

Municipal Water District of Orange County

Water Loss Management Program Assessment

Potable Water System Audits





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The Malcolm Pirnie Consultant Project Team consisted of Megan Norman, Andree Hunt, and Steve Davis (Project Manager).

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Acronyms Used in the Report

AB	Assembly Bill
ACT	Urban Water Management Planning Act of 1983
AF	Acre-Feet (325,851 gallons)
AFY	Acre-Feet per Year
AWWA	American Water Works Association
AwwaRF	AWWA Research Foundation
BMP	Best Management Practice of the CUWCC
CARL	Current Annual Real Losses
CCF	Hundred Cubic Feet (748 gallons)
CIP	Capital Improvement Program
CUWCC	California Urban Water Conservation Council
DMA	District Metered Area
DMM	Demand Management Measure
DWR	Department of Water Resources
EPA	Environmental Protection Agency
Ft	Feet
GPCD	Gallons Per Capita Per Day
GPM	Gallons Per Minute
In	Inches
ILI	Infrastructure Leakage Index
IWA	International Water Association
M36	AWWA Manual on Water Audits and Loss Control Programs
MAF	Million Acre-Feet
MGD	Million Gallons per Day
MNWD	Moulton Niguel Water District
MOU	Memorandum Of Understanding
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
NRW	Non-Revenue Water
OC	Orange County
SB	Senate Bill
UARL	Unavoidable Annual Real Losses
USBR	U.S. Bureau of Reclamation (Reclamation)
UWMP	Urban Water Management Plan
WLCC	AWWA Water Loss Control Committee





This report has been prepared to document results of an assessment jointly funded by the U.S. Bureau of Reclamation Southern California Area Office (USBR) and the State of California Department of Water Resources (DWR) under State Proposition 50. The focus of this assessment is a follow-up to the Municipal Water District of Orange County (MWDOC) Water Loss Management Program Assessment dated March 2007. The recommendations from that study were as follows:

- 1. MWDOC should enhance the accuracy of audit work for the City of Tustin by conducting additional field investigations on calibration and validity testing of water supply meters and on leak detection surveys.
- 2. Water audits in the AWWA spreadsheet software format should be prepared for additional MWDOC retail member agencies to characterize water loss issues throughout its service area.
- 3. Additional grant applications to the USBR and the DWR should be prepared and submitted in pursuit of follow-up funding of water audit work.
- 4. Results of this study should be shared with the CUWCC to advocate the extended application of the IWA/AWWA Water Audit Methodology to other signatories to the MOU.
- 5. MWDOC retail member agencies and other California conservation–conscious water utilities should begin collecting and organizing the necessary water supply and customer demand information to conduct a standard annual water audit using IWA/AWWA methodology and to perform periodic updates.
- 6. Upon collection of multiple utility audits, a database should be developed to compare audit results, utility standard performance indicators, and water loss reduction methodologies and successes.

The current study documented in this report was performed under a professional services contract agreement between MWDOC and Malcolm Pirnie, Inc. This study was performed between May 2008 and May 2010, with a discontinuity in contract accomplishment due to an approximate six-month interruption in DWR funding for the project.





The purposes of this Project were to:

- Educate the Participating retail water agencies on the most recent international water loss control methods and technologies
- Perform retail system water audits for each Participant to determine current water losses and areas for improvement
- Review each Participant's leakage management program and recommend improvements
- Assist the Participants in achieving the California Urban Water Conservation Council (CUWCC) Best Management Practice (BMP) 1.2 compliance

There were five MWDOC retail water utilities which participated in the study. These retail agencies were:

- the City of Brea
- the City of Huntington Beach
- the Laguna Beach County Water District
- the Moulton Niguel Water District
- the City of Tustin

Each agency sent representatives to multiple project meetings and workshops, participated in group dialogue to understand and question the IWA/AWWA water audit methodology, prepared multiple annual water audits using version 3.0 and 4.0 of the Free AWWA Water Audit Spreadsheet software, prepared a data validation of their individual annual water audit data, participated in a field leak detection survey, and was educated about their compliance with existing and future requirements with the CUWCC BMP 1.2.

The following represent major study findings of the MWDOC Water Loss Management Program Assessment – Potable Water System Audits Study:

- There was a significant disparity between level of participation and information provided among the participants, which limited the extent to which the Consultant could compare and extrapolate finding of the study for the whole group of five utility participants.
- Those Participants who provided sufficient data for a full audit and analysis demonstrated excellent water loss control practices. These Participants should meet





the requirements of the CUWCC BMP 1.2 with only minimal adjustments to their existing practices.

- Although the portion of each system on which leak surveys were performed was not a significant enough percentage to extrapolate the results to each of the entire distribution systems, the results from these surveys were promising. Participants typically selected portions of their system for the leak surveys with older pipes or suspected issues, yet leaks were detected in only 2 of the 5 systems.
- Individual audits for different selected audit years are provided for the five retail agency participants. Based on an assessment of audit information, data validation scores, and audit results, recommended water loss accounting follow-up activities have been provided for each participant. All participating agencies have room to improve their real water loss and apparent water loss data collection, monitoring, and control practices.
- Non-Revenue Water ranged from 3 to 10 percent of volume of water supplied, which is very good and well within the range of efficient water utilities concerned about conservation and water loss management practices.
- Due to the increasingly stringent requirements for BMP 1.2 compliance in the future, participants will need to become proficient at component analysis for bottom up data collection and analysis to achieve better understanding of individual audit elements.
- The collaborative workshop approach with multiple concurrent participation and collaboration between consultant, wholesale water agency (MWDOC), and the participating retail agencies was excellent for group presentation, dialogue confirmation of understanding of audit elements in preparation for achieving water conservation requirements of the state. This project successfully prepared agency participants for California's water loss management element of its conservation program.





1.1. Description of the Project

This report has been prepared to document results of an assessment jointly funded by the U.S. Bureau of Reclamation Southern California Area Office (USBR) and the State of California Department of Water Resources (DWR) under State Proposition 50. The focus of this assessment is a follow-up to the Municipal Water District of Orange County (MWDOC) Water Loss Management Program Assessment dated March 2007.

There has been a growing focus in California on municipal and other water conservation to address drought and regulatory water supply shortages. One form of water conservation which has recently drawn attention is the accountable management of water supplies, performed through water utility supply and demand auditing and the implementation of appropriate and cost-effective water loss control techniques. The current study documented in this report was performed under a professional services contract agreement between MWDOC and Malcolm Pirnie, Inc. This study was performed between May 2008 and May 2010, with a discontinuity in contract accomplishment due to an approximate six-month interruption in DWR funding for the project.

The purposes of the Project are to:

- Educate the Participants on most recent water loss control methods and technologies
- Perform retail system water audits for each Participant to determine current water losses and areas for improvement
- Review each Participant's leakage management program and recommend improvements
- Assist the Participants in achieving the California Urban Water Conservation Council (CUWCC) Best Management Practice (BMP) 1.2 compliance

The project was accomplished through nine scope of work tasks, as indicated below:

- 1. Perform Project Administration and Management
- 2. Collect and Review Relevant Audit Data
- 3. Complete Data Analysis and Formatting for AWWA Water Audit Software





- 4. Conduct "Unbilled Authorized Water Consumption" Review and Analysis
- 5. Conduct Leakage Management Program and Systems Operation Review
- 6. Perform Relevant Field Measurement Activities
- 7. Prepare Retail System Water Audit Reports
- 8. Provide Recommendations for Follow-Up Activities for Improved Water Loss Management
- 9. Complete Project Report

The full scope of work is indicated in Appendix A found at the end of this report.

1.2. Project Retail Utility Participants

There are five MWDOC retail water utilities which participated in the study. These retail agencies are:

- the City of Brea
- the City of Huntington Beach
- the Laguna Beach County Water District
- the Moulton Niguel Water District
- the City of Tustin

The City of Tustin was the primary participant in the 2007 MWDOC initial water loss assessment study. The locations of the participating agencies are shown on the map in Figure 1-1 below.

Per the purposes of the project stated above, the implementation of the study involved a highly collaborative workshop approach with targeted, subject-specific powerpoint presentations, data collection and formatting by the consultant team and agency participants, and roundtable discussions by the consultant team, MWDOC staff, and MWDOC agency participants.







Source: MWDOC





Municipal Water District of Orange County Water Loss Management Program Assessment December 2010



Five major workshop meetings were held at offices of MWDOC:

- May 21, 2008
- August 7, 2008
- October 9, 2008
- December 17, 2008
- October 13, 2009

Copies of PowerPoint presentation images are included in Appendix B.

Due to the project funding support received from the U.S. Bureau of Reclamation, Southern California Area Office, semi-annual progress reports for the project were prepared and submitted.





2. Background of Water Auditing and Loss Control Programs

2.1. IWA/AWWA Water Audit Methodology

The American Water Works Association (AWWA) and International Water Association (IWA) have collaborated to assemble an international best management practice methodology for utility water auditing and water loss control. The AWWA Manual M36 Third Edition presents the IWA/AWWA water audit methodology and provides an overview of the best water loss control techniques that can currently be implemented for a sustainable and cost-effective water loss control program.

As a companion to AWWA M36, the AWWA Water Loss Control Committee has developed the Free Water Audit Software (AWWA Software), which can be used for a top down water audit and preliminary investigation of water losses and their associated costs.

Some key components of IWA/AWWA Water Audit Methodology include:

- Water balance- a summary of the key water audit data that shows the annual water supplies and demands from source to customer, with the sum of quantities in all columns equal. The standard water balance is shown in Figure 2-1.
- Apparent losses- Losses in customer consumption due to customer metering inaccuracies, data handling error, and unauthorized consumption. Apparent losses represent paper losses that result in uncaptured revenue for the water utility and the distortion of customer data.
- Real losses- physical water losses from the pressurized system and the utility's storage tanks, up to the point of the customer's meter. Real losses include leakage on transmission and distribution mains, storage tank overflows, and leakage on service connections. This category does not include water loss after the customer's water meter, since this usage is metered and billed.
- Component analysis- a means to analyze specific components of the occurrence of leakage in water distribution systems and apparent water losses. For real water loss, this analysis typically assesses leakage events in their three component phases- the awareness period, the location period, and the repair period- and is conducted to determine background leakage, unreported leakage, and reported leakage.





	Water Exported	Billed Water Exported			
		pplied o the etail	Billed Authorized Consumption	Billed Metered Consumption (including water exported)	Revenue water
				Billed Unmetered Consumption	
Water From Own			Unbilled Authorized Consumption	Unbilled Metered Consumption	
Sources	Water Supplied to the retail customers			Unbilled Unmetered Consumption	Non- Revenue Water (NRW)
			Apparent Losses	Unauthorized Consumption	
				Customer Metering Inaccuracies	
Water Imported				Data Handling Errors	
			Real Losses	Leakage on Transmission and or Distribution Mains	
				Leakage and overflow at Utility's Storage Tanks	
				Leaks on Service Connections	

Source: AWWA M36 page 9.

Figure 2-1: The IWA/AWWA "Best Practice" Standard Water Balance

2.2. AWWA Spreadsheet Water Audit Software

Microsoft Excel spreadsheet software has been developed by the AWWA Water Loss Control Committee and adopted by the AWWA for performing a top down water utility audit. The major objective behind the development of this software is to bring the best practice water audit methodology developed by the International Water Association and the AWWA to all utilities, to make the water audit terms and definitions standardized throughout the industry to assess water supply efficiency in a standard reliable manner, and to give utilities a user-friendly way to compile and compare their water audit data with other utilities. This spreadsheet-based software helps to quantify, as well as track, the water losses which may occur in water distribution systems. It also helps in identifying areas where efficiency can be improved and costs associated with water loss can be recovered. Since the IW/AWWA water audit methodology gives consistent definitions for the major forms of water consumption and water losses encountered in drinking water utilities, it is considered universally applicable. In order for water utilities to make a meaningful assessment of their water loss, this software consists of a set of performance indicators (financial and operational) that evaluate utilities on systemspecific features, such as average pressure in the distribution system and total length of water mains. The term "unaccounted-for water" is no longer used in the international water community and has been replaced by the term "non-revenue water".





The AWWA Water Audit Software Version 4.0 is a Microsoft Excel spreadsheet workbook consisting of seven worksheets. The seven worksheets contain the following:

- The First worksheet provides instructions on the use of the software and allows the user to input the general information about the water audit being performed.
- The Second worksheet is the reporting worksheet, which acts as an input data screen prompting the user to enter all of the required information about the water supply, such as the volume of water supplied, customer consumption, and various quantities of losses in the distribution system in order to perform the water-balancing calculations. It also prompts for the utility-specific information, such as average distribution system pressure, length of mains, etc. for calculating the performance indicators.
- The Third worksheet is a water balance worksheet, which shows summarized totals of each component of the water audit in columns. The water balance is in the same format as Figure 2-1. The table format balances all of the water entering the system (supplies) with all of the water leaving the system (metered and unmetered demands) by performing a top down water audit to determine real water losses. All of the values entered by the user on the Reporting Worksheet are utilized for calculating the components of the water balance sheet.
- The Fourth worksheet is a 2009 addition to the software consisting of a data validity grading matrix. The premise of this feature is that the accuracy of an audit is dependent of the quality of the data used to complete it. The new data validation feature uses a process-based approach to assign a validity score from 1 to 10 for each data component and for the audit as a whole. Recommended actions for improving these scores are also included in the software. The individual data validity scores are weighted and summed on the reporting spreadsheet. The top score is 100. The higher the score, the higher is the utility's confidence in the reliability and accuracy of the input data in the audit. Table 2-1 indicates the various levels assigned to specific ranges of data validity scores. A utility's goal should be to improve the data validity score by implementing recommendations in the grading matrix spreadsheet. Some water conservation guidelines require utilities to achieve a specific level to assure confidence in water audit results.





Level	Score
Level I	0-25
Level II	26-50
Level III	51-70
Level IV	71-90
Level V	91-100

Table 2-1: Water Audit Validity Levels

Source: AWWA M36, p. 235

- The Fifth worksheet provides customer service diagrams to define and compute average length of customer service line entered on the reporting worksheet.
- The Sixth worksheet consists of definitions and guidelines for use of all the terms established in the IWA/AWWA methodology. It is extremely easy to switch between the reporting worksheet to the definitions worksheet to have access to the meaning of each term for entering the appropriate data into the reporting worksheet.
- The Seventh worksheet provides a water loss control planning guide which indicates recommendations for water loss control in functional areas based on the water audit data validity score. The worksheet also provides guidelines for setting a target ILI (Infrastructure Leakage Index) and its use as an approximate leakage reduction tool. The ILI is calculated by dividing the Calculated Average Real Leakage by the Unavoidable Annual Real Losses (UARL). The value of ILI acts as a good operational benchmark for real water loss control. A table showing the general guidelines for establishing a target ILI range has been provided in this sheet. The availability of water resources to the utility is a determinant to setting a target ILI range. A utility should seek to minimize its ILI within its economic optimum for leak mitigation.
- Also included for reference at the end of the workbook are two example water audits for the City of Philadelphia Water Department and the Regional Municipality of Peel. Units of water supply are million gallons and megaliters per year, respectively.

