandates of House Bill 3338, TWDB developed a water audit methodology for utilities that measures efficiency, encourages water accountability, quantifies water losses, and standardizes water loss reporting across the state.

The water audit worksheet developed by TWDB is comprised of data typically required for a water supply utility to conduct an internal "top-down" water audit approach, which is largely a desktop exercise gathering data and information from water consumption and loss reports already commonly compiled by

many water utilities. However, utilities seeking to gain further efficiencies can perform additional field auditing tasks in a more comprehensive "bottom-up" manner. Bottom-up practices can determine more precisely where losses are occurring, thus better validating the accuracy of the water audit and guiding the utilities' strategies for loss control efforts. To assist water utilities in undertaking their top-down water audit, this manual provides guidance on the specific data and information that should be gathered to assemble a realistic assessment of water loss. *The most important step in the auditing process is to begin.*

This standardized approach to auditing water loss provides utilities with a reliable means to analyze their water loss performance. By reducing water loss, utilities can increase their efficiency, improve their financial status, minimize their need for additional water resources, and assist long-term water sustainability.

1 Introduction

Water is one of our most precious resources, yet within North America only a few states have begun to implement proactive water accountability policies for their utilities. Water auditing and loss control are emerging as significant conservation measures because as utilities minimize water loss, they increase their efficiency and reduce the need to search for additional water sources. For utilities to effectively identify losses in their systems, they must first employ water auditing as a routine business practice, using a method that has clearly defined terms and meaningful performance indicators. In recognizing the need for such a reliable method, the Water Loss Control Committee of the American Water Works Association adopted (AWWA, 2003) the method published by the International Water Association's Water Loss Task Force (Alegre and others, 2000). This methodology not only assists utilities in identifying where their losses are occurring, but also expresses by volume how much is lost and associates a cost to those losses. It also standardizes the water audit reporting process for water utilities.

The Texas Water Development Board (TWDB) water audit program begins with an examination of the water utility's business practices and procedures. It uses the terms from the International Water Association and American Water Works Association Water Audit Method (hence referred to as the Water Audit Method)—system input volume, authorized consumption, real and apparent loss—as well as the performance indicators included in this method. Since all water is essentially accounted for in this approach, the term “unaccounted-for” water is discouraged. The Water Audit Worksheet (Appendix 1.1) is the audit form developed by TWDB, based on the Water Audit Method. The approach defined in this manual also asks water utilities to assess the validity of the data that they enter into the water audit. A scale is provided for all components of water consumption and loss, assigning low assessment scores to data that are mere approximations and high assessment scores for components that are derived from well-calibrated meters or other well-substantiated means.

2 *Implementing Water Audits as the Foundation of the Water Loss Control Program*

For utilities to operate efficiently, they should use recommended practices to monitor and control water and revenue losses. These include active leakage control, as well as metering production flows and customer consumption. Consumption data serve as the basis for billing and revenue collection for most water utilities, but the data are also critical to water demand management. Customer billing systems, which are commonly used to archive customer account and consumption data, should be configured so that consumption volumes are not distorted by billing adjustments or inconsistent procedures. By correcting deficiencies in archiving customer consumption in billing systems, utilities can often recover significant uncaptured revenue. Today's water utilities can also use other advanced technologies, such as automatic meter reading technologies, Advanced Metering Infrastructure, Supervisory Control and Data Acquisition (SCADA) Systems, Geographic Information Systems (GIS), hydraulic modeling, and sophisticated leak detection technologies, such as leak correlators and leak noise loggers. Many of these technologies help reduce real loss, which saves water resources.

By using the above technologies, water utilities can address a variety of losses; however, the foundation of the water loss control program is the compilation of the water audit on a routine basis as a standard business practice. Water utilities should compile a regular water audit in a fashion similar to how an accounting firm routinely examines the finances of a business: by tracking volumes of water supplied by the water utility from source to customer, just as accountants track a firm's finances throughout its business path. The water audit quantifies production flows, cus-

tomers consumption, and a number of different loss volumes and assigns costs to these volumes. Throughout the audit process, utilities determine specific areas of water loss, examine deficiencies in their overall performance, review current practices and procedures for developing data, and calculate the costs of water loss. The Water Audit Worksheet (Appendix 1.1) uses a standard set of terms and definitions so that all utilities in the state are measuring water loss in the same way. Because many water utilities historically used water accounting practices that fell short in accurately determining where losses occurred and how to recover lost revenues, the water audit provides a tool for systematically evaluating those losses. The methods included in this manual follow a standard, best management practice approach advocated by the American Water Works Association, and TWDB encourages all water utilities to implement this method. Although House Bill 3338 requires that water utilities file a water audit only once every five years, TWDB recommends that water utilities compile a water audit annually on the same business year frequency as the financial audits that many water utilities perform.

Water loss programs should be planned based upon validated water audit data. The self-assessment feature described in this publication guides water utilities in taking steps to first obtain sufficiently validated data before making important loss control program decisions on the data produced by the water audit. An internal top-down water audit approach is largely a desk-top exercise gathering data and information from water consumption and loss reports already commonly compiled by many utilities. Once a water utility produces this top-down water audit with

sufficiently validated data, it can begin bottom-up field auditing activities to better validate the initial data. Bottom-up activities are longer term in nature and can be implemented incrementally over periods of months or years. These activities typically involve some investment, but the projected costs of these activities can be objectively weighed against the inherent costs of the losses, as detailed in the validated top-down water audit. In the long run, investment in bottom-up activities will likely save the utility from

costly, ineffective programs that may not provide a substantial return on investment. Bottom-up practices are discussed in Chapter 5.

Utilities should use the Water Audit Worksheet to compile the top-down water audit. To assist in this process, TWDB has provided a worksheet designed as a software application for utilities to download to their computers, so they can continue to use the methodology.

3 Understanding the Water Audit Method

The Water Audit Method takes the approach that all water is accounted for and quantified as either a component of beneficial consumption or wasteful loss by measuring (metering) or estimating water quantities. Under this approach, no water is “unaccounted for,” and this flawed term and the flawed indicator “unaccounted-for-water percentage” should be avoided. Figure 3.1 shows the Water Balance of the Water Audit Method. All quantities of water fit into one of the boxes of the water balance. The sum of the quantities of each column in the water balance is the same; hence, all quantities balance.

Standard terms and definitions that accompany the components shown in Figure 3.1 are given in Table 3-1, and

TWDB recommends reviewing these definitions before filling out the Water Audit Worksheet.

3.1 HOW MUCH ARE LOSSES COSTING THE UTILITY?

All losses impart a cost impact to the water utility and the communities they serve. By accurately assessing where and how much water is being lost, utilities can determine how much water loss is costing. These costs can then be compared to potential investments in loss control activities to determine cost-benefit ratios for effective loss reduction. When water utilities reduce losses, they may also improve their financial bottom line. All component volumes of

| | | | | | |
|------------------------|--------------------------|---------------------------------|--------------------------------|----------------------------------|-------------------|
| Corrected input volume | Authorized consumption | Billed authorized consumption | Billed metered consumption | Revenue water | |
| | | | Billed unmetered consumption | | |
| | | Unbilled authorized consumption | Unbilled metered consumption | | |
| | Wholesale water imported | Water losses | Apparent losses | Unbilled unmetered consumption | Non-revenue Water |
| | | | | Unauthorized consumption | |
| | | | | Customer meter under-registering | |
| Real losses | | | Billing adjustment and waivers | | |
| | | | Reported leaks | | |
| | | | Unreported loss | | |

Figure 3.1. Water Balance

Table 3-1. Standard Definitions of the Water Audit Method

| Definitions |
|--|
| <p>System Input Volume: The total water supplied to the water distribution system, corrected for any error in the production meters. It includes the sum total of purchased surface or groundwater, water obtained through the utility's own wells, water purchased through contracted interconnections with other water suppliers, or water obtained from other sources. This is the total of all production meter readings for the entire audit year from all sources.</p> <ul style="list-style-type: none"> • Production Meter Accuracy—All production and bulk purchase volumes should be metered. Meters should be well maintained and calibrated to ensure a high degree of accuracy. For any given water utility, one or more production meters may incur a degree of inaccuracy due to wear, malfunction, or improper installation. • Corrected System Input Volume—The level of production meter accuracy is usually a percentage. To calculate corrected system input volume, divide the system input volume by the percentage of accuracy to achieve the corrected system input volume—the volume actually placed into the distribution system. Since inaccurate meters often under-register, this number will usually be larger than the reported system input volume. |
| <p>Authorized Consumption: This category consists of all water that has been authorized for use by the utility and its customers. Authorized consumption includes, but is not limited to, water used for residential and commercial uses, fire fighting, public fountains, golf courses, municipal landscape watering, line flushing, city offices, water treatment facility use, dust control, and construction practices. Authorized consumption is all the water the utility gave permission to a business, individual, or itself to use. It may be billed or unbilled, metered or unmetered.</p> <ul style="list-style-type: none"> • Billed Metered—Water that is appropriately metered and billed. • Billed Unmetered—Estimated water that has been sold but not metered; for example, dust-control trucks and types of businesses using authorized water drawn from fire hydrants or other unmetered uses. • Unbilled Metered—Water that is metered but not billed, such as city/government offices, city park irrigation, water treatment facility use, some fire department use, and line flushing. • Unbilled Unmetered— Estimated water that is not billed or metered, such as most line flushing (see Form D in Appendix 2). Estimations may also be entered for this category. <p>Installing meters on any of the sources of significant unmetered water represents bottom-up activity to improve the accuracy of the top-down water audit and better manage these water uses.</p> |
| <p>Water Losses: This is derived by subtracting authorized consumption from corrected system input volume. Water losses exist in two major classifications: apparent losses and real losses. Both are considered types of water loss. Apparent loss is valued at the customer retail rate because it had the opportunity to be sold. Real loss, however, is calculated at the variable production cost of water.</p> <ul style="list-style-type: none"> • Apparent Losses—These are “paper” losses that occur when water reaches a customer, but the volume is not accurately measured and/or recorded due to customer meter inaccuracy, systematic data handling discrepancies, or unauthorized consumption. Apparent loss is water that has been consumed but not paid for due to error in quantifying the volume of water. These losses cost water utilities revenue and understate the collective measure of customer consumption in the water utility's service area. Valued at the customer retail (revenue) rate, these losses are often very cost effective to recover. • Real Losses—These are the “physical” losses, largely leakage, from the infrastructure: mains, valves, service lines, and tank overflows. Leakage occurrences are categorized as “reported” (visible) events or “unreported” (nonvisible—found only by active leak detection) events. Real losses occur prior to reaching customers and effectively force the water utility to treat and deliver more water than its customer population actually requires. These losses are typically valued at the variable production rate (costs for water treatment, pumping, or bulk water purchase); however, if the utility is experiencing a water shortage, then real losses may be valued at the customer retail rate because recovered leakage could be viewed as water that can be sold to customers. |
| <p>Revenue Water: Revenue water consists of billed wholesale water exported and billed metered and unmetered water. These are usually the primary categories through which the utility can generate revenue.</p> |
| <p>Non-revenue Water: This term is the sum of apparent loss, real loss, and unbilled authorized consumption. Non-revenue water is clearly defined as all water for which no revenue is received.</p> |

non-revenue water (unbilled authorized consumption, apparent loss, and real loss) should be assigned a cost value.¹

Apparent losses differ from real losses in the manner in which they occur but, perhaps more dramatically, in the financial impact that they impart to the water utility. Apparent losses occur when water has reached the customer, but by not accurately recording the consumption, a portion of the revenue is not captured. Apparent losses are, therefore, valued at the customer retail rate. Water utilities often use rate structures with different rates for different customer classes, such as residential and industrial, and for different tiers of water consumption. For purposes of simplicity in compiling the water audit, utilities can use a single, composite rate for all customer classes to determine the cost impact of apparent losses.