The seven worksheets have been completed for a specific audit year by the five MWDOC retail utility participants in this study and are included in Appendix E to this Report. Retail audit results are presented and discussed in Section 7 of this report.





2.3. Water Loss Management

Water losses in a distribution system may be divided into two categories - namely, real losses and apparent losses. Apparent losses are the paper losses that occur in utility operations due to customer meter inaccuracies, data errors in the billing process, and unauthorized consumption or water theft. This water is consumed, but it is improperly measured, or un-paid. These losses reduce utility revenue and lead to distortion of data on customer consumption patterns. Real losses are the physical losses of water from the distribution system, including leakage and storage overflows. These losses inflate the water utility's production costs and put a stress on water resources, since they represent water that is extracted and treated but never reaches customers for a beneficial use. In order to make the water distribution system more efficient, utmost importance must be placed on water loss management. Independent of the type of method being used for performing a water audit, there will always be an uncertainty while calculating non-revenue water, apparent losses, and real losses.

The relationship shared by real losses from the IWA/AWWA water balance and UARL (Unavoidable Annual Real Losses) is clearly shown in Figure 2-2. The UARL calculation is based on length of mains, number of services, customer meter location, and average pressure in the distribution system. There are four methods of managing real losses, which are indicated by the four arrows in Figure 2-2. Putting a focus on these four management methods can reduce real losses, but, at a given average system operating pressure, the total real losses cannot be economically reduced any further than the value of UARL.

Figure 2-3 shows the four basic methods for managing apparent losses. Dependent upon the amount of attention given to each component related to apparent losses in the diagram, the losses will increase or decrease. A primary objective of the waterconserving, revenue efficient utility is to keep real and apparent losses at a minimum to minimize use of water resources and maximize revenue.





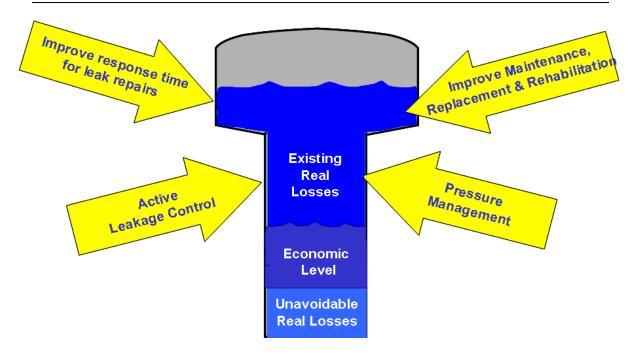


Figure 2-2: the four basic methods of managing Real Losses

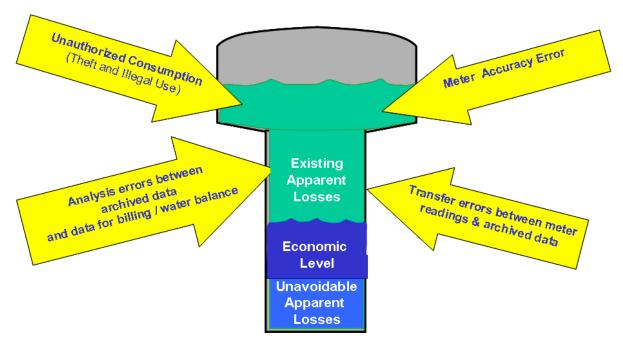


Figure 2-3: The four basic methods of managing Apparent Losses





2.4. California Regulatory Environment

The State of California has been subjected to loss of water resources through perfection of water rights of neighboring states, protection of endangered fish species in the Bay-Delta region of the State, and long-term drought. These conditions have prompted more stringent requirements for urban water conservation resulting in the formation of the California Urban Water Conservation Council (CUWCC), requirements for signing a Memorandum of Understanding (MOU) with the CUWCC to maintain qualification for State grant funding, and the recent passage of the Water Conservation Act of 2009 (SBX7-7). This new law is the water conservation component of the Bay-Delta legislative package with a goal of achieving a statewide reduction in urban per capita water use of twenty percent by December 31, 2020. Successful achievement of this conservation requirement will achieve a statewide water savings of about 380,000 acrefeet per year by 2020. Understanding and applying IWA/AWWA water audit methodologies will assist retail agencies in making their water delivery systems more efficient and achieving these stringent regulatory water reduction requirements.

2.4.1. CUWCC BMP 1.2

The California Urban Water Conservation Council recently revised BMP 1.2, the water loss control best management practice formerly known as BMP 3. BMP 1.2 is part of the CUWCC Foundational Utility Operations Program and incorporates the new water loss management procedures documented in AWWA M36 and applies them to water utilities in California. Retail water utilities are expected to use the free AWWA Audit Software to complete their standard water audit and water balance. The full text of BMP 1.2 is provided in Appendix C.

2.4.2. AB 1420 and BMP 1.2 Compliance

Effective January 1, 2009, AB 1420 amended the Urban Water Management Planning Act to require that water management grants or loans made to water suppliers and awarded or administered by DWR be conditioned on implementation of the water Demand Management Measures (DMMs). These DMMs correspond to the 14 CUWCC BMPs.

Of the retail utility Participants in this study, Huntington Beach and MNWD are currently signatories to the CUWCC Memorandum of Understanding (MOU) and are required to meet BMPs to retain grant eligibility.

2.4.3. Implementation Requirements

To be in compliance with BMP 1.2, water utilities need to complete at least the following actions:

Complete the standard water audit and balance using the AWWA Audit Software at least annually.





- Test source, import, and production meters annually.
- Develop a validated data set from all entries of their water audit and water balance within four years, following AWWA Software methodology. Agencies should achieve a Water Audit Data Validity score of 66 or higher no later than the end of the first four- year period and should achieve a score Level IV no later than the end of the fifth year of implementation.
- Perform component analysis at least once every four years to analyze the causes of real and apparent losses.
- Reduce real losses to the extent cost-effective via economic analysis.
- Advise customers whenever it appears possible that leaks exist on the customer's side of the water meter.

2.4.4. Implementation Schedule

Table 2-2 below shows the implementation schedule for BMP 1.2 from the commencement of implementation. For agencies that signed the CUWCC MOU prior to December 31, 2008, implementation should commence no later than July 1, 2009, with agencies providing the first full BMP 1.2 report by December 1, 2010 for years 2008-09 and 2009-10. Agencies signing the MOU after December 21, 2008 should begin implementation no later than July 1 of the year following the year the agency signed the MOU.

Year	Coverage Requirements	
1+	 Provide Full BMP 1.2 Report Complete audit using AWWA software Repair all reported leaks and breaks Locate and repair unreported leaks when cost-effective 	
2+	 Test source, import, and production meters annually Establish/maintain a record-keeping system for the repair of reported leaks 	
4+	 Record estimated leakage volume from report to repair and cost of repair Achieve Data Validity Score of 66 or higher 	
5-10	 Achieve Data Validity Score Level IV Demonstrate progress in water loss control performance as measured by gallons per service connection per day" 	

Table 2-2: BMP 1.2 Implementation Sci	hedule
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2.5. Retail Agency Top-Down Water Audits

The top down water audit is completed by gathering available records and entering data into the AWWA Audit Software. Participating retail water agencies were asked to enter their data into the AWWA Software themselves to enable them to learn the software for future BMP 1.2 reporting. Completion of the top down audit using the AWWA Software is a key component of BMP 1.2 compliance. Agencies are required to complete the standard water audit and balance at least annually. The annual audit worksheets are to be submitted in the BMP 1.2 report form every reporting period. Agencies are also required to develop a validated data set for all data used in the water audit within 4 years of implementation, and the validation for reported data must be kept and made available.

The CUWCC has not yet identified a benchmark for a statewide utility comparative performance indicator in terms of water loss standards. The standard will be determined after the first 4 years of data has been collected and reviewed and will be voted on by the Council by Year 6. The current BMP 1.2 language identifies "gallons per service connection per day" and "gallons per mile of mains per day" as performance indicators that can be used to measure progress. Other financial and operational performance indicators used in the AWWA audit method are identified in Table 2-3.

Function	Performance Indicator	Comments
Financial: Nonrevenue water by volume	Volume of nonrevenue water as a percentage of system input	Easily calculated from the water balance. Should be used in high level financial terms only and not as a measure of operational efficiency.
Financial: Nonrevenue water by cost	Value of non-revenue water as a percentage of the annual cost of running the system	Good financial indicator that incorporates different unit costs for nonrevenue components.
Operational: Apparent Losses	[gal/service connection/d]	Basic and useful performance indicator for apparent losses; easy to calculate.
Operational: Real Losses	[gal/service connection/d] (if service connection density is greater than 32/mi)	Best traditional performance indicator. Useful for target setting but not for comparison between systems.
Operational: Unavoidable Annual Real Losses	UARL (gal) = (5.41Lm + 0.15Nc + 7.5Lc) x P Where: Lm =length of water mains, mi Nc = number of service connections Lc = total length of private service connection pipe, mi = Nc x average distance from curb stop to customer meter , Lp P = average operation pressure, psi	Theoretical reference value representing the technical low limit of leakage that could be achieved if the best technology were successfully applied. Key variable in ILI calculation. Not valid for systems with <3,000 connections.
Operational: Real Losses	ILI (dimensionless) = CARL/UARL	Ratio of Current Annual Real Losses (CARL) to Unavoidable Annual Real Losses (UARL); considered by AWWA to be the best indicator for comparisons between systems.

Source: AWWA M36: Water Audits and Loss Control Programs, p. 53





This section describes relevant water system physical and financial information used in the AWWA Water Audit Software. The source of the information is the 2008 Orange County Water Agencies Water Rates Report for calendar year 2008. More recent information for the five agencies has become available through the draft version of the 2009 Water Rates Report included in Appendix D at the end of this report.

3.1. City of Brea

The City of Brea is a retail water supplier which serves its customers both local groundwater and imported water purchased from the Metropolitan Water District of Southern California (MWD) through MWDOC. Brea's water supplies consisted of 60% local groundwater and 40% imported water in FY 2008. General water system data is summarized below in Table 3-1.

Population	39,584
Miles of Mains (8" and larger)	162 miles
Annual Water Produced and Purchased	11,453 AF
Less Annual Water Sales	10,689 AF
Less Internal Uses (flushing, cleaning, irrigation, etc.)	100 AF
Equals Non-Revenue Water	961 AF (9%)
Peak Month Use Last Fiscal Year	1,365 AF in September 2004
Average Single Family Residential Use (monthly)	16 ccf

Table 3-1: City of Brea General Water System Data

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)

Brea's meter maintenance program includes testing and calibrating all water meters 1 ¹/₂inch and larger every two years. These meters are repaired or replaced in house. All residential water meters are replaced every 15-20 years regardless of cumulative volume through the meter.

Financial information for the City of Brea is provided in Table 3-2.





Source of Funds 2007-08					
Amount Perce					
Collected from Rate Payers (monthly or bi-monthly water bills)	\$10,456,506	87%			
Other Operating Revenues	192,963	2%			
Investment Income	370,358	3%			
Property Taxes	0	0%			
Capital Reserve Fund	1,044,083	9%			
Total Source of Funds	\$12,063,910	100%			
Source of Supply	Amount \$5,355,076	Percent 44%			
Use of Funds	2007-08				
Source of Supply					
Pumping	249,973	2%			
Treatment	0	0%			
Transmission & Distribution	368,555	3%			
Customer Accounts	0	0%			
Administrative	1,584,484	13%			
Principal & Interest (all obligations)	1,582,107	13%			
Capital Improvements funded by non-debt	2,573,715	21%			
Other	0	0%			
Transfers to City General Fund	350,000	3%			
Total Use of Funds	\$12,063,910	100%			
Net Source and Use of Funds	\$ 0				

Table 3-2: City of Brea Financial Information

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)

3.2. **City of Huntington Beach**

The City of Huntington Beach has 52,300 service connections and 614 miles of water mains. Huntington Beach is a member of the CUWCC. The City's water sources included 19.7% imported water and 80.3% local groundwater in FY 2008. General water system data for Huntington Beach, as documented in Orange County Water Agencies Water Rates, Water System Operations and Financial Information 2008, is summarized in Table 3-3 below.





3-2

General Water System Data			
Population		203,490	
Miles of Mains (8"& larger)	376	Miles	
Annual Water Produced & Purchased	31,857	AF	
Less Annual Water Sales	30,697	AF	
Less Internal Uses (flushing, cleaning, irrigation, etc.)	40	AF	
Equals Unaccounted for Water	1,120	AF 3.5 % UAW	
Peak Month Use Last Fiscal Year	3,421	AF in July 2007	
Average Single-family Residential Use (monthly) 12 ccf			

Table 3-3: City of Huntington Beach General Water System Data

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)

Huntington Beach has an in-house meter test bench which is used to test some meters removed for replacement to gather data on apparent losses due to meter inaccuracies. Huntington Beach replaces ³/₄-inch and 1-inch residential meters every 15 years, with the exception of high consumption meters. 1 ¹/₂ and 2-inch positive displacement meters are replaced by consumption and age of meter. 2 through 10-inch compound and Class II meters are overhauled on a maintenance program using a factor of consumption at last overhaul data. Huntington Beach reads its own customer meters and maintains statistics on missed meter reads and meter reader performance.

Financial information for the City of Huntington Beach is summarized in Table 3-4 below.





Source of Funds 2007-08						
Amount Percent						
Collected from Rate Payers (monthly or bi-monthly water bills)	\$31,952,860	92.05%				
Other Operating Revenues	0	0%				
Investment Income	1,668,747	4.81%				
Property Taxes		0%				
Other	1,092,292	3.15%				
Total Source of Funds	\$34,713,899	100%				
Use of Funds		Percent				
0 00 1	Amount	Percent 30.45%				
Source of Supply	\$10,570,413 3,098,614	50.43% 8.93%				
Pumping Treatment	703,256	2.03%				
Transmission & Distribution	-	8.36%				
Customer Accounts	2,901,192	3.82				
	1,327,415					
Administrative	5,387,078	15.52%				
Principal & Interest (all obligations)	-0-	0%				
Capital Improvements funded by non-debt	1,786,423	5.15%				
Other	1,507,582	4.34%				
Transfers to City General Fund	4,224,069	12.17%				
Reserves (set aside)	3,207,857	9.24%				
Total Use of Funds	\$34,713,899	100%				
Net Source and Use of Funds	\$ 0					

Table 3-4: City of Huntington Beach Financial Information

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)

3.3. Laguna Beach County Water District

Laguna Beach County Water District (LBCWD) is a retail water district with 8,513 service connections. LBCWD currently purchases 100 percent of its water supplies from Metropolitan Water District through MWDOC. General water system data for LBCWD is summarized in Table 3-5 below.