Real losses cause a portion of the treated, pressurized water to be lost from the distribution system before customer use. In effect, the utility treats a greater volume than its customer base requires, hence incurring excess production costs. The cost for real losses is, therefore, typically valued at the variable production cost and/or the purchase cost of imported bulk water supply. The variable production cost is defined as the cost of raw water, electricity to treat and distribute water, and chemicals to treat the water for the year. One way to calculate the variable production cost is to divide the sum of the raw water, energy, and chemical costs by the corrected input volume. In cases of water shortage where any real loss reduction results in additional customer sales, then the real losses should be valued at the customer retail rate.

¹ When compiling the water audit, utilities should use consistent volume units throughout the audit. Often water utilities measure their water supply in one unit (for example, gallons) and their customer consumption in another unit (for example, cubic feet). Typically, the customer consumption values must be converted to align with the units of measurement for the water supplied

3.2

PERFORMANCE INDICATORS

The water audit method features a number of performance indicators that allow water utilities to reliably assess their water loss standing and track their performance. The performance indicators are designed specifically to

- track the water utility's progress on a year-to-year basis,
- set performance targets, and
- benchmark performance with other water utilities.

The complete list of performance indicators is shown in Table 3-2. The indicators are categorized as operational or financial in nature. The level of detail they project is also identified as 1) basic level indicators, 2) intermediate indicators, and 3) detailed indicators. An array of operational performance indicators exists—one for apparent losses and four for real losses. The operational performance indicators are well suited to evaluate operational efficiency, track progress, and benchmark with other water utilities. Also shown are financial performance indicators included in the International Water Association and American Water Works Association Water Audit Method, including non-revenue water by volume and non-revenue water by cost.

Water utilities can track their performance in controlling apparent losses by using the apparent loss indicator (Op23), which reflects the volume of apparent losses quantified in the water audit, normalized by dividing this volume by the number of service connections per day.

For real losses, the water utility can likewise track performance using two normalized indicators of real losses (Op24). Dividing the quantity of real losses from the water audit by the number of service connections (or miles of pipe for low density systems) per day gives the Op24 indicator. A second variation of this indicator can also be calculated by dividing the result by the

average pressure across the system. These performance indicators are good for setting specific leakage reduction targets and tracking performance.

The unavoidable annual real losses are another performance indicator. These losses are a theoretical reference for low-level leakage that recognizes even the best maintained water distribution systems in the world have some leakage. Unavoidable annual real losses are calculated from the equation in Table 3-2 by using the most influential factors in system leakage: length of piping in the water distribution system, number of customer service connections, and average system pressure. Note that age of the piping is not an influential factor.

The primary performance indicator used for comparing performance with other water utilities (benchmarking) is the infrastructure leakage index. This index provides utility managers with the ability to weigh leakage efficiency relative to the ideal low level that might exist in the water utility (Appendix 1.4). The Water Loss Control Committee of the American Water Works Association

also gives guidelines for using the infrastructure leakage index as a preliminary leakage reduction target-setting tool.

The index takes into account system-specific attributes, including the length of mains, number of customer service connections, and average pressure; therefore, leakage efficiency can be compared among water utilities in an objective manner. This avoids a "one size fits all" approach to target setting. The infrastructure leakage index is the ratio of the real loss volume from the water audit over the level of unavoidable annual real losses as calculated for each system using the equation shown in Table 3-2 (Op25). As a ratio, the lower the value of the infrastructure leakage index, the closer the actual level of real losses is to the unavoidable annual real losses. The index represents how efficiently the system's infrastructure upkeep, leakage management, and repair activities are operating at the current pressure, with a validated low infrastructure leakage index value implying that the utility is very efficient.

Table 3-2. International Water Association and American Water Works Association Water Audit Method—Performance Indicators

| Function | Level* | Code* | Performance Indicator | Comments |
|---|-------------------|-------------------|---|---|
| Operational: Apparent losses | 1 Basic | Op23 | [gallons/service connection/day] | Basic but meaningful performance indicator for apparent losses. Easy to calculate once apparent losses are quantified. |
| Operational: Real losses | 1 Basic | Op24 | [gallons/service connection/day] or [gallons/mile of mains/day] (only if service connection density is less than 32/mile) | Best of the simple "traditional" performance indicators. Useful for target setting. Limited use for comparisons between systems. |
| Operational: Real losses | 2 Intermediate | Op24 | [gallons/service connection/day/pressure] or [gallons/mile of mains/day/pressure] (only if service connection density is < 32/mile) | Easy to calculate this indicator if the infrastructure leakage index is not yet known. Useful for comparisons between systems. |
| Operational: Unavoidable annual real losses | 3 Detailed | UARL ^a | UARL (gallons) = $(5.41L_m + 0.15N_c) \times P$, (Eq. 1) where L_m = length of water mains, miles N_c = number of service connections P = average pressure in the system | A theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. A key variable in calculating the infrastructure leakage index. The calculation for unavoidable annual real losses is not valid for systems with less than 3,000 service connections. |
| Operational: Real losses | 3 Detailed | Op25 | Infrastructure leakage index (dimensionless) = Real loss volume/UARL ^a | Ratio of real loss volume to unavoidable annual real losses). Best indicator for comparisons between systems. |
| Financial: Non-revenue water by volume | 1 Basic | Fi36 | Volume of non-revenue water as % of corrected system input volume | Easily calculated from the water balance. Has limited value in high-level, financial terms only. Misleading to use this as a measure of operational efficiency. |
| Financial: Non-revenue water by cost | 3 Detailed | Fi37 | Value of non-revenue water as a percentage of the annual cost of running the system | Incorporates different unit costs for non-revenue components. Good financial indicator. These costs include operations, maintenance, and any annually incurred costs for long-term upkeep of the system, such as repaying capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs, and all other costs that exist to sustain the drinking water supply. These costs should not include any costs to operate wastewater, biosolids, or other systems outside of drinking water. |

* Descriptors assigned to the performance indicators from Alegre and others (2000).

^aUARL=unavoidable annual real losses

4 Validating and Interpreting the Water Audit Data

Assembling a basic top-down water audit is the first step a water utility should take to establish accountability and manage water and revenue losses. The main advantage of the top-down approach is that it is relatively quick, using existing data from records routinely compiled by most water utilities and estimates for components where data do not exist. The top-down approach allows the water utility to get the process started.

The drawback to the top-down approach, particularly for the first time auditor, is that some of the data may be of suspect quality or estimates may be relatively crude. In such cases, utilities should interpret the validity of the water audit results cautiously. If many of the water audit quantities are derived from estimates, new data collection procedures and/or bottom-up field activities should ultimately be instituted over the course of time to generate more accurate and realistic data that better validate the water audit results and lead to better loss control program decisions.

Validation is defined as the process by which water audit data is confirmed to reflect the actual operating conditions of the water utility within a reasonable degree of accuracy. Water is indestructible; it can be neither created nor destroyed. Therefore, the quantities in the Water Balance (Figure 3.1) *must* balance, with each column adding to the same amount. All of the water managed by a utility can be assigned to the components shown in the balance, but it is frequently difficult to ascertain how accurate the quantities are in each of the boxes. Often some of the data, such as billed metered consumption, is very accurate because it is usually derived from customer meter data. However, other components, such as unauthorized consumption, may be much less valid if the water utility has

not collected data from individual investigations of unauthorized consumption, instead merely entering an estimate or "best guess" for this quantity. For most utilities, some of the components of the water audit have data that are more accurate, or "valid," than other data. Since the sum of each column has to balance, overestimating one component means one or more of the other components are underestimated. But which components are over- or understated and by how much?

Another uncertainty in the top-down Water Audit Method is the unreported leaks. It is quantified as a "catch-all" component, meaning that the volume of real losses is the quantity that remains after authorized consumption, apparent losses, and reported leakage have been subtracted from the corrected input volume. Although this approach allows the top-down audit to be completed quickly, it results in assigning to unreported loss the collective inaccuracies in quantifying authorized consumption, apparent losses, and reported leakage. As a consequence

- 1) understating the quantity of authorized consumption, apparent losses, and reported leakage effectively overstates the volume of unreported loss; and
- 2) overstating the quantity of authorized consumption, apparent losses, and reported leakage effectively understates the volume of unreported loss.

Although the audit worksheet does not require a breakdown of leakage rates between leaks on water mains, leaks on customer services, or tank overflows, it is good practice if records are kept to this level of detail.

The reason that unreported loss is quantified in a "catch-all" method is that a true assessment of all leakage occurring in a distribution system often requires extensive bottom-up work to quan-

tify, which is beyond the scope of the top-down intentions expressed in this publication.

4.1 INDICATING THE LEVEL OF VALIDATION

Since this publication's Water Audit Method uses a top-down approach for expediency, it is important for utilities to not only obtain the results of the water audit, but also a sense of how reliable, or valid, their data are. In order to rate the degree of validity, a scale is included on the worksheet to allow water utilities to assess the various components of the water audit. A composite is then calculated to represent the relative degree of validity of the water audit results.

An assessment table (Appendix 1.3) has been developed using a 1-5 scale for the assignable components of the water audit. A score of 1 represents the lowest degree of certainty of a component. A purely arbitrary estimate of unauthorized consumption that amounts to a "rough guess" is an example of a component that should be assessed with a 1. Conversely, a score of 5 indicates a high degree of accuracy, an example of which might be system input volume derived from measured data gathered from current model, well-calibrated production meters and reliable data management. Assessments of 2, 3, and 4 represent incrementally greater levels of accuracy or validity of the data.

In the drinking water industry, a high level of data accuracy is achieved typically by

- metering water quantities to the greatest extent possible;
- accurately cataloging metered flow data in a billing system or other database; and
- conducting regular maintenance or auditing functions, such as meter testing and calibration, and audits of billing records to detect unauthorized consumption

from meter tampering, or similar activities.

Water utilities that carry out all three levels of scrutiny for a given component should assign a high degree of validation to their quantities in the water audit. Systems that perform none of these activities for a given component have poor validity; hence, an assessment of 1 would apply.

Not all components of the water audit can be feasibly metered. Metering production flows and customer consumption is recommended as a minimum. In the absence of meters, estimates must be used.

Water utilities can improve the validity of their water audit data incrementally over time by instituting improvements that raise their scores. If production sources are unmetered, installing meters is a major step to move the utility from low validity to a higher validity. Improvements such as this can be identified from the recommendations listed in Appendix 1.3. A water audit should be compiled annually on the utility's business year frequency and improvements in data validity be incorporated incrementally over time.

4.2 INTERPRETING AND COMPARING WATER AUDIT DATA

The validity assessments on the Water Audit Worksheet are also used to calculate a composite for the entire water audit based on a scale of 85. This composite rates the level of validation for the water audit.

If a water utility is conducting a water audit for the first time and has a collective validation score of less than 40, then the results of the water audit should be viewed as preliminary, and the water utility should begin to carry out activities that improve the validation of the water audit. Improving the measured data from the system's production meters is the recommended starting point. Since

data from water audits with a composite at 40 or less are viewed as preliminary, this data should not be benchmarked with other utilities. Likewise, it would be premature to design long-term loss reduction programs and targets on such preliminary data. The water audit data can be best used for tracking performance within the water utility from year to year, until the validity of the water audit is upgraded.