General Water System Data			
Population		20,530	
Miles of Mains (8"& larger)	132	Miles	
Annual Water Produced & Purchased	3,874	AF	
Less Annual Water Sales	3,956	AF	
Less Internal Uses (flushing, cleaning, irrigation, etc.)	18	AF	
Equals Unaccounted for Water	64	AF	0 % UAW
Peak Month Use Last Fiscal Year	473 AF in Sept. 07		
Average Single-family Residential Use (monthly) 15ccf			

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)

LBCWD replaces meters every 20 years and maintains meter boxes every 3 years. Financial information for LBCWD is summarized in Table 3-6 below.

Source of Funds 2007-08			
	Amount	Percent	
Collected from Rate Payers (monthly or bi-monthly water bills)	\$6,738,228	66%	
Other Operating Revenues	142,877	1%	
Investment Income	1,193,716	12%	
Property Taxes	1,957,706	19%	
Other	152,088	2%	
Total Source of Funds	\$10,184,615	100%	
Source of Supply	Amount \$2,424,267	Percent	
Use of Funds 2007-08			
Source of Supply	\$2,424,267	28%	
Pumping	433,482	5%	
Treatment		0%	
Transmission & Distribution	1,897,028	22%	
Transmission & Distribution Customer Accounts	1,897,028 229,814	22% 3%	
Customer Accounts	229,814	3%	
Customer Accounts Administrative	229,814 2,024,828	3% 23%	
Customer Accounts Administrative Principal & Interest (all obligations)	229,814 2,024,828 -0-	3% 23% 0%	
Customer Accounts Administrative Principal & Interest (all obligations) Capital Improvements funded by non-debt	229,814 2,024,828 -0- 1,584,070	3% 23% 0% 18%	
Customer Accounts Administrative Principal & Interest (all obligations) Capital Improvements funded by non-debt Other	229,814 2,024,828 -0- 1,584,070	3% 23% 0% 18%	

Table 3-6: LBCWD Financial Information

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)





3.4. Moulton Niguel Water District

Moulton Niguel Water District (MNWD) is a retail water district serving about 167,000 people through 53,810 service connections. MNWD currently purchases 100 percent of its potable water supplies (81 percent of total water supplies) from Metropolitan Water District through MWDOC. No groundwater pumping occurs. Recycled water is used for non-potable purposes, providing about 19 percent of total water supplies. Annual water use is reported at about 43,000 acre-feet. General water system data for MNWD is summarized in Table 3-7 below. The table reports an "unaccounted for water" (UAW) amount of 5.4 percent of total water supplied.

General Water System Data			
Population	166,677		
Miles of Mains (8"& larger)	740 Miles		
Annual Water Produced & Purchased	42,887 AF		
Less Annual Water Sales	39,758 AF		
Less Internal Uses (flushing, cleaning, irrigation, etc.)	1,163 AF		
Equals Unaccounted for Water	1,965 AF 5.4 % UAW		
Peak Month Use Last Fiscal Year	3,596 AF in July 2008		
Average Single-family Residential Use (monthly) 16 ccf			

Table 3-7: Moulton Niguel Water District General Water System Data

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)

Moulton Niguel reports that small residential water meters are tested every 3-5 years with replacement targeted on a 15-20 year cycle. Commercial meters are tested every year for accuracy. Residential meters are read monthly, and commercial meters are read bi-monthly.

Financial information for the Moulton Niguel Water District for Fiscal Year 2007-08 is presented in Table 3-8.





Source of Funds 2007-08			
	Amount	Percent	
Collected from Rate Payers (monthly or bi-monthly water bills)	\$24,843,950	52%	
Other Operating Revenues	229,493	0%	
Investment Income	3,936,098	8%	
Property Taxes	18,193,555	38%	
Other	698,889	1%	
Total Source of Funds	\$47,901,985	100%	

Table 3-8: Moulton Niguel Water District Financial Information

Use of Funds 2007-08

	Amount	Percent
Source of Supply	18,400,709	36%
Pumping	242,222	0%
Treatment		
Transmission & Distribution	2,958,395	6%
Customer Accounts	214,764	0%
Administrative	7,871,315	15%
Principal & Interest (all obligations)	8,273,386	16%
Capital Improvements funded by non-debt	13,111,847	26%
Other	0	0%
		0%
Total Use of Funds	\$51,072,638	100%
Net Source and Use of Funds	(\$3,170,653)	

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)





3.5. City of Tustin

The City of Tustin recently used 30 percent imported water and 70 percent local groundwater in FY 2007-08. General water system data for Tustin is summarized in Table 3-9 below.

General Water System Data			
Population	67,706		
Miles of Mains (8"& larger)	69 Miles		
Annual Water Produced & Purchased	13,659 AF		
Less Annual Water Sales	11,933 AF		
Less Internal Uses (flushing, cleaning, irrigation, etc.)	415 AF		
Equals Unaccounted for Water	790 AF 5.5 % UAW		
Peak Month Use Last Fiscal Year 1,490 AF in Sept. 2007			
Average Single-family Residential Use (monthly)	24 ccf		

Table 3-9: City of Tustin General Water System Data

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)

Tustin maintains small residential water meters on a regular program designed to replace every residential meter within 15 years. Broken and inaccurate meters are replaced on an as-needed basis as determined by City staff.

Financial information for the City of Tustin for Fiscal Year 2007-08 is presented in Table 3-10.





Source of Funds 2007-08					
Amount Percent					
Collected from Rate Payers (monthly or bi-monthly water bills)	10,923,061	97%			
Other Operating Revenues	23,338	.2%			
Investment Income	291,039	2.6%			
Property Taxes	-0-	0%			
Other	3,315	.1%			
Total Source of Funds	\$11,240,753	100%			
Amount Percent					
Use of Funds	2007-08				
0 00 1 DA 16	1				
Source of Supply: RA, Met	2,255,437	19%			
Pumping: Wells & booster pump stas.	1,604,806	14%			
Treatment	3,777,497	32%			
Transmission & Distribution	675,435	5.7%			
Customer Accounts	90,212	.8%			
Administrative	504,332	4%			
Principal & Interest (all obligations)	560,184	4.7%			
Capital Improvements funded by non-debt	1,202,104	10%			
Other	14,710	0%			
Transfers to City General Fund	1,131,278	10%			
Total Use of Funds	\$11,815,995	100%			
Net Source and Use of Funds	(\$575,242)				

Table 3-10: City of Tustin Financial Information

Source: OC Water Agencies Water Rates, Water System Operations and Financial Information 2008 (FY 2007-08)





4. Leakage Management Program and System Operations Assessment

The primary focus of CUWCC BMP 1.2 is the reduction of real losses due to leaks and breaks from water mains and customer service connections, pipes, joints, and fittings; from leaking reservoir walls; and from reservoir or tank overflows. Leakage is typically the greatest portion of real water losses as defined by the IWA/AWWA water audit method.

BMP 1.2 requires the following leakage management activities:

- Agencies must repair all reported leaks and breaks to the extent cost-effective.
- Agencies must maintain records for the repair of reported leaks, including (by the end of Year 2 of implementation):
 - Time of report
 - Leak location
 - Type of leaking pipe segment or fitting
 - Leak running time from report to report
 - Estimated leakage volume from report to repair (by end of Year 4)
 - Cost of repair, including pavement restoration and paid-out damage claims (by end of Year 4)
- Agencies must locate and repair unreported leaks to the extent cost-effective
- Agencies must perform component analysis at least once every four years, with the goal of identifying causes, volumes, and value of water loss for each component to support economic analysis and selection of intervention tools.

One caveat of the AWWA Software is that it calculates real losses by subtracting apparent losses from total water losses and provides no mechanism to account for measured real losses through field activities. Some utilities, not including those participating in this study, maintain multiple field leak detection crews with in-office administrative and technical support to maintain an extensive program for monitoring, reporting, and repairing water distribution system leaks. One such utility is the Miami-





Dade County Water and Sewer Department (WASD), which targets a complete system leakage survey every 9-10 months. The survey incorporates field noise loggers, noise correlators, computer software for pinpointing, and human acoustic validation. WASD staff has developed customized, utility-specific formulas for estimating leaks from various pipeline materials and various leak configurations and sizes. They apply these empirical results to develop a monthly estimation of leakage volume assuming a leak run time of one-half of their leak detection cycle. WASD staff has more faith in their volumetric leakage losses than their top-down calculated apparent losses. In this case, the Miami-Dade water audit uses total production minus real losses to estimate apparent losses, atypical of the AWWA audit approach.

The following are reported leak detection programs for the five participating retail agencies in this study.

4.1. City of Brea

The City of Brea did not provide information on their leakage detection or management programs. Brea now maintains records on pipe inventories, but has not historically.

4.2. City of Huntington Beach

Huntington Beach is currently updating its pipe inventories in its GIS database.

4.3. Laguna Beach County Water District

LBCWD repairs all reported main breaks and leaks. LBCWD has a database of repaired leaks and can pull up information on leaks by street. LBCWD also maintains a monthly operations report which details water losses due to main breaks, overflows, and other causes as well as water used for hydrant flushing. These reports contain the following information:

- Description and location of event
- Date
- Run time from report to repair (minutes)
- Estimated flow (gpm)
- Estimated leakage volume (gallons)

Water losses documented in LBCWD operations reports are presented in Table 4-1 below.





	Documented Water Losses by Type (AF)			
Year	Main and Service Line Breaks	Overflows	Other Water Loss	Total
2007-08	0.09	-	-	0.09
2006-07	0.36	-	-	0.36
2005-06	0.13	-	0.07	0.20

Table 4-1: LBCWD Documented Water Losses (FY 2006-08)

Laguna Beach's method for tracking reported leaks is mostly consistent with the requirements of BMP 1.2 and would require only minimal modifications to achieve full compliance. In order to be in full compliance and to improve leakage management procedures, Laguna Beach should consider the following minor modifications to its documentation procedures:

- 1. Add time of leak report to the reporting spreadsheet.
- 2. Include documentation of repair cost, including materials, labor, pavement restoration, and damage cost.
- 3. Consider including a separate column for type of leaking pipe segment or fitting. While LBCWD typically records this information under the event description, it may be useful to have it identified separately in order to ensure it is recorded and analyze data.

LBCWD's documented water losses for FY 2006-2007 represent only a fraction of a percent of total water losses calculated using the AWWA Software.

4.4. Moulton Niguel Water District

Moulton Niguel did not report any in-house or outside contracted periodic leak detection program or leakage management procedures.

4.5. City of Tustin

The City of Tustin did not report any in-house or outside contracted periodic leak detection program or leakage management procedures.





Malcolm Pirnie retained the ME Simpson Co., Inc. as a sub-consultant to perform leak detection services for the five retail water utilities participating in the project. The individual utilities selected lengths of distribution system pipeline that were suspected of having potential leaks due to leakage history, pipeline material, or pipeline age. Utility staff were invited to accompany ME Simpson staff to witness and assist in the leak detection process. Since leak detection and mitigation is the focus of BMP 1.2, the field observation of leak detection and noise correlation are important elements of training to meet these requirements in the future. The following are results for each agency. The entire leak detection methodology and results reports for the five utilities are included as Appendix F. Results were provided to each utility.

5.1. City of Brea

A survey of approximately 16.8 miles (88,704 lineal feet) of water main was performed for the City of Brea. The survey included all fire hydrants, accessible mainline valves, and selected services within the area selected by Brea. The survey was conducted using an electronically enhanced listening device which measures the time it takes the sound of a leak to travel from the leak to the leak correlator connection point. The leak correlator is connected to the water line at two locations in order to compute the exact leak location. Hydrants and accessible valves were used as acoustic listening points to identify leaks.

The survey for Brea identified one main line leak on a 10-inch main at Beechwood Drive and Parkcrest Way, with a estimated rate of leakage potential of 79,200 GPD. Based on a production price of \$2.17 per thousand gallons, this leak was costing Brea \$171.86 per day or \$62,730 annually. Based on this analysis, the cost of the leak survey will be recovered through leak repair and value of water saved within 1 month.

5.2. City of Huntington Beach

A survey of approximately 12 miles (63,360 lineal feet) of water main was performed for the City of Huntington Beach. The survey included all fire hydrants, accessible mainline valves, and selected services within the area selected by Huntington Beach. The survey was conducted using an electronically enhanced listening device which measures the time it takes the sound of a leak to travel from the leak to the leak correlator connection point. The leak correlator is connected to the water line at two locations in order to compute the exact leak location. Hydrants and accessible valves were used as listening points to identify leaks.





The survey did not locate any discernable leaks in the Huntington Beach water distribution system, which is consistent with Huntington Beach's top-down audit results.

5.3. Laguna Beach County Water District

A survey of approximately 6.5 miles (34,320 lineal feet) of water main was performed for LBCWD. The survey included all fire hydrants, accessible mainline valves, and selected services within the area selected by LBCWD. The survey was conducted using an electronically enhanced listening device which measures the time it takes the sound of a leak to travel from the leak to the leak correlator connection point. The leak correlator is connected to the water line at two locations in order to compute the exact leak location. Hydrants and accessible valves were used as listening points to identify leaks.

The survey identified 1 hydrant leak at 49 La Costa Court, with an estimated leakage potential of 1,440 GPD. Based on a production price of \$4.40 per thousand gallons, this leak was costing Brea \$3.34 per day or \$2,312.64 annually. Based on this analysis, repair of the leak, and value of water saved, the cost of the leak survey will be recovered within 20 months.

5.4. Moulton Niguel Water District

A survey of approximately 16.5 miles (87,120 lineal feet) of water main was performed for MNWD. The survey included all fire hydrants, accessible mainline valves, and selected services within the area selected by MNWD. The survey was conducted using an electronically enhanced listening device which measures the time it takes the sound of a leak to travel from the leak to the leak correlator connection point. The leak correlator is connected to the water line at two locations in order to compute the exact leak location. Each hydrant and accessible valve was used as a listening point to identify leaks. Water pipelines constructed of PVC were investigated via correlation, and correlation distances for PVC did not exceed 500 feet unless listening points were unavailable.

The survey did not locate any discernable leaks on the MNWD water distribution system.