A composite between 40 and 70 represents progressively greater validity in the water audit data. Utilities with assessments in this range can place greater faith in the water audit results, which can be reliably used for planning and developing targeted loss control efforts. Water audits in this range have sufficient validity so that their data can be compared with data from similarly assessed water audits of other water utilities. This also opens the door for performance benchmarking. The utility should continue to address lower assessments in any individual components of the water audit by upgrad-

ing procedures or practices in order to improve validation in these areas.

Water audits with an assessment between 70 and 85 reflect mature programs of auditing and loss control with a high level of confidence in the water audit results. Data from these water audits are highly reliable in guiding and tracking advanced programs in apparent and real loss control. Performance tracking within the water utility and benchmarking with similar water audits can be carried out in a reliable manner.

The validation of water audits is an important tool necessary for distinguishing data that are preliminary and approximate in nature versus data that are refined and accurate. The best actions for water utilities to take to improve their water accountability depend to a large degree on the level of validity of their water audit. Appendix 1.3 provides "improvement" guidance for each component in the water audit to allow water utilities to determine the next step to a higher level of validity.

5 *Using Bottom-up Activities to Better Validate the Water Audit Data*

Once water utilities have completed a preliminary, top-down water audit, they will have at least a general assessment of the level of apparent and real loss occurring. If the composite validation of the water audit is below 40, the utility should seek bottom-up activities in those specific audit components that have low scores of 2 or less. If the composite is higher, the utility can seek bottom-up activities that control the larger components of loss. Below are brief descriptions of the most important validation and bottom-up activities that utilities can undertake. (See Appendix 1.3 for additional information.)

5.1 SYSTEM INPUT VOLUME AND CONSUMPTION

5.1.1

Production and Wholesale Meters

Production and wholesale meters measure the large bulk supply volumes, such as source water or purchased water. The collective water from all such meters is entered into the Water Audit Worksheet as the first number under system input volume (line 12). Any notable degree of error in this quantity carries throughout the entire worksheet and can have an unduly negative influence on the accuracy of the water audit. Production and wholesale meters should be current, well calibrated, and continuously monitored, with measured data stored in a reliable billing system or database. Calibrating these meters is relatively inexpensive since they are typically few in number.

5.1.2

Customer Metering for Reliable Billed Consumption Data

The American Water Works Associa-

tion recommends that water utilities meter all water withdrawn from their distribution system at the customer's point of service. Water utilities that do not meter their customers should seek to establish metering along with billing based upon consumed volumes of water. Billed metered and unbilled metered consumption can then be reliably derived.

5.1.3

Unmetered Consumption

Although utilities should strive to meter all customer consumption, some volume of water will always be withdrawn from the distribution system in unmetered fashion. Water used for fire fighting is a prime example, as well as water taken from fire hydrants for distribution system maintenance and testing. These uses can be metered to the extent possible; however, on an annual basis the total water used as unbilled authorized consumption is usually small. The utility should assign this component secondary priority for bottom-up assessments unless there is a very strong reason to believe that large, continuous uses of water are being consumed in unmetered fashion. In that case, the utility should launch a bottom-up investigation to confirm the existence and quantity of such use.

5.2

APPARENT LOSSES

5.2.1

Customer Meter Accuracy

Standard customer meters used in the United States are generally highly accurate and reliable, with long service lives, some over 20 years. Even with proper sizing and installation all meters will eventually lose accuracy and under-

register flow at a rate influenced by the amount of cumulative consumption passed through the meter. Chemically aggressive water may also shorten the lifespan of meter accuracy. Water utilities should monitor the demographics of their customer meter population (for example, age, size, and number) and perform testing on random and targeted samples of customer meters on a periodic basis to project when the limits of acceptable accuracy are expected to be reached. Irrigation meters and commercial meters should be tested first because these meters usually generate the majority of the revenue for the utility. In this way, a high level of accuracy will be ensured throughout the meter population.

5.2.2

Systematic Data Handling Error in Customer Billing Systems

Customer water meters generate readings that allow a water utility to measure the amount of water consumption occurring in a given period of time. However, the meter reading must be accurately transmitted and stored to a proper database, typically a customer billing system. Systematic and random errors can occur in the data transfer and archiving process. For example, when meters are read by humans, numbers can be transposed or viewed incorrectly. A fast-growing number of water utilities have installed automatic meter reading technologies to better allocate human resources, improve safety, and reduce data transfer error in the customer meter reading process. This progressive technology also improves customer service by reducing billing errors related to the above problems.

Most water utilities store customer consumption data in a customer billing system. Although such systems are designed for financial (billing) purposes, they have also become the de facto operational database for tracking customer usage patterns. Many billing systems

have incorporated data adjustment and estimate procedures in order to address the variety of billing issues that occur. Unfortunately, sometimes these procedures unduly modify the consumption values in the process of making financial adjustments. An example is a billing routine that generates a credit to a customer by artificially reducing consumption. Although such a routine achieves the desired billing result, it distorts the measure of customer consumption. Utilities should analyze the information flow path in the billing system by flowcharting the process. Such an exercise can often reveal procedures that result in consumption values being understated. Fortunately, such issues are often easily corrected by relatively minor procedural and/or programming changes.

5.2.3

Unauthorized Consumption

There is a certain percentage of any population that will maliciously seek to obtain water service without paying for it. Typical examples include taking water illegally from fire hydrants, tampering with customer meters or meter reading equipment, and illegally tapping into service connections or fire service lines. There are limitless ways to take water in an unauthorized fashion, and every water utility should have in place at least minimal policies and safeguards to thwart, detect, and abate unauthorized consumption. For most systems, the total water lost to unauthorized consumption is small relative to the system input volume, and an approximate estimate should be used in the top-down water audit. Bottom-up activities should include examination of billing data for suspicious consumption patterns (successive periods of zero or lower than average consumption, for example) and follow-up investigation of individual customer properties to confirm evidence of tampering or similar illegal activity. Enforcement policies may need to be strengthened if pat-

terms of unauthorized consumption are chronic and widespread. Such policies could include service discontinuance and criminal judgments.

5.3

REAL LOSSES

All water utilities incur leakage losses; only the amount varies. Leaks and most visible main breaks occur for a variety of reasons, including poor installation workmanship or materials, corrosion, external forces, environmental extremes, and other causes. Leakage is always occurring, and only grows worse if left unchecked. Therefore, all water utilities should provide system maintenance and upkeep functions that include appropriate components of leakage management: active leakage control, timely quality repair, water main rehabilitation, and pressure management.

5.4

ACTIVE LEAKAGE CONTROL

Active leakage control is defined as any water utility program that proactively seeks nonvisible leakage. The most typical functions of active leakage control are routine leak detection surveys and the use of minimum hour flow measurement in District Metered Areas or pressure zones. District Metered Areas are zones or metered areas created within the distribution system to isolate flow to monitor water loss. Large meters are installed on the main lines, and with the aid of "radio read" or similar automated meter technology, the utility is able to compare customer usage to the actual main line flow meter. Although this effort will not pinpoint leaks, it will aid utilities in locating high loss sections so they can begin leak detection surveys with more accuracy.

Leaks and water main breaks that surface and are visible are defined as "reported" since they usually come to the water utility's attention by a report from a customer, police, or other citizen. Most water utilities are effective in addressing

reported leaks since these events represent emergency or nuisance conditions. These leaks are addressed quickly so the duration of the leak event is short and volume of water lost is relatively small, even if the leak is spraying at a high rate of flow. Unfortunately, many water utilities respond only to reported leaks and operate no active leakage control programs to identify and control unreported leaks. Unreported leaks usually account for the majority of annual real loss volumes in most water utilities because they are numerous and run undetected for long periods of time. All water utilities should operate an active leakage control program, even if this involves conducting a leak detection survey once every several years. Utilities with extensive and/or aging water distribution systems should operate an ongoing program, with constant leak detection and possible use of District Metered Areas to monitor flows closely and respond to new leakage shortly after it arises. Even for systems that have a good active leakage control program, it is likely that a portion of the leakage will go undetected and, thus, unreported. This volume and the background leakage are collectively labeled "unreported loss" in the Water Audit Worksheet. The top-down Water Audit Method (Appendix 1.1) quantifies unreported loss as a "catch-all" component, meaning that this volume of real losses is the quantity that remains after authorized consumption, apparent losses, and reported leakage have been subtracted from the system input volume.

5.4.1

Timely, Quality Leak Repair Policies and Functions

This practice appears to be straightforward: once a leak or break is known to the water utility, respond quickly and make the repair. This function, however, can be more complicated than it seems. On some occasions, utilities use a "band-aid" repair approach that does not identify the underlying cause

of the failure and execute a repair that addresses that root cause. Unfortunately, many leaks occur at the site of previous repairs. Utility policy also plays a role in repair functions. When water utilities play a stronger role in customer service connection leak repairs, leak run time is usually reduced and quality repairs are implemented. Water utility managers should review their leak repair practices and look for ways to ensure that timely, quality repairs are implemented.

5.4.2

Water Main Rehabilitation and Replacement

All infrastructure eventually reaches the limits of its useful service life and must be renewed or replaced. This holds true for water infrastructure, such as pumps, pipelines, valves, hydrants, and appurtenances. In order to capture as much of the original investment in an asset as possible, most utilities want to ensure that the asset remains in service for its entire life. This is achieved by proper maintenance, such as that provided by active leakage control programs and timely repair efforts. At the time in which a water asset reaches the end of its useful life, a number of different options exist. Historically, water utilities relied upon outright replacement as the sole option once an asset reached this stage. Although replacement is the most comprehensive means of renewing an asset, it is also the most expensive option and often requires considerable disruption, such as full trench excavation to replace pipelines. More recently, "trenchless" technologies are providing means to renew pipeline assets without as much above-ground disruption and sometimes at lesser cost than full pipe replacement. All water utilities should have in place a capital program to renew water infrastructure as needed. This program should take into account the variety of options that can efficiently and economically maintain infrastructure integrity.

5.4.3

Pressure Management

Because more water is lost under high pressure conditions than low pressure, pressure management is a recent innovation that strives to reduce water loss. Where appropriate, it reduces excessive background leakage, inhibits the growth of new leakage, and limits the risk of breaks due to pressure transients. Evaluations of water distribution systems across the world have found that 1) many water utilities operate systems with very high pressure; and 2) in many systems, the condition of the piping makes the infrastructure very susceptible to high pressure, particularly poor infrastructure, plastic pipe, and poor service connection piping. Regarding the former, many water utilities have not set realistic upper limits for operating pressures. Additionally, in many distribution systems, pressure may rise during night or minimum consumption hours when customer demand drops. Conversely, when customer consumption is high during the day, pressure drops. Pressure management schemes now exist to regulate night or minimum consumption periods to reduce pressure and save water lost to leakage. During the high demand daytime periods, pressures rise to provide sufficient volume to meet demand. Not all water utilities operate with excessive pressure or have strong pressure management potential. However, all water utilities should understand the range of pressures within their water distribution system, including the occurrence of pressure transients, to judge the feasibility of pressure management to reduce leakage and sustain infrastructure.

6 Conclusion

As water utilities incorporate routine water audits as part of their standard business practices, they can expect to become more efficient by focusing on problem areas that were identified in the top-down audits. With decreasing water availability and rising costs for water treatment or purchase, auditing water supplies is essential for water utilities to ensure efficiency in their operations and preserve water resources.