5.5. City of Tustin

A survey of approximately 5.3 miles (27,984 lineal feet) of water main was performed for the City of Tustin. The survey included all fire hydrants, accessible mainline valves, and selected services within the area selected by Tustin. The survey was conducted using an electronically enhanced listening device which measures the time it takes the sound of a leak to travel from the leak to the leak correlator connection point. The leak correlator is connected to the water line at two locations in order to compute the exact leak location. Each hydrant and accessible valve was used as a listening point to identify leaks. The survey did not locate any discernable leaks on the Tustin water distribution system.





6. Apparent Loss Review and Assessment

Apparent losses per definition in the IWA/AWWA water audit methodology are the nonphysical water losses that occur when water is successfully delivered to the customer but is not measured or recorded accurately. When such errors occur systematically, the aggregate measure of water consumption can be underreported. The result can be a significant loss in revenue to the utility as well as a difference in reported production and reported metered consumption.

The three primary components of apparent losses are:

- 1. Meter inaccuracies, such as meters under-registering flow from mechanical wear, tampering, and improper installation. Meters become less accurate with cumulative volume through the meter, particularly at the low-flow range of the meter.
- 2. Accounting discrepancies, including non-billed accounts, billing software inaccuracies, billing adjustments and waivers.
- 3. Unauthorized consumption, such as fire hydrant theft, system theft, and unauthorized connections.

Reduction of apparent losses, unlike reduction of real losses, does not create a new source of water for the utility and, as a result, has not been the focus of water conservation best management practices such as the CUWCC BMP 1.2. However, the reduction of apparent losses creates new revenue for the utility, which may be used to fund other forms of water loss control and other water conservation activities. Since apparent losses result in lost revenue to the utility, they are valued at the retail rate and are, therefore, typically the most costly losses.

Table 6.1 identifies apparent losses by type for each Participating Agency. These results are taken from the most recent agency annual water audits included in Appendix E.





Agency	Calculated Apparent Losses (AFY)						
	Unauthorized Consumption	Customer Metering Inaccuracies	Data Handling Errors	Total	Total Water Supplied		
City of Brea	31.000	58.000	1.000	90.000	0.7%		
City of Huntington Beach	10.000	500.000	1.000	511.000	1.6%		
Laguna Beach County Water District	11.0	Unknown	Unknown	N/A	Unknown		
Moulton Niguel Water District	91.000	Unknown	Unknown	N/A	Unknown		
City of Tustin	5.000	425.814	-	430.814	3.0%		

Table 6-1: Apparent Losses for Participating Agencies

6.1. City of Brea

The City of Brea reports that residential water meters are replaced every 15 to 20 years regardless of cumulative volume through the meter. All water meters sized 1 1/2 – inches and larger are tested and calibrated every two years regardless of cumulative volume through the meter. The length of time between residential meter replacements is predictably resulting in apparent water loss due to under-registration of the water meter at low flow rates. Brea reports a low customer metering inaccuracy relative to the other participating agencies, but without testing, this estimate is questionable.

6.2. City of Huntington Beach

The City of Huntington Beach has an existing meter accuracy test program, including an in-house test bench. Huntington Beach currently performs accuracy testing on selected meters that have been pulled from the system for replacement.

Huntington Beach's meter replacement program utilizes monthly audits comparing monthly consumption to the previous three month's consumption and the previous year's consumption. This generates replacement of small water meters and repairs of 3-inch to 10-inch meters. Huntington Beach has a 15-year replacement program for 2-inch and smaller meters. All 3-inch to 10-inch meters are field tested based on consumption and are repaired and calibrated as needed.

Cost of meter replacement for Huntington Beach, as provided by the City, is listed in Table 6-2 below. These costs do not take into account labor.





Meter Size	Meter Cost
³∕₄-inch	\$58.19
1-inch	\$92.13
1 ½-inch	\$183.18
2-inch	\$268.30

Table 6-2: Huntington Beach Meter Replacement Costs

Huntington Beach reads its own customer meters and maintains statistics on missed meter reads and meter reader performance. Huntington Beach also has an AMR pilot program in place.

6.3. Laguna Beach County Water District

LBCWD is currently implementing a meter replacement program, based upon meter age. LBCWD has calculated that its meters have a useful life of 17.5 years, and 25 percent of the meters in its system are over 20 years old. Meter replacement cost is \$110 to \$120 per meter, including labor. LBCWD also has a significant number of fire sprinklered structures and is changing out these meters per fire sprinkler standards.

LBCWD does not have an in-house meter test shop and uses a contractor to calibrate source meters. For customer meters, LBCWD reads its own meters and maintains statistics on missed meter reads and meter reader performance.

6.4. Moulton Niguel Water District

MNWD has an in-house meter test shop and has data from meter accuracy testing on the volume lost due to meter inaccuracies. MNWD also performs portable water meter testing. Residential meters are replaced every 15-20 years. Zero or low usage meters are checked at the time of reading for proper function. Commercial meters are tested every year, and residential meters are tested every 3-5 years.

6.5. City of Tustin

Tustin maintains a meter replacement program which is based on meter cumulative flow rather than age. Cumulative flow at which each meter is replaced and meter replacement costs are shown in Table 6.3 below. Tustin does not have an in-house meter test bench, but contracts with Measurement Control for its meter accuracy testing. Meter accuracy testing is performed regularly at varying meter lifespans to determine optimum replacement time for each meter type. While apparent losses due to meter inaccuracy still represent the most significant loss in the Tustin water system, these losses are still relatively low, as is Tustin's water loss overall.





6-3

Meter Size	Usage Units (CCF) at Replacement	Meter Cost	Labor Cost
5/8-inch	2,000	\$41.50	\$30.75
1-inch	3,500	\$92.00	\$30.75
1 ½-inch	>10,000	\$178.50	61.50
2-inch	>10,000	\$268.00	\$61.50
3-inch	As needed	Market price	\$500.00
4-inch	As needed	\$2,165.14	\$500.00
6-inch	As needed	Market price	\$500.00

Table 6-3: Tustin Meter Replacement Costs





As previously stated, a major objective of this study was to educate participating utilities through workshops and collaborative discussion about the IWA/AWWA water audit methodology, individual components of water usage, and application of the free AWWA water audit software. Knowledge and methodology gleaned from the study provide utilities with tools to meet the regulatory requirements of CUWCC BMP 1.2, maintain eligibility for California grant funding, and better achieve utility water conservation and efficiency goals. Major workshop topics of discussion included:

- Context of Water Loss in the U.S.
- AWWA M36 "Water Audits and Loss Control Programs"
- IWA/AWWA Standard Water Balance
- Differentiating Real and Apparent Water Losses
- Production and Demand Data Requested of Participating Utilities
- Authorized Unmetered Consumption
- Water Meters
- AWWA Water Audit Software Version 4.0 with Data Validation
- CUWCC BMP 1.2 Water Loss Control Requirements
- Recommended Field Leak Surveys

The above topics have been documented in copies of PowerPoint presentations included in Appendix B. Participating Utilities collected information and filled out annual audits using Versions 3.0 and 4.0 of the AWWA Audit Software. This section presents the results of the participating agency audits and provides recommendations for further enhancement to achieve compliance with CUWCC BMP 1.2. For each agency, the reporting spreadsheet is presented for the selected year of audit followed by the water balance spreadsheet. A discussion of results of each agency audit follows.





7.1. City of Brea

7.1.1. Summary of Audit Results

The City of Brea staff participated in the collaborative workshops and completed multiple drafts of the AWWA Water Audit Software, including Version 4.0 with the data validation and scoring features. The reporting spreadsheet for the most recent audit for Brea fiscal year 2006-07 is included in Figure 7-1. The corresponding water balance for the reporting year is presented as Figure 7-2.





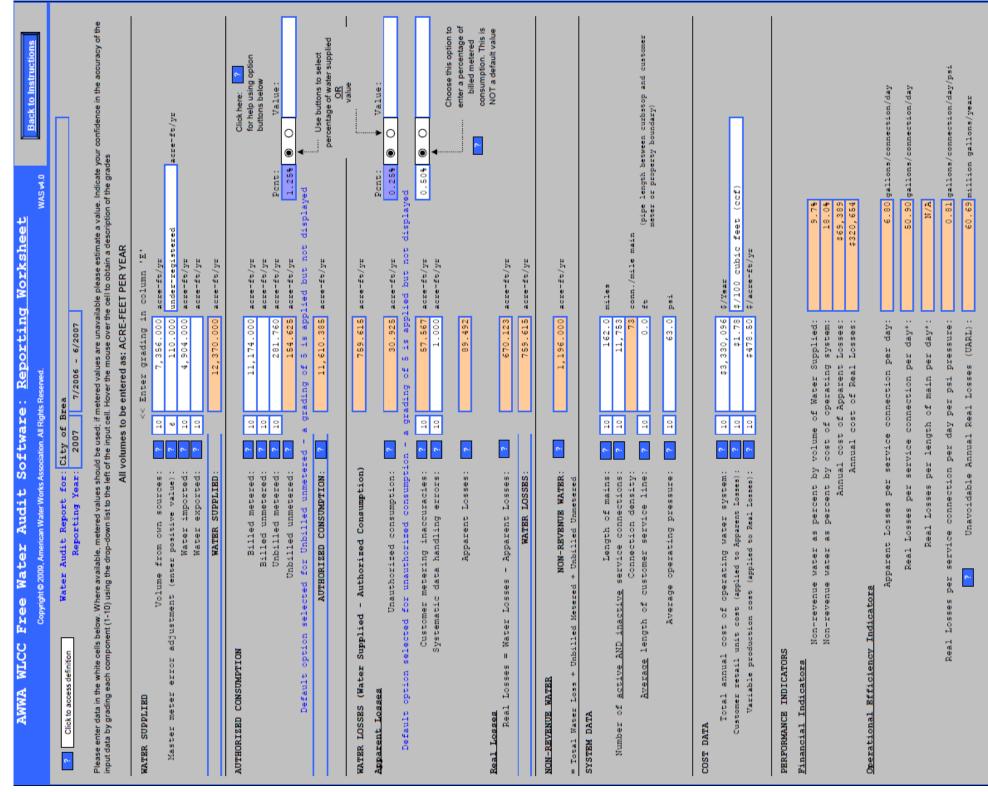


Figure 7-1: City of Brea Reporting Worksheet



Municipal Water District of Orange County Water Loss Management Program Assessment December 2010

۲	MUNICIPAL WATER DIBTRICT OF ORANDE COUNTY
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AWWA WLCC	Free Water 2	Audit Softwa	are: Water Balance	Water Audit Report For:	Report Yr:
Cc	opyright©2009, America	n Water Works Associatio	n. All Rights Reserved. WAS v4.0	City of Brea	2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 11,174.000	Revenue Water
Own Sources		Authorized Consumption	11,174.000	Billed Unmetered Consumption	11,174.000
(Adjusted for known errors)		11,327.250		0.000 Unbilled Metered Consumption	Non-Revenue Water
			Unbilled Authorized Consumption	0.000	(NRW)
7,356.000			153.250	Unbilled Unmetered Consumption	
				153.250	
	Water Supplied			Unauthorized Consumption	1,086.000
	12,260.000		Apparent Losses 30.650	30.650 Customer Metering Inaccuracies	
	12,200.000		30.050		
				Systematic Data Handling Errors	
		Water Losses		0.000	
Water Imported		932.750		Leakage on Transmission and/or Distribution Mains	
			Real Losses	Not broken down	
4,904.000			902.100	Leakage and Overflows at Utility's Storage Tanks	
				Not broken down	
				Leakage on Service Connections Not broken down	

Figure 7-2: City of Brea Water Balance





Performance Indicator	Result
Non-revenue water as percent by volume of Water Supplied	9.7%
Non-revenue water as percent by cost of operating system	18.0%
Apparent Losses per service connection per day	6.80 gallons/connection/day
Real Losses per service connection per day	50.90 gallons/connection/day
Unavoidable Annual Real Losses (UARL)	60.69 million gallons/year
Infrastructure Leakage Index (ILI)	3.60

Table 7-1: Brea Performance Indicator Assessment

7.1.2. Data Gaps

The City of Brea provided all necessary data to complete the water audit and analyze financial and operational performance for the audit period. Additionally, Brea has completed its data validity scoring and demonstrates excellent record-keeping practices overall. Given Brea's audit and data validity scoring results, the City is well on track to achieving CUWCC BMP 1.2 compliance and requires only minimal adjustments to its practices to meet all requirements of the BMP within the specified time frames.

Table 7-2 shows the activities required for Brea to be in compliance with BMP 1.2 and the completion status of each.





·							
Requirement for Compliance	Year Completion Required	Status	Notes				
Compile standard water audit and balance	Annual	Completed	Brea needs to prepare audits for most recent years 2008 and 2009				
Test source, import, and production meters annually	Year 2	Completed	Accuracy testing and calibration conducted semi- annually				
Achieve a Water Audit Data Validity Score of 66 or higher	Year 4	Completed	Data Validity Score of 93 for FY 2006-07 audit				
Achieve a Water Audit Data Validity Score of Level IV (71-90) or higher	Year 5	Completed	Data Validity Score of 93 for FY 2006-07 audit				
Seek training in the AWWA water audit method and component analysis process	Year 4						
Complete a component analysis of real losses	Year 4	-					
Demonstrate progress in water loss control performance as measured by gallons per service connection per day	Year 5 through Year 10						
Repair all reported leaks and break to the extent cost-effective	Ongoing						
Maintain a record-keeping system for the repair of reported leaks	Year 2						
Include estimated leakage volume from report to repair and cost of repair in leak records	Year 4						
Locate and repair unreported leaks to the extent cost effective	Ongoing						

Table 7-2: Status of Brea BMP 1.2 Compliance

7.1.3. Recommended Follow-Up Activities

The Consultant recommends that Brea consider the following activities to improve their water loss management practices and ensure compliance with BMP 1.2





- Formalize a regular review of permitting and billing practices and a regular auditing process to reveal scope of systematic data handling errors. When refinements to the computerized billing system are undertaken, enhance reporting capabilities.
- Revise record-keeping system for the repair of reported leaks to include all information required by BMP 1.2, if not already included. Consider a GIS database to track locations of reported leaks, as well as pipe materials and age, to facilitate early identification of problem areas. While Brea does not currently have a major leakage problem per results of the field survey, leakage increases with system age, and simple, affordable steps for tracking leakage can prevent a problem from developing.
- Consider a more intense meter accuracy testing program, including maintaining records on cumulative flow for each meter and pulling meters from the system at random for testing to develop a database tracking meter accuracy versus cumulative flow through the meter. The current system for meter replacement in Brea based on 15 to 20 years in service does not allow for early identification of meters which have stopped working entirely, and does not account for meters which have decreased in accuracy gradually. Mechanical, positive displacement-type residential meters generally have an economic life of about ten years based on cumulative volume through the meter. Additionally, Brea should consider tracking time-of-day water use for a sample of selected residential meters to characterize customer demand at low, normal, and high flow rates in order to confirm economic optimum for meter replacement, confirm appropriate meter sizing, and to refine apparent loss estimates.
- Consider implementing a regular leak survey program to detect unreported leaks and background leakage. While Brea's current real losses do not warrant annual surveys of its full system, partial surveys of problem areas or of samples of the system may assist the City in completing the component analysis required under BMP 1.2 and in early detection of background leakage.

7.2. City of Huntington Beach

7.2.1. Summary of Audit Results

The City of Huntington Beach participated avidly in all workshops and collaborative meetings, often sending multiple persons. Staff provided requested data and prepared multiple drafts of various water audits for multiple years. Their most recent full audit results for fiscal year 2008-2009 is included in Appendix F. The reporting spreadsheet for the audit is provided in Figure 7.3 below. The water balance for 2008-09 is shown in Figure 7.4.





7-7

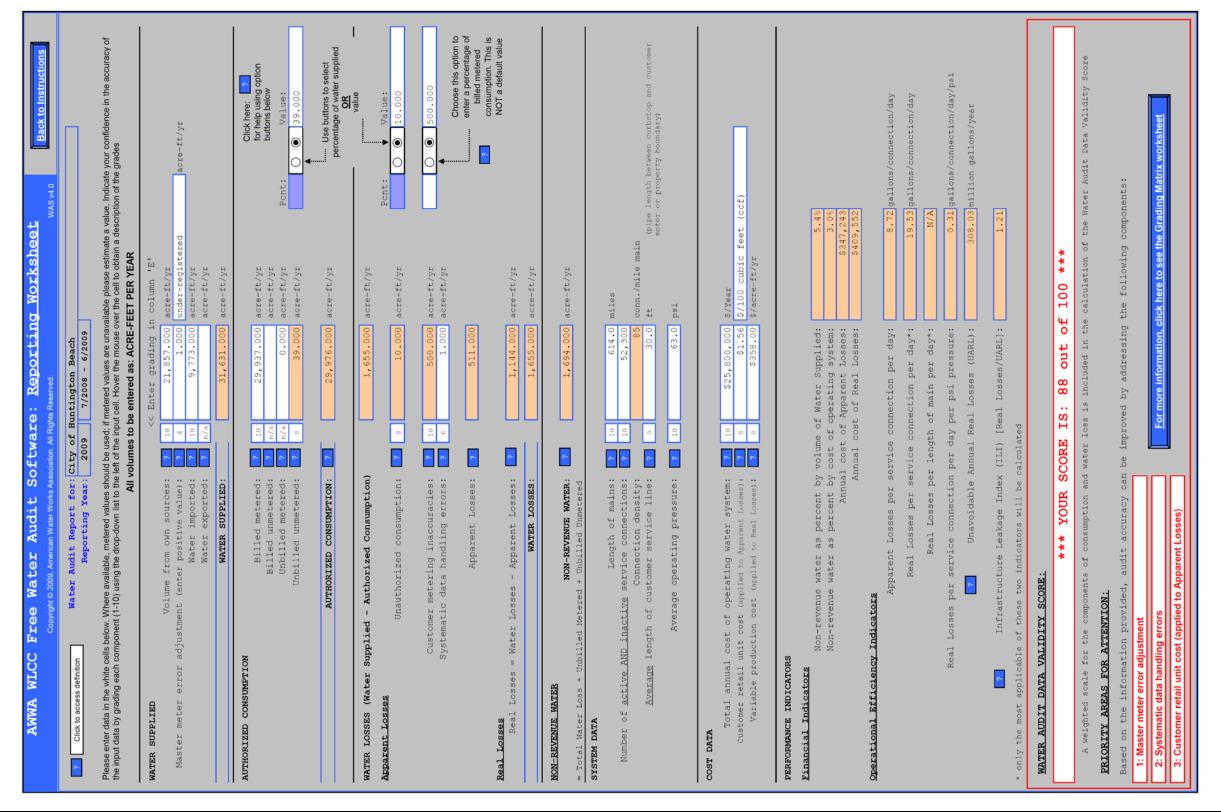


Figure 7-3: City of Huntington Beach Reporting Worksheet



MUNICIPAL WATER DISTRICT OF ORANDE COUNTY

AWWA WLCC	Free Water	Audit Softwa	are: Water Balance	Water Audit Report For:	Report Yr:
Co	opyright©2009, America	n Water Works Association	n. All Rights Reserved. WAS v4.0	City of Huntington Beach	2009
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 29,937.000	Revenue Water
Own Sources (Adjusted for		Authorized Consumption	29,937.000	Billed Unmetered Consumption	29,937.000
(Aujusted 101 known errors)		29,976.000	Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Wate (NRW)
21,858.000			39.000	Unbilled Unmetered Consumption 39.000	
	Water Supplied			Unauthorized Consumption	1,694.000
	31,631.000		Apparent Losses 511.000	10.000 Customer Metering Inaccuracies	
				500.000 Systematic Data Handling Errors	
		Water Losses		1.000	
Water Imported		1,655.000	Real Losses	Leakage on Transmission and/or Distribution Mains Not broken down	
9,773.000			1,144.000	Leakage and Overflows at Utility's Storage Tanks	
				Not broken down Leakage on Service Connections	
				Not broken down	

Figure 7-4: City of Huntington Beach Water Balance





Performance Indicator	Result
Non-revenue water as percent by volume of Water Supplied	5.4%
Non-revenue water as percent by cost of operating system	3.0%
Apparent Losses per service connection per day	8.72 gallons/connection/day
Real Losses per service connection per day	19.53 gallons/connection/day
Unavoidable Annual Real Losses (UARL)	308.03 million gallons/year
Infrastructure Leakage Index (ILI)	1.21

Table 7-3: Huntington Beach Performance Indicator Assessment

7.2.2 Data Gaps

Huntington Beach provided all necessary data to complete the water audit and analyze financial and operational performance for the audit period. Additionally, Huntington Beach has completed its data validity scoring and demonstrates excellent record-keeping practices overall. Given Huntington Beach's audit and data validity scoring results, the City is well on track to achieving BMP 1.2 compliance and requires only minimal adjustments to its practices to meet all requirements of the BMP within the specified time frames.

Table 7-4 shows the activities required for Huntington Beach to be in compliance with BMP 1.2 and the current completion status of each.





7-10

Requirement for Compliance	Year Completion Required	Status	Notes				
Compile standard water audit and balance	Annual	Completed					
Test source, import, and production meters annually	Year 2	Completed	Accuracy testing and calibration conducted semi-annually				
Achieve a Water Audit Data Validity Score of 66 or higher	Year 4	Completed	Data Validity Score of 88 for FY 2008-09 audit				
Achieve a Water Audit Data Validity Score of Level IV (71-90) or higher	Year 5	Completed	Data Validity Score of 88 for FY 2008-09 audit				
Seek training in the AWWA water audit method and component analysis process	Year 4						
Complete a component analysis of real losses	Year 4	-					
Demonstrate progress in water loss control performance as measured by gallons per service connection per day	Year 5 through Year 10	-					
Repair all reported leaks and break to the extent cost-effective	Ongoing	Ongoing					
Maintain a record-keeping system for the repair of reported leaks	Year 2	Partially Completed					
Include estimated leakage volume from report to repair and cost of repair in leak records	Year 4						
Locate and repair unreported leaks to the extent cost effective	Ongoing						

Table 7-4: Status of Huntington Beach BMP 1.2 Compliance

7.2.3. Recommended Follow-Up Activities

The Consultant recommends that Huntington Beach consider the following activities to improve their water loss management practices and ensure compliance with BMP 1.2





- Formalize a regular review of permitting and billing practices and a regular auditing process to reveal scope of systematic data handling errors. When refinements to the computerized billing system are undertaken, enhance reporting capabilities.
- Revise record-keeping system for the repair of reported leaks to include all information required by BMP 1.2, if not already included. Consider a GIS database to track locations of reported leaks, as well as pipe materials and age, to facilitate early identification of problem areas. While Huntington Beach does not currently have a leakage problem, leakage increases with system age and simple, affordable steps for tracking leakage can prevent a problem from developing.
- Consider a more intense meter accuracy testing program, including maintaining records on cumulative flow for each meter and pulling meters from the system at random for testing to develop a database tracking meter accuracy vs. cumulative flow. The current system for meter replacement in Huntington Beach allows for early identification of meters which have stopped working entirely, but may overlook meters which have decreased in accuracy gradually. Additionally, Huntington Beach should consider tracking time-of-day water use, perhaps in conjunction with its AMR pilot program, in order to confirm appropriate meter sizing and to refine apparent loss estimates.
- Consider implementing a regular leak survey program to detect unreported leaks and background leakage. While Huntington Beach's current real losses do not warrant annual surveys of its full system, partial surveys of problem areas or of samples of the system may assist Huntington Beach in completing the component analysis required under BMP 1.2 and in early detection of background leakage.

7.3. Laguna Beach County Water District

7.3.1. Summary of Results

Laguna Beach County Water District staff participated in all project meetings and workshops and provided all data required for the multiple preparations of annual water system audits for their utility. The lack of an in-house meter testing facility precluded reporting of estimated customer metering inaccuracy. They also did not have a basis to estimate billing system and customer data handling inaccuracies. Laguna Beach did not feel it had sufficient information to rate enough audit data input categories to compute a data validity score. Figure 7.5 indicates the LBCWD water audit reporting spreadsheet for FY 2007. Figure 7.6 provides the annual water balance.





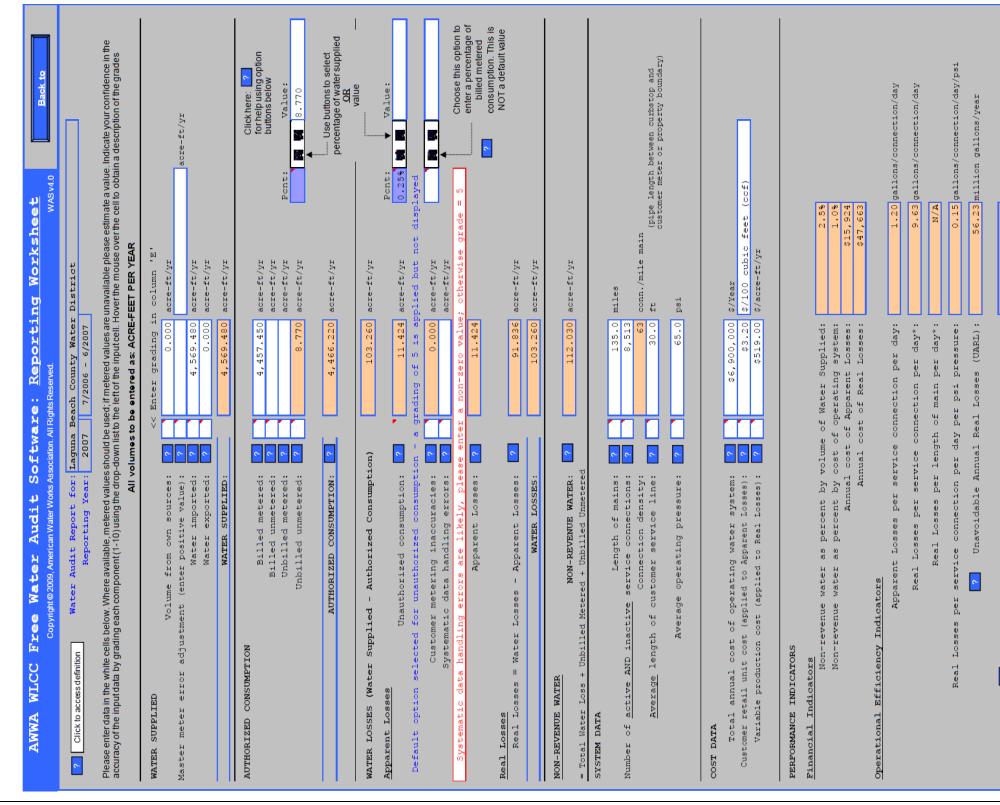


Figure 7-5: Laguna Beach County Water District Reporting Worksheet



Municipal Water District of Orange County Water Loss Management Program Assessment December 2010

			Add a grading value for 11 parameter(s) to enable an audit score to be calculated						
			calc				sheet	1	
			þe		nts:		c work		
			ţ		npone:		Matrix		
0.53			SCOFE		Based on the information provided, audit accuracy can be improved by addressing the following components:		For more information, click here to see the Grading Matrix worksheet		
			audit		the foll		re to see t		
			an		sing		ick he		
<pre>Infrastructure Leakage Index (ILI) [Real Losses/UARL]:</pre>			able		y addres		mation, el		
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je Ind	ors wil		par		accur				
eakag	dicato		11		udit				
ture I	two in	Y SCORE:	for	: N	ded, a				
struct	these	S TTI	Lue	ENTION	provi			acies	
Infra	le of	VALID	va	я АТТ	tion			naccur	
~ .	* only the most applicable of these two indicators will be calculated	WATER AUDIT DATA VALIDIT	ding	PRIORITY AREAS FOR ATTEN	nforma	P	l _	3: Customer metering inaccuraci	
	nost ar	DIT I	grad	ARE	the i	1: Water imported	2: Billed metered	ler met	
	the I	SR AU	4 A	ORITY	d on	Vater	Silled r	ustom	
	* only	WATE	Add	PRIC	Base	1: V	2: 6	ë	

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AWWA WLCC	Free Water	Audit So <u>ftw</u>	are: Water Balance	Water Audit Report For:	Report Yr:
	Copyright©2009, America			District	2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported)	Revenue Water
Own Sources		Authorized Consumption	4,457.450	4,457.450 Billed Unmetered Consumption	4,457.450
(Adjusted for				0.000	
known errors)		4,466.220	Unbilled Authorized Consumption	Unbilled Metered Consumption 0.000	Non-Revenue Wate (NRW)
0.000			8.770	Unbilled Unmetered Consumption	
	Water Supplied	, ,		8.770 Unauthorized Consumption	112.030
			Apparent Losses	11.424	
	4,569.480		11.424	Customer Metering Inaccuracies	
				0.000	
				Systematic Data Handling Errors	
		Water Losses		0.000	
Water Imported		103.260		Leakage on Transmission and/or Distribution Mains	
			Real Losses	Not broken down	
4,569.480			91.836	Leakage and Overflows at Utility's Storage Tanks	
				Not broken down	
				Leakage on Service Connections	
				Not broken down	

Figure 7-6: Laguna Beach County Water District Water Balance





Performance Indicator	Result
Non-revenue water as percent by volume of Water Supplied	2.5%
Non-revenue water as percent by cost of operating system	1.0%
Apparent Losses per service connection per day	1.20 gallons/connection/day
Real Losses per service connection per day	9.63 gallons/connection/day
Unavoidable Annual Real Losses (UARL)	56.23 million gallons/year
Infrastructure Leakage Index (ILI)	0.53

Table 7-5: LBCWD Performance Indicator Assessment

7.3.2. Data Gaps

The following information would improve the accuracy of the LBCWD audit:

- LBCWD is missing data on customer metering inaccuracies and systematic data handling errors. Exclusion of this data will cause apparent losses to appear artificially low and, consequently, will cause real losses to appear artificially high.
- LBCWD is showing an ILI of less than 1, which may indicate a data flaw. It would be beneficial to confirm the accuracy of production and customer meters and to compare the results from the audit year with data from more recent years, such as FY 2007-08 and FY 2008-09.
- LBCWD has not completed the data validity scoring component of the audit software. This information is required by BMP 1.2 and would prove useful in identifying areas of strength and deficiencies in the audit.