The water audit method featured in this manual is designed to guide water utilities in identifying and quantifying components of water supply, customer consumption, and loss, so they can effec-

tively focus their resources on priority areas of water loss. By implementing appropriate water management programs, these water utilities can extend existing supply resources and minimize the search for additional water resources to supply growing populations.

With routine water auditing and targeted loss control efforts, water utilities can anticipate incremental drops in water loss each year. As with any business plan, it may take several years for utilities to begin to see the effects of implementing this water loss management program. Therefore, goals can be long term but certainly achievable.

7 *References*

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8 *Acknowledgments*

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Appendix 1

B. **System Input Volume:** The total water supplied to the distribution structure. It is the total of all production meter readings for the entire year. List the volume or percentage requested in each item, along with the scores from Appendix 1.3 that in your judgment best represent the degree of validation of the data.

12. **Water Volume from own Sources:** Includes all water taken as source water from permitted sources, such as rivers, lakes, streams, and wells.
13. **Production Meter Accuracy (enter a percentage):** Achieved by calibrating or verifying the accuracy level (expressed as a percentage) of production meters. For example purposes, if the meter over-registered by 4 percent, enter 1.04; if it under-registered by 4 percent, enter .96.
14. **Corrected Input Volume (calculated automatically online):** The sum obtained when the production meter adjustment is either added to or subtracted from the system input volume. Divide "water volume from own sources" by the production meter accuracy. You must add the decimal point when the calculation is done manually (for example, to .96).

Example: If "water volume from own sources" registered 1.8 MG/year through two production meters, which were found to be collectively under-registering flow by 4 percent, then the corrected input volume (CIV) is:

$$\text{Corrected Input Volume} = (1,800,000)/(0.96) = 1,875,000$$

15. **Wholesale Water Imported:** Amount of purchased wholesale water transferred into the utility's water distribution system from other water suppliers.
 16. **Wholesale Water Exported:** Amount of wholesale water transferred out of the utility's distribution system. It may be put into the system initially but is only in the system for a brief time for conveyance reasons.
 17. **System Input Volume:** Calculated as the corrected input volume plus water imported minus water exported (Line 14, plus Line 15, minus Line 16).
- C. **Authorized Consumption:** All water that has been authorized for use or consumption by the utility or its customers. Remember to convert these volumes into the same units as the water delivery volume. Note: Any type of legitimate consumption should be classified in one of the four components of authorized consumption.
18. **Billed Metered:** All retail water sold and metered.
 19. **Billed Unmetered:** All water sold but not metered.
 20. **Unbilled Metered:** All water metered but not billed, such as back flushing water, parks, golf courses, and municipal government offices.
 21. **Unbilled Unmetered:** All water not billed or metered, such as flushing fire hydrants.
 22. **Total Authorized Consumption:** The total of the above four components, automatically calculated in the online worksheet.
- D. **Water Losses:** Water delivered to the distribution system that does not appear as authorized consumption.
23. Calculated as the difference of the system input volume and total authorized consumption (Line 17 minus Line 22).

Texas Water Development Board Water Audit Worksheet

A. WATER UTILITY GENERAL INFORMATION

1. Water Utility Name: _____
2. Contact: Name _____
Telephone# _____ Email Address _____
3. Reporting Period: From ____/____/____ to ____/____/____
4. Source Water Utilization, percentage: Surface Water _____% Groundwater _____%
5. Population Served:
 - a. Retail Population Served _____
 - b. Wholesale Population Served _____
6. Utility's Length of Main Lines, miles _____
7. Number of Wholesale Connections Served _____
8. Number of Retail Service Connections Served _____
9. Service Connection Density
(Number of retail service connections/Miles of main lines) _____
10. Average Yearly System Operating Pressure (psi) _____
11. Volume Units of Measure (check one):
 _____ acre-ft _____ million gallons _____ thousand gallons _____ gallons

**Assessment
Scale**

B. SYSTEM INPUT VOLUME

12. Water Volume from own Sources _____
13. Production Meter Accuracy (enter percentage) _____ %
14. Corrected Input Volume _____
15. Wholesale Water Imported _____
16. Wholesale Water Exported _____
17. **System Input Volume**
*(Corrected input volume, plus imported water,
minus exported water)* _____

| | Assessment Scale |
|--|---------------------|
| C. AUTHORIZED CONSUMPTION | |
| 18. Billed Metered | _____ |
| 19. Billed Unmetered | _____ |
| 20. Unbilled Metered | _____ |
| 21. Unbilled Unmetered | _____ |
| 22. Total Authorized Consumption | _____ |
| D. WATER LOSSES | |
| 23. Water Losses <i>(Line 17 minus Line 22)</i> | _____ |
| E. APPARENT LOSSES | |
| 24. Average Customer Meter Accuracy <i>(Enter percentage)</i> | _____ % _____ |
| 25. Customer Meter Accuracy Loss | _____ |
| 26. Systematic Data Handling Discrepancy | _____ |
| 27. Unauthorized Consumption | _____ |
| 28. Total Apparent Losses | _____ |
| F. REAL LOSSES | |
| 29. Reported Breaks and Leaks <i>(Estimated volume of leaks and breaks repaired during the audit period)</i> | _____ |
| 30. Unreported Loss <i>(Includes all unknown water loss)</i> | _____ |
| 31. Total Real Losses <i>(Line 29, plus Line 30)</i> | _____ |
| 32. Water Losses (Apparent + Real) <i>(Line 28 plus Line 31) = Line 23</i> | _____ |
| 33. Non-revenue Water <i>(Water Losses + Unbilled Authorized Consumption)</i> <i>(Line 32, plus Line 20, plus Line 21)</i> | _____ |

G. TECHNICAL PERFORMANCE INDICATOR FOR APPARENT LOSS

34. Apparent Losses Normalized
(Apparent Loss Volume/# of Retail Service
Connections/365) _____

H. TECHNICAL PERFORMANCE INDICATORS FOR REAL LOSS

35. Real Loss Volume (Line 31) _____

36. Unavoidable Annual Real Losses, volume (calculated) _____

37. Infrastructure Leakage Index (calculated)
(Equals real loss volume divided by unavoidable
annual real losses) _____

38. Real Losses Normalized
(Real Loss Volume/# of Service Connections/365)
(This indicator applies if service connection
density is greater than 32/mile) _____

39. Real Losses Normalized
(Real Loss Volume/Miles of Main Lines/365)
(This indicator applies if service connection
density is less than 32/mile) _____

I. FINANCIAL PERFORMANCE INDICATORS

40. Total Apparent Losses (Line 28) _____

41. Retail Price of Water _____

42. Cost of Apparent Losses
(Apparent loss volume multiplied by
retail cost of water, Line 40 x Line 41) _____

43. Total Real Losses (Line 31) _____

44. Variable Production Cost of Water*
(*Note: In case of water shortage, real losses
might be valued at the retail price of water
instead of the variable production cost.) _____

45. Cost of Real Losses
(Real loss multiplied by variable production
cost of water, Line 43 x Line 44) _____

46. Total Assessment Score _____

47. Total Cost Impact of Apparent and Real Losses _____

B. **System Input Volume:** The total water supplied to the link structure. It is the total of all production meter readings for the entire year. List the volume or percentage requested in each item, along with the scores from Appendix 1.3 that in your judgment best represent the degree of validation of the data.

12. **Water Volume from own Sources:** Includes all water taken as source water from permitted sources, such as rivers, lakes, streams, and wells.
13. **Production Meter Accuracy (enter a percentage):** Achieved by calibrating or verifying the accuracy level (expressed as a percentage) of production meters. For example purposes, if the meter over-registered by 4 percent, enter 1.04; if it under-registered by 4 percent, enter .96.
14. **Corrected Input Volume (calculated automatically online):** The sum obtained when the production meter adjustment is either added to or subtracted from the system input volume. Divide "water volume from own sources" by the production meter accuracy. You must add the decimal point when the calculation is done manually (for example, to .96).

Example: If "water volume from own sources" registered 1.8 MG/year through two production meters, which were found to be collectively under-registering flow by 4 percent, then the corrected input volume (CIV) is:

$$\text{Corrected Input Volume} = (1,800,000)/(0.96) = 1,875,000$$

15. **Wholesale Water Imported:** Amount of purchased wholesale water transferred into the utility's water distribution system from other water suppliers.
 16. **Wholesale Water Exported:** Amount of wholesale water transferred out of the utility's distribution system. It may be put into the system initially but is only in the system for a brief time for conveyance reasons.
 17. **System Input Volume:** Calculated as the corrected input volume plus water imported minus water exported (Line 14, plus Line 15, minus Line 16).
- C. **Authorized Consumption:** All water that has been authorized for use or consumption by the utility or its customers. Remember to convert these volumes into the same units as the water delivery volume. Note: Any type of legitimate consumption should be classified in one of the four components of authorized consumption.
18. **Billed Metered:** All retail water sold and metered.
 19. **Billed Unmetered:** All water sold but not metered.
 20. **Unbilled Metered:** All water metered but not billed, such as back flushing water, parks, golf courses, and municipal government offices.
 21. **Unbilled Unmetered:** All water not billed or metered, such as flushing fire hydrants.
 22. **Total Authorized Consumption:** The total of the above four components, automatically calculated in the online worksheet.
- D. **Water Losses:** Water delivered to the distribution system that does not appear as authorized consumption.
23. Calculated as the difference of the system input volume and total authorized consumption (Line 17 minus Line 22).

Water Audit Worksheet Instructions

(All numbers used in this worksheet are for example purposes only)

The following instructions can be used in completing the Water Audit Worksheet. The instructions are labeled by line number shown on the worksheet. The Water Audit Worksheet requests that the water utility enter general information and water supply, consumption, and loss quantities. It also requests assessment scores representing the degree of validation of individual components. For those components that include an assessment line, enter a number between 1 and 5. (See Appendix 1.3 for more information.) If a component does not apply, then enter 0 (for example, if the water utility does not import any water, enter 0 for wholesale water imported). You may visit the TWDB Web site for the online version of the water audit:

<http://www.twdb.state.tx.us/conservation/municipal/waterloss/>

A. Water Utility Information

1. **Water Utility Name:** List the formal name of the water utility for which the water audit exists.
2. **Contact:** List the name of the primary contact person responsible for completing the water audit for the water utility, the telephone number, and email address.
3. **Reporting Period:** Enter calendar year or fiscal year dates for the reporting period.
4. **Source Water Utilization:** Enter percentages to represent the proportions of surface water and groundwater withdrawn for source water supply. Remember that the total of the two percentages must equal 100%.
5. **Population Served:** List separately the retail and wholesale populations served. You may multiply the number of connections by three if needed to estimate the retail population.
6. **Utility's Length of Main Lines, miles:** List the total length of pipeline in the water distribution system in miles.
7. **Number of Wholesale Connections Served:** List the number of wholesale interconnections supplying water to other water utilities.
8. **Number of Retail Service Connections Served:** List the number of retail customer service connections served by the utility's water distribution system.
9. **Service Connection Density:** Calculate the service connection density by dividing the number of retail customer service connections by the length of miles of pipeline in the water distribution system.
10. **Average Yearly System Operating Pressure:** List the average pressure across the entire water distribution systems for the audit period. If a hydraulic model of the network exists, the average pressure can be calculated by the model; otherwise, an estimate can be used.
11. **Volume Units of Measure:** Select the volume units of measure for the water audit. The units must be consistent throughout the entire water audit. If choosing million gallons for system input (from production meters), then authorized consumption (billed and unbilled) and all other entries must also be entered in million gallons. This typically requires a conversion for billed metered consumption.

B. **System Input Volume:** The total water supplied to the infrastructure. It is the total of all production meter readings for the entire year. List the volume or percentage requested in each item, along with the scores from Appendix 1.3 that in your judgment best represent the degree of validation of the data.

12. **Water Volume from own Sources:** Includes all water taken as source water from permitted sources, such as rivers, lakes, streams, and wells.
13. **Production Meter Accuracy (enter a percentage):** Achieved by calibrating or verifying the accuracy level (expressed as a percentage) of production meters. For example purposes, if the meter over-registered by 4 percent, enter 1.04; if it under-registered by 4 percent, enter .96.
14. **Corrected Input Volume (calculated automatically online):** The sum obtained when the production meter adjustment is either added to or subtracted from the system input volume. Divide "water volume from own sources" by the production meter accuracy. You must add the decimal point when the calculation is done manually (for example, to .96).

Example: If "water volume from own sources" registered 1.8 MG/year through two production meters, which were found to be collectively under-registering flow by 4 percent, then the corrected input volume (CIV) is:

$$\text{Corrected Input Volume} = (1,800,000)/(0.96) = 1,875,000$$

15. **Wholesale Water Imported:** Amount of purchased wholesale water transferred into the utility's water distribution system from other water suppliers.
16. **Wholesale Water Exported:** Amount of wholesale water transferred out of the utility's distribution system. It may be put into the system initially but is only in the system for a brief time for conveyance reasons.
17. **System Input Volume:** Calculated as the corrected input volume plus water imported minus water exported (Line 14, plus Line 15, minus Line 16).

C. **Authorized Consumption:** All water that has been authorized for use or consumption by the utility or its customers. Remember to convert these volumes into the same units as the water delivery volume. Note: Any type of legitimate consumption should be classified in one of the four components of authorized consumption.

18. **Billed Metered:** All retail water sold and metered.
19. **Billed Unmetered:** All water sold but not metered.
20. **Unbilled Metered:** All water metered but not billed, such as back flushing water, parks, golf courses, and municipal government offices.
21. **Unbilled Unmetered:** All water not billed or metered, such as flushing fire hydrants.
22. **Total Authorized Consumption:** The total of the above four components, automatically calculated in the online worksheet.

D. **Water Losses:** Water delivered to the distribution system that does not appear as authorized consumption.

23. Calculated as the difference of the system input volume and total authorized consumption (Line 17 minus Line 22).

E. **Apparent Losses:** Water that has been consumed but not properly measured or billed. These losses represent under-registered or under-billed water that occurs via customer meter inaccuracy, systematic data handling error in the customer billing system, and unauthorized consumption:

24. **Average Customer Meter Accuracy:** List the composite accuracy percentage for your customer's meters. This percentage is typically derived from meter testing results. A representative assessment of customer meter accuracy can be obtained by testing as few as 50 meters.

25. **Customer Meter Accuracy Loss:** Obtained by dividing the billed metered water volume by the degree of average customer meter accuracy (Line 18 ÷ Line 24).

Example: If billed metered (line 18) consumption registered 1.5 MG/year and random meter testing found customer meters to be collectively under-registering flow by 8 percent (so they are 92 percent accurate), then the customer meter accuracy loss is:

$$\text{Custom Meter Accuracy} = [(1,500,000)/(0.92) - 1,500,000] = 130,434.78 \text{ gallons}$$

26. **Systematic Data Handling Discrepancy:** List the estimated volume of water recorded by customer meters but distorted by meter reading or billing system error.

27. **Unauthorized Consumption (theft):** Estimate amount of water loss due to theft. Include an estimate of water taken illegally from fire hydrants, as well as water loss at the customer service connection. Theft at the customer connection can include tampering with meters or meter reading equipment, in addition to illegal taps and other similar occurrences.

28. **Total Apparent Losses:** This value is calculated automatically online as the sum of customer meter accuracy loss, systematic data handling error, and unauthorized consumption.

F. **Real Losses:** These are physical losses from the pressurized water distribution system, including water mains and all appurtenances (for example, valves and hydrants) and customer service connection piping. Real losses represent water that is lost from the distribution system prior to reaching the customer destination.

29. **Reported Breaks and Leaks:** Reported breaks and leaks are brought to the attention of the water utility by customers, public safety officials, other utilities, or other members of the general public. Usually these visible water main breaks are very disruptive and water utilities respond quickly to these events, so the run duration of the break or leak is relatively short. Estimate the total volume of water loss during the water audit period from reported breaks and leaks that were repaired during the year. Leakage flow rates must be estimated for various types of breaks and leaks, as well as the approximate duration of the breaks or leaks prior to repair.

30. **Unreported Loss:** This is a "catch-all" volume, meaning that this volume of real losses is the quantity that remains after authorized consumption, apparent losses, and reported leakage have been subtracted from the system input volume. In every water distribution system, even those employing effective active leakage control programs, there exists some amount of undetected leakage. Some of this loss is comprised of unreported leakage that has not yet been detected in leak surveys. It also includes a subcomponent known as background leakage, which is the collective weeps and seeps at pipe joints and on customer service connections that cannot be detected with acoustic sounding devices. Any degree of error in quantifying metered and estimated volumes in the water audit results in error in this component. As the validation of the water audit improves over time, so will the level of validation of the unreported loss volume.

- 31. **Total Real Losses:** This value is calculated automatically online as the sum of reported breaks and leaks and unreported loss.
 - 32. **Water Losses:** Calculated as the sum of apparent losses and real losses. This value should equal the value of Line 23. This line is included as a balancing check.
 - 33. **Non-revenue Water:** Calculated as the sum of apparent losses, plus real losses, plus unbilled metered consumption and unbilled unmetered consumption. This is the water that does not contribute to the water utility billings.
- G. Technical Performance Indicator for Apparent Loss:** Performance indicators are quantitative measures of key aspects within the utility. Using these indicators, the utility will have a history to track its performance from year to year. One performance indicator exists for apparent loss.
- 34. **Apparent Losses Normalized:** Calculated as the volume of apparent loss, divided by the number of retail customer service connections, divided by 365 days. This performance indicator allows for reliable performance tracking in the water utility's efforts to reduce apparent losses.
- H. Technical Performance Indicator for Real Loss:** Several performance indicators exist for real loss.
- 35. **Real Loss Volume:** This is the quantity from Line 31.
 - 36. **Unavoidable Annual Real Losses:** Calculated reference value using the equation shown in Table 3-2. This is a theoretical value of the technical low level of leakage that might be attained in a given water utility, based upon several system specific parameters.
 - 37. **Infrastructure Leakage Index:** This performance indicator is calculated as the ratio of real losses over the unavoidable annual real losses. The index measures the water utility's leakage management effectiveness and is an excellent performance indicator for comparing performance among water utilities. The lower the value of the infrastructure leakage index, the closer the utility is operating to the theoretical low level of the unavoidable annual real loss. Appendix 1.4 gives general guidance on setting preliminary leakage reduction targets using the infrastructure leakage index without changing water pressure.
 - 38. **Real Losses Normalized:** Calculated as the real loss volume, divided by the number of retail service connections, divided by 365. Use this calculation if the service connection density is greater than, or equal to, 32 per mile. This indicator allows for reliable performance tracking in the water utility's efforts to reduce real losses.
 - 39. **Real Losses Normalized:** Calculated as the real loss volume, divided by the number of miles of pipeline, divided by 365. Use this calculation if the service connection density is less than 32 per mile. This indicator allows for reliable performance tracking in the water utility's efforts to reduce real losses.

I. Financial Performance Indicators

40. **Total Apparent Losses:** List the volume from line 28.
41. **Retail Price of Water:** Water utility rate structures usually feature multiple tiers of pricing based upon volume consumed. For the water audit, it is best to use a single composite price rate to represent the retail cost of water, which is used to place a value on the apparent losses. The largest number of accounts in most utilities is residential accounts; therefore, the residential pricing tier may be used in place of weighted calculations to determine a composite rate.
42. **Cost of Apparent Losses:** Calculated by multiplying the apparent loss volume by the retail price of water. This represents the potential amount of missed revenue due to apparent losses.
43. **Total Real Losses:** List the volume from line 31.
44. **Variable Production Cost of Water:** Marginal production cost including variable costs, which are typically the costs of raw water, energy, and chemicals. If applicable, the cost of raw water should include the price of take or pay contracts. These costs are applied to determine the cost impact of real losses. In cases of water shortage, real losses might be valued at the retail price of water instead of the variable production cost.
45. **Cost of Real Losses:** Calculated by multiplying the real loss volume by the variable production cost of water. These costs represent the additional operating costs incurred by the water utility due to the real losses (in other words, leakage).
46. **Total Assessment Score:** Add the individual assessment scores to obtain a total.
47. **Total Cost Impact of Apparent and Real Losses:** Calculated by adding lines 42 and 45. This amount indicates the cost inefficiency encountered by the water utility for losses. This cost value can be objectively weighed against potential loss control programs to determine the cost effectiveness of such programs.

If you or the utility has any software application questions, please call Juan Moran-Lopez at 512-463-0987 or email: Juan.Moran-Lopez@twdb.texas.gov

For more information on water audits, visit the American Water Works Association Web site: <http://www.awwa.org/Resources/topicspecific.cfm?ItemNumber=3653&navItemNumber=1583>

Guidance Matrix for Assigning Scores to Components of the Water Audit

| COMPONENT | ASSESSMENT TABLE | | | | |
|---|--|---|---|---|--|
| SYSTEM DATA | 1 | 2 | 3 | 4 | 5 |
| <i>Length of mains</i> | Estimates only | Paper records in poor condition (no totals from year to year) | Good annual paper records | Electronic records and asset management system in good condition; includes system backup | GIS data and asset management database in agreement; random field checks validate databases |
| <i>Improvements in quantifying the length of mains</i> | Research and collect paper records for a number of years prior to audit year | Improve to include all totals for at least five years prior to audit year | Convert to electronic databases with backup | Link GIS and asset management databases; conduct field verification of data | Continue with standardization and random field validation to improve knowledge of system |
| <i>Average operating pressure</i> | Estimates only | Random pressure testing and averaging | Pressure testing through system standardized on annual basis | Combine pressure testing to calibrate hydraulic model to develop average system pressure | District testing and averaging matching data from hydraulic model |
| <i>Improvements in quantifying the average operating pressure</i> | Develop total system pressure by averaging known pressure from hydrant and random pressure tests | Improve standardization of pressure testing and recording | Analyze SCADA pressure data and assess average system pressure through hydraulic network modeling | Conduct standardized pressure testing as part of calibration process for developing hydraulic model | Continue with standardization and random field validation to improve knowledge of system; refine hydraulic model |
| System Data | 10 | | | | |
| WATER SUPPLIED | 1 | 2 | 3 | 4 | 5 |
| <i>Volume from own sources</i> | No meters; volume quantified by estimates only | Partially metered; several supply sources metered but not all | Fully metered; no regular testing or calibration of meters | Fully metered; partial testing or electronic calibration; no meters greater than 15 years old | Fully metered; annual electronic calibration and flow testing; no meters greater than 15 years old |
| <i>Improvements in quantifying volume from own sources</i> | Install meters | Complete 100% metering | Initiate testing of meters | Reduce age of meters unless able to prove accuracy of all old meters through flow testing | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |

Appendix 1.3 continued

| | | | | | |
|---|--|---|--|---|--|
| <i>Production meter accuracy</i> | No testing of production meters; estimated adjustment used only as needed | Testing of production meters only where problems suspected | Systematic testing of meters; underperforming meters not always replaced | Systematic testing of all meters within at least a five-year cycle; all meters over standards replaced or repaired and retested | Testing of all production meters conducted in year of audit; replacement of all meters outside standard accuracy range |
| <i>Improvements to master meter error adjustment</i> | Start testing program | Develop systematic testing program | Replace or repair all non-standard meters | Test all production meters annually; repair or replace all underperforming meters | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |
| <i>Water imported</i> | No meters; volume quantified by estimates only | Partially metered; several supply sources metered but not all | Fully metered; no regular testing or calibration of meters | Fully metered; partial testing or electronic calibration; no meters greater than 15 years old | Fully metered; annual electronic calibration and flow testing; no meters greater than 15 years old |
| <i>Improvements in quantifying volume of water imported</i> | Install meters | Complete 100% metering | Initiate testing of meters | Reduce age of meters unless able to prove accuracy of all old meters through flow testing | No new work; standardize calibration, testing, and replacement to maintain this high level of service |
| <i>Water exported</i> | No meters; volume quantified by estimates only | Partially metered; several interconnections metered but not all | Fully metered; no regular testing or calibration | Fully metered; partial testing or electronic calibration; no meters greater than 15 years old | Fully metered; annual electronic calibration and flow testing; no meters greater than 15 years old |
| <i>Improvements in quantifying volume of water exported</i> | Install meters | Complete 100% metering | Initiate testing of meters | Reduce age of meters unless able to prove accuracy of all old meters through flow testing | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |
| Water Supplied | | | | | 20 |
| AUTHORIZED CONSUMPTION | 1 | 2 | 3 | 4 | 5 |
| <i>Billed metered</i> | No consumption data gathered; flat or fixed rate in use only | Manual meter reads and billings; no regular audits of customer billing data | Automated billing system; no annual checks of data | Automated meter reading and billing system; internally checked or checked by third party on less than annual basis | Automated meter reading and billing system audited by third party on annual basis |
| <i>Improvements in quantifying volume of billed metered consumption</i> | Start meter reading and volume-based billing; plan computerized billing system | Develop computerized billing system; consider automatic meter reading | Conduct internal checks of billing data; install automatic meter reading | Conduct third-party audit of billed data | Continue and standardize program |

Appendix 1.3 continued

| | | | | | |
|---|---|--|--|---|--|
| <i>Billed unmetered</i> | Estimates of consumption used | Production meters used to determine consumption; all areas not monitored | Production meters used to determine consumption; all areas monitored | District meters (each 3,000 or fewer connections) used to determine consumption; No total coverage; rest use production meters | District meters (each covers 3,000 connections or less) throughout system used to determine consumption |
| <i>Improvements in quantifying volume of billed unmetered consumption</i> | Develop methods to meter at a higher level (production or district level) | Improve level of monitoring to all areas or consider metering any unmetered accounts | Reduce size of monitored areas or meter unmetered accounts | Reduce size of monitored areas and standardize system analysis, or meter unmetered accounts | Continue and standardize program; all customers who can feasibly be metered are metered |
| <i>Unbilled metered</i> | No testing; estimates only | Testing only where problems suspected | Systematic testing of all meters; underperforming meters not always replaced | Systematic testing of all meters within at least a five-year cycle; all meters over standards replaced or repaired and retested | Testing of all production meters conducted in year of audit; replacement of all meters outside standard accuracy range |
| <i>Improvements in quantifying volume of unbilled metered consumption</i> | Start testing program and regular meter readings | Develop systematic testing program; consider automatic meter reading | Replace or repair all non-standard meters; install automatic meter reading | Test all meters annually; repair or replace all underperforming meters | No new work; standardize calibration, testing, and replacement to ensure this high level of service continues |
| <i>Unbilled unmetered</i> | Overall estimates throughout system | Partial estimates for some of variables; basic estimates for others | Estimates using formulae (for example, time x gallons per flush) for known events | Partial estimates using test data; other estimates using formulae from known number of events | Estimates using previous metered testing to determine overall estimated values |
| <i>Improvements in quantifying volume of unbilled unmetered consumption</i> | Develop estimates for various unbilled metered events; use default of 1.25% of input volume; change to metered values | Record number of events and develop standard formula for calculating volume, or change to metered values | Conduct test studies of defined duration to determine actual versus estimated volumes, or change to metered values | Conduct test studies on all variables to determine actual versus estimated volumes, or change to metered values | Change to metered values; use of diffuser to accurately determine flushing volume |
| Authorized Consumption | | | | | |

Appendix 1.3 continued

| APPARENT LOSSES | 1 | 2 | 3 | 4 | 5 |
|---|--|---|---|---|---|
| <i>Average customer meter accuracy</i> | No testing or replacement; estimates only | Testing or replacement of 1 to 5% of meters in year of audit | Analysis of test data finds meters meeting specs, or testing or replacement of 5 to 10% of meters per year | Previous test data analyzed and all meters in specifications, or testing or replacement of 10 to 50% of meters in year of audit | Previous test data analyzed and all meters in specifications, or testing or replacement of over 50% of meters in year of audit |
| <i>Improvements in quantifying loss due to customer meter inaccuracies</i> | Conduct testing regime on small number of meters targeted to suspected problem areas such as meter age or type | Standardize testing and test or replace 5 to 10% of meters; consider increasing number of meters tested or replaced after review of test data | Consider increasing number of meters tested or replaced after review of test data | Consider increasing number of meters tested or replaced after review of test data | Consider increasing number of meters tested or replaced after review of test data |
| <i>Systematic data handling discrepancy</i> | No review of billing system | Automated system but no checks of data validity | Automated system; less than annual checks of data | Automated system; internally checked on at least annual basis | Assessment of data handling errors conducted internally and audited by third party on annual basis |
| <i>Improvements in quantifying losses due to systematic data handling error</i> | Conduct internal review of meter reading and billing systems | Conduct internal checks on data validity and meter reading procedures | Conduct annual internal checks of billing data | Conduct third party audit of billed data with specific review of possible data handling and meter reading errors | Continue and standardize program |
| <i>Unauthorized consumption</i> | Arbitrary volume estimates | Default of 0.25% of input volume | Number of events of each type evaluated; multiply by estimated gallons lost per event | Number of occurrences evaluated; monitoring and enforcement program started | Monitoring and enforcement program well established with analyzed losses less than 0.25% and declining from previous years |
| <i>Improvements in quantifying volume of unauthorized consumption</i> | Develop estimates for likely major incidents of unauthorized consumption; use default of 0.25% of input volume | Evaluate number of occurrences of each of major incidents of unauthorized consumption | Identify losses and aim to reduce; audit areas of suspected losses; examine policy and procedures for gaps allowing fraud | Put in place a monitoring and enforcement plan to show reductions in water lost; implement improved policy and procedures for better policing | Continue with monitoring and enforcement program; review at least annually; consider new regulations to thwart specific incidents of unauthorized consumption |

Appendix 1.3 continued

| REAL LOSSES | 1 | 2 | 3 | 4 | 5 |
|--|--|---|---|---|---|
| <i>Reported leaks</i> | Arbitrary estimates; repairs of reported leaks and breaks not documented | Only visual leaks and breaks from customer calls fixed; no known duration before fixing; cursory records | Visual leaks and breaks reported by customers and city staff; call-to-repair times known (greater than one week average); good records | Visual leaks and breaks reported by customers and city staff; call-to-repair times average less than one week; computerized maintenance management system used to document leak repair trends | Visual leaks and breaks reported by customers and city staff; call-to-repair times average less than two days; outstanding computer maintenance records track system deficiencies and repair crew performance |
| <i>Improvements in quantifying reported leaks</i> | Report leaks and breaks and develop standards to find, repair, and document leaks and breaks | Standardize recording of leak location and repair data | Continue to standardize recordkeeping process; plan computerized maintenance management system; cut average leak run time to less than one week | Implement computerized maintenance management system to document repairs; reduce leak run time average to less than two days; plan proactive leak detection | Use capabilities of computerized maintenance management system to track failure trends in distribution system and repair crew activity costs; conduct proactive leak detection |
| <i>Unreported loss</i> | If no active leakage control activities exist, unreported leaks are undetected and quantity is zero | Limited leak detection using basic sounding performed for a portion of the distribution system; no detailed records/database | Proactive leak detection using basic sounding, correlation, and detailed leak detection records; one or more District Metered Areas in use | Proactive leak detection using basic sounding, correlation, flow monitoring, and detailed leak detection and asset condition records; detailed component analysis results | Fully integrated flow monitoring and leak detection program with continuous reporting and analysis of system leakage; integration with asset management, GIS, and economic level of leakage |
| <i>Improvements in quantifying unreported loss</i> | Plan proactive leak detection, and/or evaluate the feasibility of continuous flow monitoring in one or more District Metered Areas | Upgrade leak detection capabilities using electronic correlation; set structured leak survey schedule; improve detail of records/database | Improve sonic leak detection and flow monitoring capabilities; improve records to include analysis of asset condition; conduct a component analysis by estimating leak run times and repair times | Fully integrate all leak detection and asset management functions; continue to install District Metered Areas as economically feasible; start to analyze economic level of leakage | Continue to standardize and audit on regular basis |
| Real Losses | | | | | 10 |

Appendix 1.3 continued

| COST DATA | 1 | 2 | 3 | 4 | 5 |
|--|--------------------------|---|--|--|--|
| <i>Customer retail unit cost (applied to apparent losses)</i> | Estimates only | Residential rate only | Weighted average residential rate using volumes in each rate block | Weighted average combination usage rate (includes residential, commercial, and industrial) | Third-party reviewed; weighted average combination usage rate (includes residential, commercial, and industrial) |
| <i>Improvements in quantifying the annual retail unit costs</i> | Conduct structured audit | Evaluate volume of water used in each usage block by residential users; multiply volumes by full rate structure | Evaluate volume of water used in each usage block by all classifications of users; multiply volumes by full rate structure | Conduct a third-party audit of water used in each usage block by all classifications of users; multiply volumes by full rate structure | Continue with this program |
| <i>Variable production cost (applied to real losses)</i> | Estimates only | Extrapolated from evaluation of partial system electric and chemicals costs | Non-audited evaluation of total system electric and chemical costs | Internally audited wholesale, electric, and chemical costs | Third party audited wholesale, electric, chemical, and detailed support costs annually |
| <i>Improvements in quantifying the variable production costs</i> | Conduct structured audit | Conduct cost evaluation of total system electric and chemical costs | Conduct an annual internal audit | Conduct a third-party audit | Continue with this program |
| Cost Data | | | | | 10 |
| Total Score | | | | | 85 |

American Water Works Association General Guidelines for Setting a Target Infrastructure Leakage Index

(without a full economic analysis of leakage control options*)

Once data has been entered into the Water Audit Worksheet, the performance indicators are automatically calculated. The Water Loss Control Committee of the American Water Works Association provided the following table to assist water utilities in gauging an approximate infrastructure leakage index that is appropriate for their water system and local conditions. The lower the amount of leakage and real losses that exist in the system, the lower the infrastructure leakage index will be.

| Target Infrastructure Leakage Index Range | Financial Considerations | Operational Considerations | Water Resources Considerations |
|---|--|---|--|
| 1.0 - 3.0 | Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability. | Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand. | Available resources are greatly limited and are very difficult and/or environmentally unsound to develop. |
| >3.0 - 5.0 | Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population. | Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place. | Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management and water conservation) are included in the long-term plan. |
| >5.0 - 8.0 | Cost to purchase or obtain/treat water is low, as are rates charge to customers. | Superior reliability, capacity, and integrity of the water supply infrastructure make it relatively immune to supply shortages. | Water resources are plentiful, reliable, and easily extracted. |
| Greater than 8.0 | Although operational and financial considerations may allow a long-term infrastructure leakage index greater than 8.0, such a level of leakage is not an effective use of water as a resource. Setting a target level greater than 8.0 other than as an incremental goal to a smaller long-term target is discouraged. | | |
| Less than 1.0 | If the value of the infrastructure leakage index for your system is 1.0 or less, two possibilities exist: 1) You are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control; or 2) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low value but do not employ extensive leakage control practices in your operations. In such cases, it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters or to identify any other potential sources of error in the data. | | |

Note: This table offers an approximate guideline for setting leakage reduction targets. The best means of setting such targets include performing economic assessments of various loss control methods. However, this table is useful if such assessments are not possible or a preliminary target is desired.