Table 7-6 shows the activities required for LBCWD to be in compliance with BMP 1.2 and the completion status of each.





Requirement for Compliance	Year Completion Required	Status	Notes		
Compile standard water audit and balance	Annual	Completed			
Test source, import, and production meters annually	Year 2	Completed	Accuracy testing and calibration conducted semi-annually		
Achieve a Water Audit Data Validity Score of 66 or higher	Year 4	Incomplete	Data Validity Scoring not completed		
Achieve a Water Audit Data Validity Score of Level IV (71-90) or higher	Year 5	Incomplete	Data Validity Scoring not completed		
Seek training in the AWWA water audit method and component analysis process	Year 4	Complete			
Complete a component analysis of real losses	Year 4	Partially Complete	Performed for reported losses		
Demonstrate progress in water loss control performance as measured by gallons per service connection per day	Year 5 through Year 10	-			
Repair all reported leaks and break to the extent cost-effective	Ongoing	Ongoing			
Maintain a record-keeping system for the repair of reported leaks	Year 2	Complete			
Include estimated leakage volume from report to repair and cost of repair in leak records	Year 4	Partially Complete	Estimated volume included		

Table 7-6: Status of LBCWD BMP 1.2 Compliance

7.3.3. Recommended Follow-Up Activities

LBCWD should consider a GIS database to record pipe age as well as to track leak locations. While developing pipe inventory would be a long-term project since LBCWD does not maintain age records currently, it would be beneficial to track this information as pipes are replaced. While LBCWD does not currently have a major leakage problem per results of the field survey, leakage increases with system age,





and simple, affordable steps for tracking leakage can prevent a problem from developing.

- To improve its meter replacement program, LBCWD should maintain records of meter cumulative volume and should implement meter accuracy test on randomly pulled residential meters at varying consumption levels. Meter accuracy is typically a function of cumulative volume rather than age; therefore, a meter replacement program based on meter age may not be optimally efficient in reducing apparent losses. The current system for meter replacement in LBCWD based on 15 to 20 years in service does not allow for early identification of meters which have stopped working entirely, and does not account for meters which have decreased in accuracy gradually. Mechanical, positive displacement-type residential meters generally have an economic life of about ten years based on cumulative volume through the meter. Additionally, LBCWD should consider tracking time-of-day water use for a sample of selected residential meters to characterize customer demand at low, normal, and high flow rates in order to confirm economic optimum for meter replacement, confirm appropriate meter sizing, and to refine apparent loss estimates.
- Development of a database which tracks meter accuracy relative to cumulative volume will provide for a more accurate assessment of apparent losses and a more efficient meter replacement program. Improved meter accuracy data will also allow for a more accurate assessment of real losses at a lower cost than leak detection field work.
- LBCWD should formalize a regular review of its billing practices and conduct a regular auditing process to reveal scope of systematic data handling errors. When refinements to the computerized billing system are undertaken, LBCWD should consider enhancing reporting capabilities, including exception reports.

7.4. Moulton Niguel Water District

7.4.1. Summary of Results

Moulton Niguel Water District staff participated in the initial and mid-term meetings and workshops, which afforded them the consultant presentation and discussion about IWA/AWWA water audit methodologies and how to prepare an annual audit using the AWWA free audit spreadsheet software. Their audit reporting year is 2006-07. More urgent utility priorities prevented MNWD staff from attending the last BMP 1.2 presentation and workshop. This meeting presented the most recent Version 4.0 of the AWWA software and discussed how to conduct a data validation analysis for scoring the utility's confidence in the accuracy of its audit input data. MNWD staff did not provide sufficient audit information nor source and accuracy information for the consultant to perform a data validity assessment for the FY 2006-07 water audit. Additionally, missing system and cost information for the audit did not allow the audit software to calculate





system performance indicators. Therefore, an assessment with respect to BMP 1.2 compliance was not accomplished. Figure 7.7 provides the water auditing reporting spreadsheet for 2006-07. Figure 7.8 provides MNWD water balance for the same audit year.





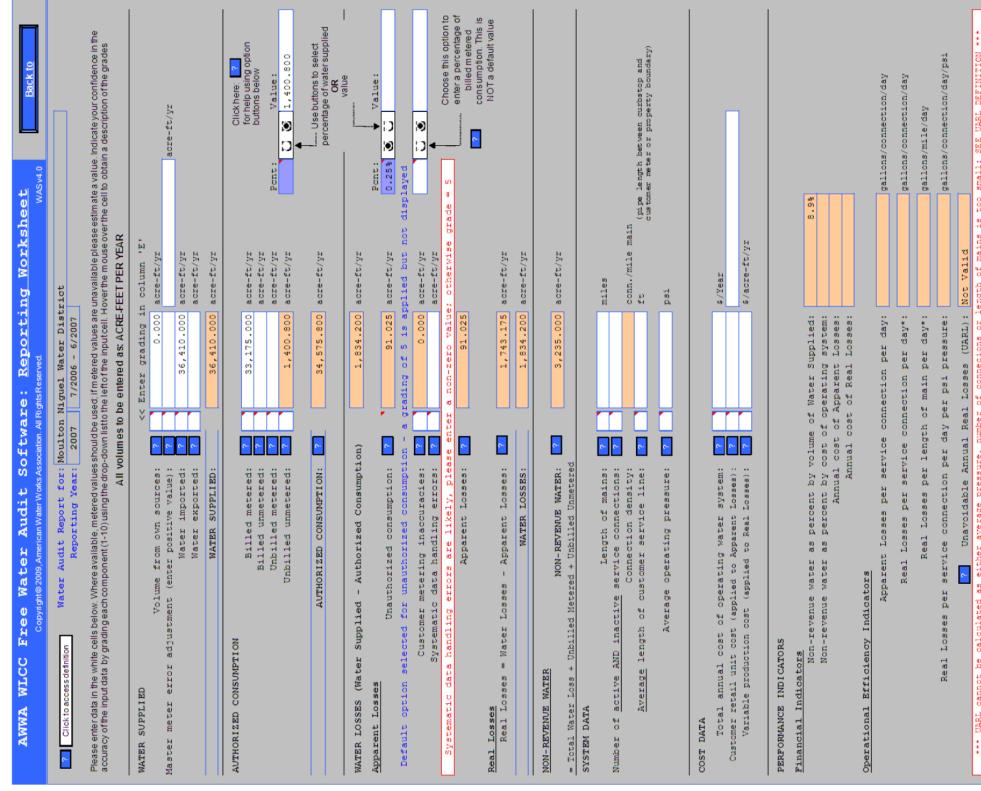


Figure 7-7: Moulton Niguel Water District Reporting Worksheet



r caludadua as fluit average pressur, numer ol connectons of fendua as too small: Job WANN DETWILLOW """ Infrastructure Leakage Index (ILI) [Real Losses/UARI]:	* ONLY UNE MOST ADDITCADLE OF UNESE UNO INDICATORS WILL DE CALCULATED WATTER AUDIT DATA VALIDITY SCORE:	ng value for 11 parameter(s) to enable an audit score to be calculated	FOR ATTENTION:	rmation provided, audit accuracy can be improved by addressing the following components:	For more information, click here to see the Grading Matrix worksheet	g Inaccuracies	
The struct of the struct as	* ONLY THE MODIT DATA VALIDITY S	Add a grading value :	PRIORITY AREAS FOR ATTENTION:	Based on the information provid 1: Water Imported	2: Billed metered	3: Customer metering inaccuracies	

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Co	opyright©2009, America	n Water Works Association	n. All Rights Reserved. WAS v4.0	Moulton Niguel Water Distric	t 2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. wate exported) 33,175.00	Revenue water
Own Sources		Authorized Consumption	33,175.000	Billed Unmetered Consumption	33,175.000
(Adjusted for known errors)		34,575.800	Unbilled Authorized Consumption	0.00 Unbilled Metered Consumption 0.00	Non-Revenue Water
0.000			1,400.800	Unbilled Unmetered Consumption	
	Water Supplied	•		1,400.80 Unauthorized Consumption	3,235.000
	36,410.000		Apparent Losses 91.025	91.02 Customer Metering Inaccuracies	5
				0.00 Systematic Data Handling Errors	0
		Water Losses		0.00	0
Water Imported		1,834.200	Real Losses	Leakage on Transmission and/or Distribution Mains Not broken down	
36,410.000			1,743.175	Leakage and Overflows at Utility's Storage Tanks	
				Not broken down Leakage on Service Connections	-
				Not broken down	

Figure 7-8: Moulton Niguel Water District





7-20

7.4.2. Data Gaps

The Moulton Niguel water audit indicates multiple data gaps which need to be filled prior to an accurate assessment of data validity and accuracy of audit results. No evaluation of compliance with CUWCC BMP 1.2 was performed, since a completed annual audit forms the basis for initial compliance independent of audit results.

Recommended Follow-Up Activities 7.4.3.

The Consultant recommends that MNWD consider the following activities to improve their water loss management practices and ensure compliance with BMP 1.2

- Implement an annual water system auditing process to collect, evaluate, and maintain data required to compete annual audits in the IWA/AWWA format as required by CUWCC BMP 1.2. Complete the data validation portion of the annual audit and implement audit suggestions for improving the data validation score, if warranted.
- Formalize a regular review of billing system practices and a conduct a regular customer billing system auditing process to reveal scope of systematic data handling errors. When refinements to the computerized billing system are undertaken, enhance reporting capabilities.
- Revise record-keeping system for the repair of reported leaks to include all information required by BMP 1.2, if not already included. Consider a GIS database to track locations of reported leaks, as well as pipe materials and age, to facilitate early identification of problem areas. While MNWD does not currently have a system leakage problem per results of the field survey, leakage increases with system age, and simple, affordable steps for tracking leakage can prevent a problem from developing.
- Consider a more intense meter accuracy testing program, including maintaining records on cumulative flow for each meter and pulling meters from the system at random for testing to develop a database tracking meter accuracy versus cumulative flow through the meter. The current system for residential meter replacement in MNWD is based on 15 to 20 years in service. The meter reading procedures do allow for early identification of meters which have stopped working entirely. A sample of residential meters is tested every 3-5 years for accuracy. Mechanical, positive displacement-type residential meters generally have an economic life of about ten years based on cumulative volume through the meter. Additionally, MNWD should consider tracking time-of-day water use for a sample of selected residential meters to characterize customer demand at low, normal, and high flow rates in order to confirm economic optimum for meter replacement, confirm appropriate meter sizing, and to refine apparent loss estimates.





7.5. City of Tustin

7.5.1. Summary of Results

The City of Tustin participated avidly in all project meetings and workshops. Tustin staff submitted all data in response to requests for information and completed multiple versions of the IWA/AWWA water audit. Their audit year was calendar year 2007. Tustin demonstrates excellent record-keeping practices necessary to comply with CUWCC BMP1.2. Due to their low calculated ILI, they should perform audits for additional calendar years to validate consistency with their 2007 reported low leakage and system infrastructure leakage index. Their audit reporting spreadsheet is shown below in Figure 7.9. Their water balance is provided in Figure 7.10.





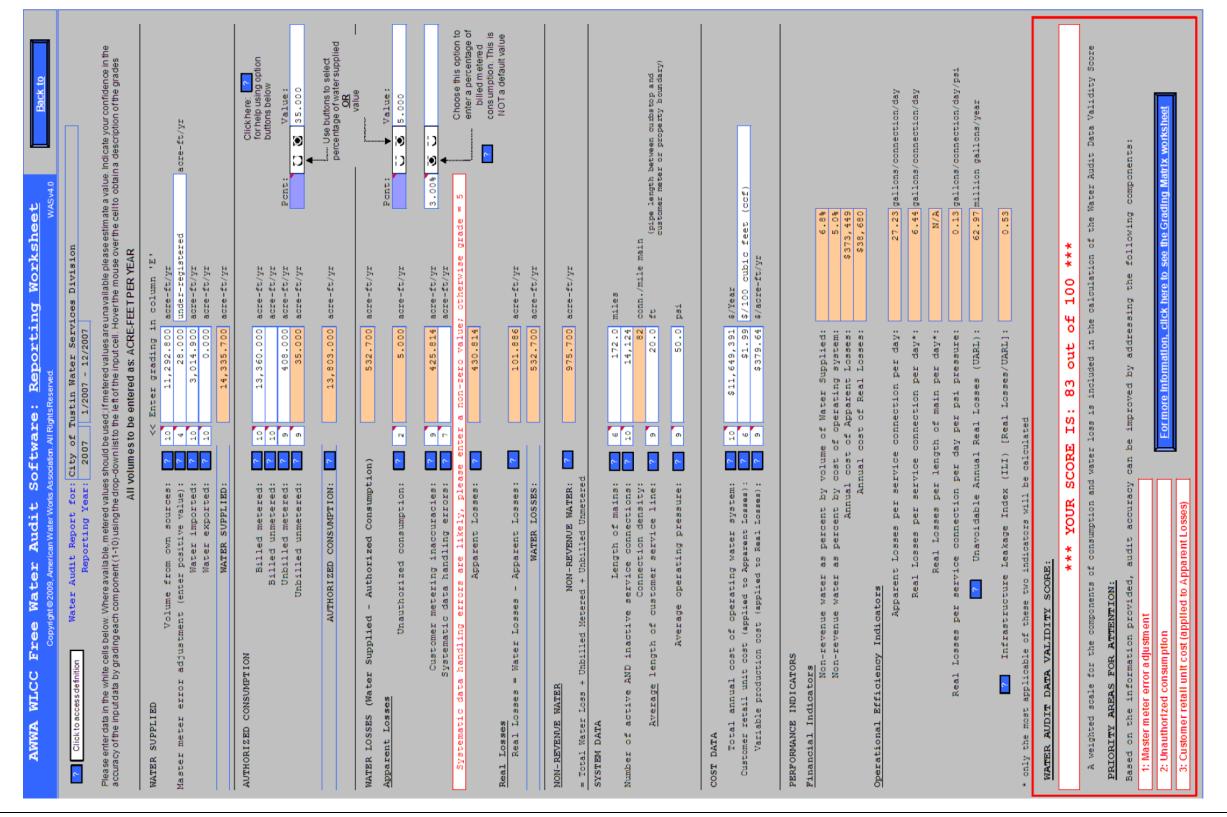


Figure 7-9: City of Tustin Reporting Worksheet





AWWA WLCC	Free Wat <u>er</u>	Audit Softwa	are: Water Balance	Water Audit Report For:	Report Yr:
		n Water Works Association		Division	2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 13,360.000	Revenue Water
Own Sources		Authorized Consumption	13,360.000	Billed Unmetered Consumption	13,360.000
(Adjusted for known errors)		13,803.000		0.000	
		13,803.000	Unbilled Authorized Consumption	Unbilled Metered Consumption 408.000	Non-Revenue Water (NRW)
11,320.800			443.000	Unbilled Unmetered Consumption	
				35.000	
	Water Supplied			Unauthorized Consumption	975.700
			Apparent Losses	5.000	
	14,335.700		430.814	Customer Metering Inaccuracies	
				425.814 Systematic Data Handling Errors	
		Water Losses			
Water Imported	-	532.700		Leakage on Transmission and/or Distribution Mains	
			Real Losses	Not broken down	
3,014.900			101.886	Leakage and Overflows at Utility's Storage Tanks	
				Not broken down	
				Leakage on Service Connections Not broken down	

Figure 7-10: City of Tustin Water Balance





Performance Indicator	Result
Non-revenue water as percent by volume of Water Supplied	6.8%
Non-revenue water as percent by cost of operating system	5.0%
Apparent Losses per service connection per day	27.23 gallons/connection/day
Real Losses per service connection per day	6.44 gallons/connection/day
Unavoidable Annual Real Losses (UARL)	62.97 million gallons/year
Infrastructure Leakage Index (ILI)	0.53

Table 7-7: Tustin Performance Indicator Assessment

7.5.2. Data Gaps

Tustin provided all necessary data to complete the water audit and analyze financial and operational performance for the audit period. Additionally, Tustin has completed its data validity scoring and demonstrates excellent record-keeping practices overall. Given Tustin's audit and data validity scoring results, the City is well on track to BMP 1.2 compliance and requires only minimal adjustments to its practices to meet all requirements of the BMP within the specified time frames.

In order to verify Tustin's real losses and perform component analysis, it would be beneficial for Tustin to provide detailed records on reported leakage and previous leak detection activities. Additionally, given Tustin's extremely low ILI, review of data from adjacent years would be beneficial to confirm the validity of the data.

Table 7-8 shows the activities required for Tustin to be in compliance with BMP 1.2 and the completion status of each.





Requirement for Compliance	Year Completion Required	Status	Notes
Compile standard water audit and balance	Annual	Completed	
Test source, import, and production meters annually	Year 2	Completed	
Achieve a Water Audit Data Validity Score of 66 or higher using the AWWA	Year 4	Completed	Data Validity Score of 83 for CY 2007 audit
Achieve a Water Audit Data Validity Score of Level IV (71-90) or higher	Year 5	Completed	Data Validity Score of 83 for CY 2007 audit
Seek training in the AWWA water audit method and component analysis process	Year 4	Completed	
Complete a component analysis of real losses	Year 4		
Demonstrate progress in water loss control performance as measured by gallons per service connection per day	Year 5 through Year 10		
Repair all reported leaks and break to the extent cost-effective	Ongoing	Ongoing	
Maintain a record-keeping system for the repair of reported leaks	Year 2		
Include estimated leakage volume from report to repair and cost of repair in leak records	Year 4		
Locate and repair unreported leaks to the extent cost effective	Ongoing		

Table 7-8: Status of Tustin BMP 1.2 Compliance





8. Summary of Findings, Conclusions, and Recommendations

- There was a significant disparity between level of participation and information provided among the participants, which limited the extent to which the Consultant could compare and extrapolate finding of the study for the whole group of five utility Participants. Table 8-1 presents available data provided by individual participating utilities for the audit reporting year indicated. Data for the two utilities for which a data validity score could not be determined should not be considered comparable to the three utilities providing data validity scores. The three Participants providing data validity indicate results above 80. These scores are in Level IV, as indicated in Table 8-2. Level IV achieves the required data validation level to achieve future CUWCC BMP 1.2 goals. Table 8-2 provides guidance from the AWWA Free Water Audit Software to improve water loss standing. The higher data validity score achieved results in a higher water loss standing.
- Those Participants who provided sufficient data for a full audit and analysis demonstrated excellent water loss control practices. These Participants should meet the requirements of the CUWCC BMP 1.2 with only minimal adjustments to their existing practices.
- Although the portion of each system on which leak surveys were performed was not a significant enough percentage to extrapolate the results to the entire distribution systems, the results from these surveys were promising. Participants typically selected portions of their system for the leak surveys with older pipes or suspected issues, yet leaks were detected in only 2 of the 5 systems.
- For water audits providing a data validity score, calculated Infrastructure Leakage Index (ILI) values were excellent. Table 8-3 provides guidance from the AWWA Free Audit Software for establishing a target ILI value for an individual utility based on its specific financial, operational, and water resources considerations. For calculated ILIs in this investigation, the participating utilities appear to have minimal real loss control issues. It is recommended that economics of real water losses be monitored to compare the value of water lost due to leakage to the cost of implementing an effective real loss reduction program.
- Individual audits for different selected audit years are provided for the five retail agency participants, however, not all are complete. Based on an assessment of audit information, data validation scores, and audit results, recommended water loss





accounting follow-up activities have been provided for each participant. All participating agencies have room to improve their real water loss and apparent water loss data collection, monitoring, and control practices.

- Non-Revenue Water ranged from 3 to 10 percent of volume of water supplied, which is very good and well within the range of efficient water utilities concerned about conservation and water loss management practices.
- Due to the increasingly stringent requirements for BMP 1.2 compliance in the future, participants will need to become proficient at component analysis for bottom up data collection and analysis to achieve better understanding of individual audit elements.

The collaborative workshop approach with multiple concurrent participation and collaboration between consultant, wholesale water agency (MWDOC), and the participating retail agencies was excellent for group presentation, dialogue confirmation of understanding of audit elements in preparation for achieving water conservation requirements of the state. This project successfully prepared agency participants for California's water loss management element of its conservation program.

Utility (Reporting Year)	Data Validity	Real Losses (Acre-Feet)	Apparent Losses (Acre-Feet)	UARL (MG per year)	ILI
Brea (FY 2007)	93	670.123	89.492	60.69	3.60
Huntington Beach (FY 2009)	88	1144.000	511.000	308.03	1.21
Laguna Beach County Water District (FY 2007)	NA	91.836	11.424	56.23	0.53
Moulton Niguel Water District (FY 2007)	NA	1743.175	91.025	NA	NA
Tustin (CY 2007)	83	101.866	430.814	62.97	0.53

Table 8-1: Comparative Audit Summary

NA = Non-Available





AWWA WLCC Free Water Audit Software: <u>Determining Water Loss Standing</u> Copyright © 2009, American Water Works Association. All Rights Reserved. WAS v4.0									
Water Loss Control Planning Guide									
		Water #	Audit Data Validity Leve	/ Score					
Functional Focus Area	Level I (0-25)	Level II (26-50)	Level III (51-70)	Level IV (71-90)	Level V (91-100)				
Audit Data Collection	Launch auditing and loss control team; address production metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing				
Short-term loss control	Research information on leak detection programs. Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Establish ongoing mechanisms for oustomer meter acouracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation				
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions				
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis				
Benchmarking			Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	Performance Benchmarking - ILI is meaningful in comparing real loss standing	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service				
	For validity scores of 50	or below, the shaded blocks s	hould not be focus areas until	better data validity is achieved	ł				

Table 8-2: AWWA Water Loss Control Planning Guide





General Guidelines for Setting a Target ILI (without doing a full economic analysis of leakage control options)			
Target ILI 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.	of existing infrastructure and/or	Available resources are greatly limited and are very difficult and/or environmentally unsound to develop.
	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, water conservation) are included in the long-term planning.
>5.0 - 8.0	Cost to purchase or obtain/treat water is low, as are rates charged 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 TLI greater than 8.0, such a level of leakage is not an effective utilization 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 calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI 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.		

Table 8-3: AWWA Guidelines for Setting a Target ILI





Appendix A

Malcolm Pirnie Scope of Work

SCOPE OF WORK MWDOC Water Loss Management Program Assessment Potable Water System Audit March 26, 2008

Task 0: Administration and Management

The Consultant's Project Manager and primary contact for this project will be Stephen Davis, Vice President in Malcolm Pirnie's Irvine Office. The project management task entails the following:

- Coordination with the Municipal Water District of Orange County (MWDOC) Project Manager and other MWDOC designated staff and coordination with staff from the City of Huntington Beach, the City of Brea, the Laguna Beach Co. Water District, the City of Tustin, and Moulton Niguel Water District
- Coordination of meetings and conference calls with MWDOC and utility staff
- Preparation and distribution of meeting minutes
- Preparation of monthly email project progress updates
- Invoicing

Task 1: Collect and Review Relevant Audit Data

Malcolm Pirnie, Inc. project staff will meet with MWDOC staff to kick off the project. This initial meeting will review the project scope, data requirements, budget, and timeframe for project execution.

Malcolm Pirnie, Inc., in conjunction with MWDOC staff, will plan for and hold a project kick-off meeting with the five participating water utility systems. During the meeting, Malcolm Pirnie, Inc. will:

- Explain the IWA/AWWA water auditing purpose, context, and procedures;
- Review the project scope, budget, and timeframe; and
- Answer questions that the utilities have about the data needs and project approach.

Malcolm Pirnie, Inc. will generate a list of data needed to complete an annual IWA/AWWA water audit for the five member utilities based on a selected annual time period and will provide the list to MWDOC for distribution to the participating water systems. Malcolm Pirnie, Inc. will coordinate with MWDOC and the participating systems to obtain this data. The list will include the following types of data:

- Water Supply Sources
- Water Supply Cost
- Water Supply/Production Quantities
- Water Billing Data
- Unbilled Authorized Water Consumption

- Retail Water Meter Information
- Water Billing Systems and Services
- Water Rate Structure
- Distribution System Description and Operating Characteristics
- Water Leak History and Management Program

Malcolm Pirnie, Inc. will organize and format the data provided by each system for consistency with the IWA/AWWA auditing procedure format. Malcolm Pirnie, Inc. will also perform an initial analysis of the data to identify inconsistencies and develop a list of follow-up questions.

Task 2: Complete data analysis and formatting for the IWA/AWWA water audit software

To complete an annual IWA/AWWA water audit for each utility water system, Malcolm Pirnie, Inc. will do the following:

- Input data gathered in Task 1 to the IWA/AWWA standard water audit spreadsheet software for each of the five participating systems.
- Based on the initial results of the spreadsheet software analysis, identify gaps and errors in the data and work with each agency to improve the completeness and accuracy of the data.
- Since the IWA/AWWA water auditing process is iterative, develop each agency's water audit, sequentially enhancing audit data and results. Malcolm Pirnie, Inc. will coordinate with agency staff to revise the initial audit until a high degree of confidence in the results is attained within the limits of project budget.
- Using the results of the software analysis, Malcolm Pirnie, Inc. will identify the following:
 - o Data gaps,
 - o Sources of non-revenue water,
 - Value of real and apparent losses, and
 - Cost-benefit ratio for potential corrective measures, if required.

Task 3: Conduct "Unbilled Authorized Water Consumption" Review and Analysis

The City of Tustin audit for 2004/2005, performed for the MWDOC Water Loss Management Program Assessment reported in March 2007, indicated a large percentage of total loss to the "Unbilled Authorized Water Consumption" category of the universal water balance adopted by IWA/AWWA. This use category includes fire hydrant flushing, fire hydrant testing, main flushing, internal uses, irrigation of utility properties, street cleaning, etc. This task will focus on individual utility water use quantification methods for this category of typically unmetered water uses and will compare and analyze individual approaches with reported approaches and results for other similarly situated utilities. Recommendations to improve the accuracy of losses estimated for this category will be made.

Task 4: Conduct Leakage Management Program and Systems Operation Review

Review of each utility system's leakage management program and systems operations will be based on the data obtained in Task 1, the results of the data analysis in Task 2, and the completion of a component analysis for each system.

Malcolm Pirnie, Inc. will review the information gathered from each system in Task 1 regarding water distribution system leak history, leak detection, and leakage management programs, including:

- Type of leakage management program.
- Type of leakage detection program.
- Inventory of number/type/volume of leaks, plus spatial distribution over last 5 years, if available.
- Average time to repair leaks.
- Cycle for full system leak detection.
- Number of permanent or temporary noise listening stations, if any.
- Annual expense for leak detection.
- Annual expense for leak repair.

To refine the leakage data obtained during the top-down water audits in Task 2, Malcolm Pirnie, Inc. will perform component analysis. Component analysis, as defined in the AWWA Manual M36, 3rd Edition, is a technique which models leakage volumes based upon the nature of leak occurrences and durations. While component analysis is still largely a desktop exercise, it requires additional data beyond what is used in Task 2. Malcolm Pirnie, Inc. will conduct telephone interviews and meetings with the five participating systems, if needed, in order to obtain information to perform a component analysis for each system. Data that may be needed includes:

- Number of annual report leak and break events on water mains and customer services
- Average flow rates for reported leaks/breaks at the current average system pressure
- Average run time (the sum of average awareness, location, and repair times) assigned to each leakage type
- Cost of a leak detection survey intervention (\$/mile of mains)
- Average Rate of Rise of unreported leakage

Following completion of the component analysis, Malcolm Pirnie, Inc. will summarize each agency's results. Malcolm Pirnie, Inc. will then recommend improvements to each leak management program based on the following criteria:

- Economic impact of real losses from leaks to the system over five-year period, as determined in Task 2
- Quantity of component volumes of leakage (reported leaks, unreported leaks and background leakage)

Task 5: Perform Relevant Field Measurement Activities

Based on the results of Task 4, Malcolm Pirnie, Inc. will recommend field measurements to verify results of Task 4, to increase understanding of the causes of water loss, and to help assess cost-effectiveness of potential water loss reduction activities. Potential field measurement activities include:

- Testing source and customer meter accuracy
- Recording time of day metered water low for weekly summer and winter periods to characterize the customer water usage distribution patterns
- Establishing District Metering Areas to monitor and quantify real losses for portions of a distribution system

If Malcolm Pirnie, Inc. determines that meter accuracy testing or time of day flow recorders will be necessary, equipment will be obtained by MWDOC staff. Malcolm Pirnie, Inc. may hire a MWDOC-approved subcontractor to perform field measurement activities. For data collected through field measurement activities in this task, Malcolm Pirnie, Inc. will perform statistical analyses to determine the confidence levels in the various data obtained. Malcolm Pirnie, Inc. will use the sample size and variance in order to determine the confidence in the results for the entire metered population of interest.