Appendix 2

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Leak Detection and Repair Field Guide

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. Give higher priority 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 leaks at 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 and total number of listening points.
4. If not 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 Appendix 2.1.

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 _____

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):

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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 _____

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Line Flushing Report

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

Remarks: _____

Signature: _____

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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: _____

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Appendix 2.1

Leak Rates from Holes of Known Sizes

| Area of leak square inches | Gallons per minute (gpm) | | | | | |
|-------------------------------|---------------------------------------|-----|-----|-------|-------|-------|
| | Pressure pounds per square inch (psi) | | | | | |
| | 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 | 7.6 | 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 | 239 |
| 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 | 478 |
| 1.500 | 162 | 229 | 324 | 396 | 458 | 512 |
| 1.600 | 173 | 244 | 345 | 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 – gallons per minute (gpm), Area – square inches, Pressure – pounds per square inch (psi)

Example use of Appendix 2.1:

A hole 1/8 inch by 1 1/4 inch in size at 50 pounds per square inch

First calculate the area:

1/8 inch = 0.125 inches, 1 1/4 inch = 1.25 inches, Area = 0.125 x 1.25 = 0.156 square inch

From the table, the size that is closest is 0.1 and 0.2 square inches, and the pressure is between 40 and 60 pounds per square inch. The flow rate is going to be about 36 gallons per minute.

Texas Water Development Board

Brochures, Services, and Leak Detection Equipment

The Texas Water Development Board is a nonregulatory state agency that provides many services to water utilities around the state. These services include providing brochures, conducting Water Audit/Leak Detector Workshops, and loaning leak detectors and ultrasonic flow meter equipment free for 30 days.

BROCHURES

The brochures we provide cover numerous topics, including lawn irrigation, water wise plants, and utility information. Most of these are available in Spanish. A complete list of brochures can be found on our Web site, <http://www.twdb.texas.gov/publications/brochures/conservation/>. We are able to send up to 500 brochures per year at no charge to water utilities, river authorities, and other governmental agencies.

WORKSHOPS

Water Audit/Leak Detector Workshops are available anytime of the year. This is a Texas Commission on Environmental Quality-approved workshop that entitles each operator four hours of credit toward renewing 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 necessary training materials will be provided. To be eligible for this workshop, 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. Workshop agendas and other relevant information are available by contacting Juan Moran-Lopez, 512-463-0987 or by accessing our Web site:

<http://www.twdb.state.tx.us/conservation/municipal/waterloss/>

ASSISTANCE

TWDB staff is also available to consult with utility personnel regarding water loss and in completing the Water Audit Worksheet.

EQUIPMENT

Our free equipment, an LD-12 and Panametrics, are both available for loan for 30 days. The LD-12 is an acoustical sounding device that helps pinpoint leaks and ruptured pipes. The device has headphones and a ground microphone. The Panametrics (an ultrasonic device) works with transducers that are placed onto the pipe near the master meter. This equipment will verify the flow rates going through the master or source meters.

Once again, all of this information is provided without cost to your utility. To implement one or all of these services, call Juan Moran-Lopez at 512-463-0987 or access our Web site:

<http://www.twdb.texas.gov/conservation/>

(All numbers used in this worksheet are for example purposes only)

The following instructions can be used in completing the Water Audit Worksheet. The instructions are labeled by line number shown on the worksheet. The Water Audit Worksheet requests that the water utility enter general information and water supply, consumption, and loss quantities. When completing the water audit worksheet on line, many of the calculations are performed for you. It also requests assessment scores representing the degree of validation of individual components. For those components that include an assessment line, enter a number between 1 and 5. (See Appendix 1.3 for more information). If a component does not apply, then enter 0 (for example, if the water utility does not import any water, enter 0 for wholesale water imported). You may visit the TWDB Web site for the online version of the water audit: <http://www.twdb.texas.gov/apps/overview.asp>

A. Water Utility Information

1. **Water Utility Name:** List the formal name of the water utility for which the water audit exists.
2. **Contact:** List the name of the primary contact person responsible for completing the water audit for the water utility, the telephone number, and email address.
3. **Reporting Period:** Enter calendar year or fiscal year dates for the reporting period.
4. **Source Water Utilization:** Enter percentages to represent the proportions of surface water and groundwater withdrawn for source water supply. Remember that the total of the two percentages must equal 100%.
5. **Population Served:** List separately the retail and wholesale populations served and add to obtain the total population served. You may multiply the number of connections by three if needed to estimate the retail population.
6. **Utility's Length of Main Lines, miles:** List the total length of pipeline in the water distribution system in miles.
7. **Number of Wholesale Connections Served:** List the number of wholesale interconnections supplying water to other water utilities.
8. **Number of Retail Service Connections Served:** List the number of retail customer service connections served by the utility's water distribution system.
9. **Service Connection Density:** Calculate the service connection density by dividing the number of retail customer service connections by the length of miles of pipeline in the water distribution system.
10. **Average Yearly System Operating Pressure:** List the average pressure across the entire water distribution systems for the audit period. If a hydraulic model of the network exists, the average pressure can be calculated by the model; otherwise, an estimate can be used.
11. **Volume Units of Measure:** Select the volume units of measure for the water audit. The units must be consistent throughout the entire water audit. If choosing million gallons for system input (from production meters), then authorized consumption (billed and unbilled) and all other entries must also be entered in million gallons. This typically requires a conversion for billed metered consumption.

B. System Input Volume: The total water supplied to the infrastructure. It is the total of all production meter readings for the entire year. List the volume or percentage requested in each

item, along with the scores from Appendix 1.3 that in your judgment best represent the degree of validation of the data.

12. **Produced Water:** The volume of water from own sources, and/or purchased raw water treated in own production facilities.
13. **Production Meter Accuracy (enter a percentage):** Achieved by calibrating or verifying the accuracy level (expressed as a percentage) of production meters. For example purposes, if the meter over-registered by 4 percent, enter 104; if it under-registered by 4 percent, enter 96.
14. **Corrected Input Volume (calculated automatically online):** The sum obtained when the production meter adjustment is either added to or subtracted from the system input volume. Divide "water volume from own sources" by the production meter accuracy. You must add the decimal point when the calculation is done manually (for example, to .96).

Example: If "water volume from own sources" registered 1.8 MG/year through two production meters, which were found to be collectively under-registering flow by 4 percent, then the corrected input volume (CIV) is:

Corrected Input Volume = $(1,800,000) \div (.96) = 1,875,000 - 1,800,000 = 75,000$. The additional 75,000 gallons was not registered by the meter.

15. **Water Imported:** Amount of treated bulk water purchased
16. **Water Exported:** Amount of water transferred out of the utility's distribution system.
17. **System Input Volume:** Calculated as the corrected input volume plus water imported minus water exported. (Line 14, plus Line 15, minus Line 16)

C. Authorized Consumption: All water that has been authorized for use or consumption by the utility or its customers. Remember to convert these volumes into the same units as the water delivery volume. Note: Any type of legitimate consumption should be classified in one of the four components of authorized consumption.

18. **Billed Metered:** All retail water sold and metered.
19. **Billed Unmetered:** All water sold but not metered.
20. **Unbilled Metered:** All water metered but not billed, such as back flushing water, parks, golf courses, and municipal government offices.
21. **Unbilled Unmetered:** All water not billed or metered, such as flushing fire hydrants.
22. **Total Authorized Consumption:** The total of the above four components, automatically calculated in the online worksheet.

D. Water Losses: Water delivered to the distribution system that does not appear as authorized consumption.

23. Calculated as the difference of the system input volume and total authorized consumption (Line 17 minus Line 22).

E. Apparent Losses: Water that has been consumed but not properly measured or billed. These losses represent under-registered or under-billed water that occurs via customer meter inaccuracy, systematic data handling error in the customer billing system, and unauthorized consumption:

24. **Average Customer Meter Inaccuracy:** List the composite accuracy percentage for your customer's meters. This percentage is typically derived from meter testing results. A representative assessment of customer meter accuracy can be obtained by testing as few as 50 meters.
25. **Customer Meter Inaccuracy Loss:** Obtained by dividing the billed metered water volume by the degree of average customer meter inaccuracy (Line 18 ÷ Line 24 – Line 18).

Example: If billed metered (line 18) consumption registered 1.5 MG/year and random meter testing found customer meters to be collectively under-registering flow by 8 percent, then the customer meter inaccuracy loss is:

Custom Meter Inaccuracy = [(1,500,000) ÷ (.92) – 1,500,000] = 130,434.782 gallons. The 630,434 represents water that was not registered by the meter.

26. **Systematic Data Handling Errors:** List the estimated volume of water recorded by customer meters but distorted by meter reading or billing system error. The utility may choose to set up an account within their software called unbilled consumption, it is for water not billed but that was recorded by the meter. If unbilled consumption is not tracked, this volume becomes part of your water loss.
 27. **Unauthorized Consumption (theft):** Estimate amount of water loss due to theft. Include an estimate of water taken illegally from fire hydrants, as well as water loss at the customer service connection. Theft at the customer connection can include tampering with meters or meter reading equipment, in addition to illegal taps and other similar occurrences. The online form has a box you may check that will automatically take 0.25% of production if you have low levels of confidence in the estimated amount.
 28. **Total Apparent Losses:** This value is calculated automatically online as the sum of customer meter inaccuracy loss, systematic data handling error, and unauthorized consumption.
- F. Real Losses:** These are physical losses from the pressurized water distribution system, including water mains and all appurtenances (for example, valves and hydrants) and customer service connection piping. Real losses represent water that is lost from the distribution system prior to reaching the customer destination.
29. **Reported Breaks and Leaks:** Reported breaks and leaks are brought to the attention of the water utility by customers, public safety officials, other utilities, or other members of the general public. Usually these visible water main breaks are very disruptive and water utilities respond quickly to these events, so the run duration of the break or leak is relatively short. Estimate the total volume of water loss during the water audit period from reported breaks and leaks that were repaired during the year. Leakage flow rates must be estimated for various types of breaks and leaks, as well as the approximate duration of the breaks or leaks prior to repair.
 30. **Unreported Loss:** This is a "catch-all" volume, meaning that this volume of real losses is the quantity that remains after authorized consumption, apparent losses, and reported leakage have been subtracted from the system input volume. In every water distribution system, even those employing effective active leakage control programs, experience some amount of undetected leakage. Some of this loss is comprised of unreported leakage

that has not yet been detected in leak surveys. It also includes a subcomponent known as background leakage, which is the collective weeps and seeps at pipe joints and on customer service connections that cannot be detected with acoustic sounding devices. Any degree of error in quantifying metered and estimated volumes in the water audit results in error in this component. As the validation of the water audit improves over time, so will the level of validation of the unreported leaks volume.

31. **Total Real Losses:** This value is calculated automatically online as the sum of reported breaks and leaks and unreported loss.
32. **Water Losses:** Calculated as the sum of apparent losses and real losses. This value should equal the value of Line 23. This line is included as a balancing check.
33. **Non-revenue Water:** Calculated as the sum of apparent losses, plus real losses, plus unbilled metered consumption and unbilled unmetered consumption. This is the water that does not contribute to the water utility billings.

G. Technical Performance Indicator for Apparent Loss: Performance indicators are quantitative measures of key aspects within the utility. Using these indicators, the utility will have a history to track its performance from year to year. One performance indicator exists for apparent loss.

34. **Apparent Losses Normalized:** Calculated as the volume of apparent loss, divided by the number of retail customer service connections, divided by 365 days. This performance indicator allows for reliable performance tracking in the water utility's efforts to reduce apparent losses.

H. Technical Performance Indicator for Real Loss: Several performance indicators exist for real loss.

35. **Real Loss Volume:** This is the quantity from Line 31.
36. **Unavoidable Annual Real Losses:** Calculated reference value using the equation shown in Table 3-2 of the Texas Water Loss Manual, which is found at the following link, www.twdb.texas.gov/publications/brochures/conservation/doc/WaterLossManual_2008.pdf. This is a theoretical value of the technical low level of leakage that might be attained in a water utility, based upon several specific parameters.

$$((Lm)(5.4)(365) + (Nc)(0.15)(365)) (P) = UARL$$

Lm = Length of main lines

Nc = Number of retail connections

P = Average operating pressure

The UARL is not valid for utilities having less than 3000 total connections.

37. **Infrastructure Leakage Index:** This performance indicator is calculated as the ratio of real losses over the unavoidable annual real losses. The index measures the water utility's leakage management effectiveness and is an excellent performance indicator for comparing performance among water utilities. The lower the value of the infrastructure leakage index, the closer the utility is operating to the theoretical low level of the

unavoidable annual real loss. Appendix 1.3 gives general guidance on setting preliminary leakage reduction targets using the infrastructure leakage index without changing water pressure. The ILI is not valid for utilities having less than 3000 total connections.

$ILI = \text{Total Real Loss} / \text{UARL}$.

38. **Real Losses Normalized:** Calculated as the real loss volume, divided by the number of retail service connections, divided by 365. Use this calculation if the service connection density is greater than, or equal to, 32 per mile. This indicator allows for reliable performance tracking in the water utility's efforts to reduce real losses.
39. **Real Losses Normalized:** Calculated as the real loss volume, divided by the number of miles of pipeline, divided by 365. Use this calculation if the service connection density is less than 32 per mile. This indicator allows for reliable performance tracking in the water utility's efforts to reduce real losses.

I. FINANCIAL PERFORMANCE INDICATORS

40. **Total Apparent Losses:** List the volume from line 28.
41. **Retail Price of Water:** Water utility rate structures usually feature multiple tiers of pricing based upon volume consumed. For the water audit, it is best to use a single composite price rate to represent the retail cost of water, which is used to place a value on the apparent losses. Where appropriate, use the tier with the majority of the consumption.
42. **Cost of Apparent Losses:** Calculated by multiplying the apparent loss volume by the retail price of water. This represents the potential amount of missed revenue due to apparent losses.
43. **Total Real Losses:** List the volume from line 31.
44. **Variable Production Cost of Water:** Marginal production cost is defined by only costs that are vary based on amount produced. Variable cost, typically include the cost of raw water, energy, and chemicals. If applicable, the cost of raw water should include the price of take or pay contracts. For example, if you have ground water then you only have the cost of chemicals and electricity to get the water into distribution. Add the chemicals and electricity for the year and divide by No. 17, the System Input Volume. The answer is your cost of water per thousand gallons. These costs are applied to determine the cost impact of real losses. In cases of water shortage, real losses might be valued at the retail price of water instead of the variable production cost.
45. **Cost of Real Losses:** Calculated by multiplying the real loss volume by the variable production cost of water. These costs represent the additional operating costs incurred by the water utility due to the real losses (in other words, leakage).
46. **Total Assessment Score** – total of all scoring.
47. **Total Cost Impact of Apparent and Real Losses:** Calculated by adding lines 42 and 45. This amount indicates the cost inefficiency encountered by the water utility for losses. This cost value can be objectively weighed against potential loss control programs to determine the cost effectiveness of such programs.

If further assistance is needed, please contact WLA group@twdb.texas.gov.

Helpful Instructions for the Printable Water Use Survey from Texas Water Development Board

Notifications to complete the annual water use survey for 2013 were mailed in late December 2013. The 2013 water use surveys are due by March 1, 2014.

The Water Use Survey Program has three survey forms: Municipal (long), Municipal (short) and Industrial. The links below will provide more information for each survey category and allow you to view or download the PDF survey forms. Check the top right-hand corner of your notification letter for the appropriate survey form (Look for "Form Type").

Please save a copy of the survey on your desktop before you begin entering data. Include the Survey Number and County on your survey form. If you are unable to type into the pdf form, your Acrobat may be in set to read-only. Open the saved pdf on your desktop, go to Edit/ Preferences/ Documents (categories)/ PDF-A View Mode/Choose "NEVER" for view documents in PDF-A mode.

Municipal Water Use Survey (Long Form)

The municipal long survey form is for public water systems in the State of Texas.

- Cover Letter
- Municipal Long Form
- Example Municipal Survey

Municipal Water Use Survey (Short Form)

A shorter version of municipal survey form is for select water users who provide only a limited amount of water directly to consumers. The primary recipients of these surveys include commercial or institutional facilities and mobile home parks. Use this form only if on the top right hand corner of your notification letter it indicates "Municipal Short" for the Form Type.

- Cover Letter
- Municipal Short Form

Industrial Water Use Survey

The industrial survey form is for manufacturing, steam electric and mining facilities.

- Cover Letter
- Industrial Form
- Example Industrial Survey

Keep a copy of the completed survey for your records. The downloadable forms are enterable and can be emailed when completed to waterusesurvey@twdb.texas.gov. You may fax the completed survey to: (512) 463-8468. Alternatively, the completed surveys can be mailed to:

Texas Water Development Board

Attn: Water Use Survey

P. O. Box 13231

Austin, Texas 78711-3231

For submitting previous year's survey, use the current water use survey form but change the survey year.

Please note that incomplete surveys may be returned for missing and necessary information.

If a water utility needs to submit water use information for *previous years*, please contact the Water Use Survey Team, or by phone (512) 463-7952.

Texas Water Development Board

P.O. Box 13231, 1700 N Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847. Fax 512-463-8468

SURVEY OF GROUND & SURFACE WATER USE - YEAR ENDING DECEMBER 31, 2013

Dear Survey Recipient:

The Texas Water Development Board (TWDB) is legislatively directed to plan for, and to assist financially, the development and management of the water resources of Texas. To this end, the TWDB annually collects and maintains accurate information concerning the current use of water and requests water use data for the calendar year ending December 31, 2013 from each supplier.

Please consider this letter your official notification to complete the annual water use survey for 2013. **Surveys are due March 3rd, 2014.**

There are 3 methods available to complete the survey.

1) Complete the survey online at:

<http://www.twdb.texas.gov/waterplanning/waterusesurvey/survey/online.asp>

During the initial visit, you will be asked to register your name, phone number, email address, and create a user name and password. After registering, you may log into the TWDB Program Management System where you will be presented with various agency programs, including the Water Use Survey. **If you previously registered with the agency to fill out the Water Use Survey or Water Loss Audit last year, then you may use the same log-in information to access the survey again this year.** Once you are logged in, if your registered email is the same contact email that is currently in the Water Use Survey database, you will see the system or facility you have access to. If you do not see your system or facility, you can request access to the survey number listed on the top right hand corner of this letter. Generally, the request will be approved within several hours but may take up to one business day. Once approved to fill out the online survey for a particular system, you may select the system and will then be taken to a set of overall online survey instructions.

2) Download the survey form at:

<http://www.twdb.texas.gov/waterplanning/waterusesurvey/survey/printable.asp>

Three different form types (Municipal Long, Municipal Short, or Industrial) are available for download from our webpage based upon your system or facility types. Please note that the Municipal Short form is only for those select water users who either provide a limited amount of water to commercial or institutional facilities, or are a mobile home park. Remember to save a copy of the survey on your desktop and print out a paper copy for your records. Upon completion, the survey can

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|---|---|--|
| Our Mission | : | Board Members |
| To provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas | : | Carlos Rubinstein, Chairman Bech Bruun, Member Mary Ann Williamson, Member |
| | : | Kevin Patteson, Executive Administrator |

be emailed, faxed, or mailed to the contact information listed below. Incomplete surveys may be returned for the necessary information.

3) Request a survey form to be mailed.

If you choose not to submit the survey through our online data system or enter the data on our downloadable PDF survey, you may fill it out by hand. Contact the Water Use Survey by phone, email, fax, or mail to request a paper copy of the survey form. We will need the system or facility names, mailing address, and survey number. Unless requested, paper copies of the surveys are not mailed.

Texas State Law (Section 16.012m of the Texas Water Code) REQUIRES all recipients of the Survey of Ground and Surface Water Use to submit a completed survey. Failure to return a complete survey will result in ineligibility for TWDB financial assistance to obtain water right permits, amendments or renewals from the Texas Commission on Environmental Quality (TCEQ) until the surveys are completed.

Please note that the Water Use Survey is not the same as the Water Loss Audit Report or the Water Conservation Plan Annual Report and it does not replace the separate Annual Water Use report that the TCEQ may also require for surface water rights.

If you need assistance, please contact the Water Use Survey Team. We will be glad to assist you. If we are unavailable at the time of your call and you leave a message, please include your name, survey number, call-back number, and mailing address (if requesting survey forms to be mailed to you).

Water Use Survey Hotline: 512-463-7952
Fax: 512-463-8468
E-mail: waterusesurvey@twdb.texas.gov
TWDB website: www.twdb.texas.gov

Mailing Address: TWDB - Water Use Survey Team
Capitol Station
P.O. Box 13231
Austin, Texas 78711-3231

Thank you for your cooperation and assistance. We look forward to receiving a completed water use survey from you soon.

Sincerely,

Water Use Survey Team

TEXAS WATER DEVELOPMENT BOARD

MUNICIPAL Water Use Survey for End of Term of Fiscal Year 2000-2013

Deadline to return completed survey is **March 1, 2014**, according to Chapter 31 in Texas Administrative Code (TAC) Section 358.

Once complete, make a copy for your records. For guidance, refer to end notes on the last pages of the survey form. For assistance, call Water Use Survey hotline **(512) 463-7952**.

CONTACT INFORMATION

As listed in previous correspondence; please note any revisions or changes to the contact information:

SURVEY Number¹: 999999 County: 105 HAYS

Name of System: City of Montgomery Burns PWS ID²: 2230000

Mailing Address: 1000 Santa's Little Helper drive

City/State: Springfield, TX Zip Code: 78711

Contact Name: Moe Szyslak Title: Operator

Email Address: mszyslak@rocketmail.com Telephone Number: (999) 999-9999

Please provide any additional comments or remarks below.

Please return completed survey to TWDB Water Use Survey (WUS) Team:

Email waterusesurvey@twdb.texas.gov OR Fax (512) 463-8468 OR

Mail to TWDB-WUS Team at P.O. Box 13231 Austin, Texas 78711-3231