Task 6: Prepare Retail System Water Audit Reports

Based on the results of Tasks 1 through 5, Malcolm Pirnie, Inc. will document water audit results and findings for each of the participating utilities.

Task 7: Provide Recommendations for Follow-Up Activities for Improved Water Loss Management

Malcolm Pirnie, Inc. will recommend activities, based on the results of Tasks 1 through 6, to reduce apparent and real water losses and to assess the economic feasibility of water loss reduction activities.

Task 8: Complete Project Report

Malcolm Pirnie, Inc. will prepare a draft report to MWDOC documenting the following:

- Data collected from each of the five systems
- Results of IWA/AWWA water audit software analysis for each system
- Summary and assessment of leakage management program for each system
- Field data collection results and analysis

• Recommendations for follow-up activities for water loss management program assessment and implementation.

• Implications for water savings for all of MWDOC's utility members Malcolm Pirnie, Inc. will seek comments on the draft report from MWDOC and from the

five participating systems and will incorporate these comments into the final report.

Deliverables:

Draft and Final Report incorporating results from the prior tasks

				2008	•					2009			
Task	Description	And May Jun Jul Aug Seo Oct Nov Dec	Inc. un	Aug S	seo Oct	Nov	Dec Ja	Jan Feb	Mar	Apr May Jun Jul Aug	Jun	Jul Au	ug Sep
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	Complete Data Analysis and Formatting for 2 IWA/AWWA Water Audit Software			San San									
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	5 Perform Relevant Field Measurement Activities			haran dinara	erge Jaminie moore in spirit								
	6 Prepare Retail Water System Audit Reports												
	Provide Recommendations for Follow-Up Activities 7 for Improved Water Loss Management										n an		
	8 Complete Project Report											- may A	23.

Note: Schedule anticipates a Notice to Proceed date of April 7, 2008.

Appendix B

PowerPoint Presentations

Water Loss Management Program Assessment Potable Water System Audits

> Project Kick-Off Meeting May 21, 2008

Agenda

- Introductions
- Participating Agency Contact Information
- Review Project Scope and Budget
- Review Project Schedule
- AWWA M36 Revision 3 Draft
- Water Balance Spreadsheet Software
- Consultant Data Request: Available Information/Schedule for Delivery
- References
- Open Discussion
- Next Meeting Date

Contact Infomation

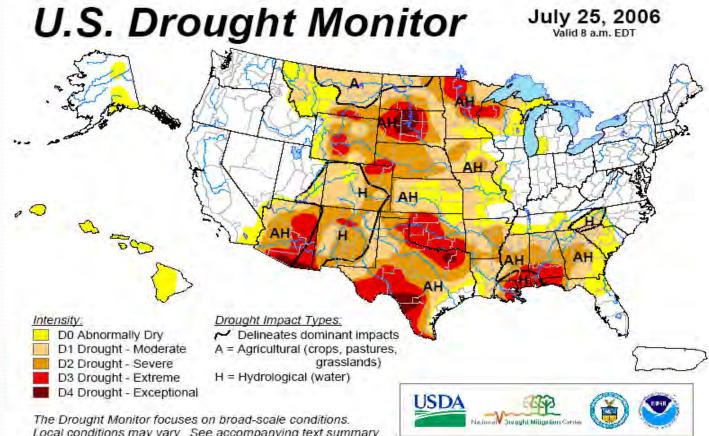
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 - rbell@mwdoc.com
- Steve Davis, Malcolm Pirnie, Inc., Project Manager
 - (949) 450-7948
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- Andree Hunt, Malcolm Pirnie, Inc., Project Scientist
 - (949) 450-7939
 - ahunt@pirnie.com

Participating Agency Contact Information

Project Background

What are the benefits of conducting a water audit?

Growing Pressure to Manage Water More Efficiently



Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, July 27, 2006 Author: C. Tankersley/L. Love-Brotak, NOAA/NESDIS/NCDC

State Regulations



"A better system of accounting is needed to instill better accountability in drinking water utilities"

Water Loss in the Past:

unstructured, reactive

- No consistent definitions for the various components of use or loss have been employed
- Worldwide, no standard definition has been found to exist for the term "unaccounted-for" water
- Percentage indicators have been found to be suspect in measuring technical performance
- Percentage indicators translate nothing about water volumes and costs
- Many water utilities have no active functions to assess or control losses

Better Understanding Real Losses

- Most leakage losses by volume over the course of the year occur on customer service connection piping – not water mains
- Policies that place the burden on customers to repair leaks on their service connections are often inefficient
- New policies/programs to address service line leakage are needed to economically reduce this leakage

Water Loss Control Improvements:

Controlling Apparent Losses

- Measurement Technology
 - Accurate production & customer meters
 - Refined datalogging capability
 - Automatic Meter Reading gaining in use
- Improved Information Management
 - Customer Billing Systems
- Rational Policies
 - Service provision
 - Unauthorized consumption
 - Billing procedures
 - Use of fire hydrants

Project Scope

- o. Administration and Management
- 1. Collect and Review Data
- 2. Kick-off Meeting with MWDOC
- 3. Kick-off Meeting with Participating Systems
- 4. Complete Data Analysis and Formatting for IWA/AWWA Water Audit Software

Project Scope

- 5. Conduct Leakage Management Program and Systems Operation Review
- 6. Perform Field Measurement Activities
- 7. Prepare Retail System Water Audit Reports
- 8. Recommend Follow-Up Activities for Improved Water Loss Management
- 9. Complete Project Report

Project Schedule-2008

	2008							
Task	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Administration and Management								
Collect and Review Relevant Audit Data								
Complete Data Analysis and Formatting for								
IWA/AWWA Water Audit Software								
Conduct "Unbilled Authorized Water								
Consumption" Review and Analysis								
Conduct Leakage Management Program								
and Systems Operation Review								
Perform Relevant Field Measurement								
Activities								

Project Schedule- 2009

		2009									
Task	Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
0	Administration and Management										
	Conduct Leakage Management										
	Program and Systems Operation										
4	Review										
	Perform Relevant Field										
5	Measurement Activities										
	Prepare Retail Water System										
6	Audit Reports										
	Provide Recommendations for										
	Follow-Up Activities for Improved										
7	Water Loss Management										
8	Complete Project Report										

AWWA M36 Revision 3 Draft

Draft dated October 2007

Explains the IWA/AWWA water audit methodology

Provided an overview of the best loss control techniques

AWWA M36 Revision 3 Draft

Contents Include:

- Conducting the Water Audit
- Identifying & Controlling Apparent Losses
- Understanding & Controlling Real Losses
- Planning & Sustaining the Water Loss Control Program
- Considerations for Small Systems

Standard Water Balance Format

		Water Exported		Billed	Billed Water Exported	
Own			Authorized	Authorized Consumption	Billed Metered Consumption	Revenue Water
Sources			Consumption		Billed Unmetered Consumption	
	Total			Unbilled Authorized	Unbilled Metered Consumption	
	System 1nput	Water		Consumption	Unbilled Unmetered Consumption	
		Supplied		Apparent	Unauthorized Consumption	
				Losses	Customer Metering & Data Inaccuracie	Non- Revenue
Water Imported	þ		Water		Leakage on Mains	Water
			Losses	Real Losses	Leakage on Service Lines (before the meter)	
					Leakage & Overflows at Storage	

Water Balance Spreadsheet

Software

- Launched April 2006
- Available for FREE download at: http://www.awwa.org/WaterWiser/waterloss/ Docs/WaterAuditSoftware.cfm
- Simple, user friendly: good for top-down audit
- "Beta tested" by 21 water utilities during 2005
- AWWA Water Loss Control Committee provides user support for the software and plans future upgrades

- Date needed to populate the Water Balance Spreadsheet Software and to make recommendations for water loss management activities.
- Date needed by: June 4th
- Please send to Richard Bell (rbell@mwdoc.com) or Steve Davis (sdavis@pirnie.com).

- Is the utility a party to the CUWCC MOU?
- Does the utility conduct an annual audit? If so, what method or format?
- Does the utility have a meter testing/repair shop? If not, is this contracted?

- Water Supply Sources
 - Water supply sources, locations, and meter designations
 - Capacity and type/size/age/manufacturer of supply meter
 - Calibration frequency and by whom
 - Calibration reports

- Water Supply Costs
 - Production cost per unit (\$/ mil gal) for water produced by the system.
 - Cost to purchase each unit (\$/mil gal) of MWDOC water.

- Water Supply/Production Data
 - Monthly metered supply data by each source for the past 3 fiscal years
 - Table showing values in cubic feet per second (cfs)
 - Table showing values in acre-feet
 - Table showing values in million gallons
 - Monthly metered supply data by each source for July thru December 2007

- Water Billing Data
 - Volume of billed consumption for past 3 fiscal years
 - Monthly by customer class
 - Monthly by meter size
 - Volume of billed consumption for July thru December 2007
- Unbilled Authorized Water Consumption
 - Fire fighting, fire training, fire hydrant flow tests, main flushing, hydrant flushing, street cleaning, public irrigation, public buildings, etc.

Water Loss Management Program Assessment

Potable Water System Audits

December 17, 2008



Agenda

- Introductions/Project Status
- Authorized Unmetered Consumption
 - a. Types
 - b. Utility procedures, methods, and sources of data
 - c. Discuss options that can improve estimates

• Water Meters

- I. Meter inventories
- II. Accuracy test data and methods
- III. Demand characterization
- IV. Meter replacement criteria
- Age
- Cumulative Volume
- Next Meeting Date



Contact Information

- Richard Bell, MWDOC, Principal Engineer/Project Manager
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- Steve Davis, Malcolm Pirnie, Inc., Project Manager
 - **(**949**)** 450-7948
 - sdavis@pirnie.com
- Andree Hunt, Malcolm Pirnie, Inc., Project Scientist
 - **(**949**)** 450-7939
 - ahunt@pirnie.com

Overview of Future Consultant/Agency/MWDOC Responsibilities

Task	Malcolm Pirnie	Agencies	MWDOC		
	Task 1-3: Complete				
Task 4: Conduct Leakage Management Program and Systems Operation Review	 Review leak history and management information gathered from each system. Perform component analysis to model leakage volumes. Recommend improvements to each leak management program. 	• Provide requested information regarding leakage detection and management.			
Task 5: Perform Relevant Field Measurement and Activities	 Recommend field measurement activities. Perform statistical analyses on data collected. Contract with field services firm to perform field measurement activities. 	• Recommend locations for field measurements.	 Obtain testing equipment. Approve subcontractor to perform field measurement activities. 		

Task	Malcolm Pirnie	Agencies	MWDOC
Task 6: Prepare Retail System Water Audit Reports	• Document water audit results and findings for each utility.		
Task 7: Provide Recommendations for Follow-Up Activities for Improved Water Loss Management	 Recommend activities to reduce apparent and real water losses and to assess the economic feasibility of water loss reduction activities. 		
Task 8: Complete Project Report	• Prepare a draft report documenting data collected, audit results, leakage management program assessments, and field data collection results and analysis.	• Provide comments on draft report	• Provide comments on draft report

Water Audit Results

	Moulton	Laguna	Tustin	Brea	Huntington
SYSTEM DATA					
Length of mains:	740	134	172	162	590
Number of <u>active AND inactive</u> service connections:		7979	14,124	11745	52,300
Connection density:		60	82	72.5	89
Average length of customer service line:		20	20	20	20
Average operating pressure:	?	?	50.0	?	63.00
COST DATA					
Total annual cost of operating water system:	?	8,824,547	11,649,391	11,118,011	29,000,000
Customer retail unit cost (applied to Apparent Losses):		?	1.99	?	1.39
Variable production cost (applied to Real Losses):		?	379.64	?	358.00

C. Unbilled Unmetered Authorized Consumption

The most common occurrences include:

- Firefighting, hydrant testing, and training
- Flushing water mains, storm inlets, and sewers
- Street cleaning
- Landscaping/irrigation
- Decorative water facilities
- Construction sites
- Water consumption at public buildings not included in the customer billing system.



Quantifying Unmetered Water Usage

Methodologies

- I. Portable Meters
- II. Estimation Methods
 - General estimation techniques
 - Practical assessments



I. Portable Meters

If no meters exist at a water source, a portable meter can be used to estimate flow.

- Portable meters can be brought to the site and installed on source piping just downstream of the water source.
- A minimum of 24 hours of continuous metering is recommended.



I. Portable Meters

One such meter is a portable, non-invasive, ultrasonic water meter:

- Clamps onto outside of the pipe
- Uses ultrasound to measure water flow in the pipe
- Requires a pipe diameter of at least 1.5 inches
- Does not perform well on some PVC piping

II. Estimation Methods

If a portable meter is not feasible, estimation and practical assessments should be made.

- Use a default value of 1.25% of water supplied for the entire authorized unmetered category.
- The California Department of Water Resources used 1-2% of the average total metered use for the previous 5 years to estimate their unmetered water usage for fire and line flushing.

II. Estimation Methods

If consumption is significantly greater than the default value, obtain detailed estimates through:

- i. Batch Procedure
- ii. Discharge Procedure

iii. Comparison Procedure



i) Batch Procedure

Used when water is transported by tank truck or container.

- Multiply the volume of the tank/container by the number of times it is filled from the distribution system.
- Careful record keeping is necessary for accurate estimates:
 - What is the number of trucks in operation?
 - What is the volume of water a truck transports?
 - The street cleaning and sewer flushing departments should be able to provide the necessary data.

ii) Discharge Procedure

When water is applied directly from a pipe , sprinkler system, fire hydrant, etc .

- Multiply the rate of water discharge by the total time it flows.
- Example: fire flows = # of events x flow rate x duration.
- Multiply the flow rate of a garden hose in gallons per minute times the number of minutes of use.
- When water pump performance characteristics are known, a volume estimate can be derived by multiplying the number of hours that the pump was operated during the year by the average pumping rate.

iii) Comparison Procedure

- For some facilities and areas, such as schools, swimming pools, and construction sites, consumption figures may be adapted from similar facilities elsewhere.
- By comparing facilities, an estimate can be developed.
- Better estimates result if the facility has similar:
 - Size
 - Hours of operation
 - Type of use
 - Landscaping
 - Most other details



Authorized Unmetered Consumption Recommendations

According to the AWWA WLCC water audit guidelines, authorized unmetered consumption in most water utilities is a small component, which is very often substantially overestimated.

- This component has many sub-components of water use which are often tedious to identify and quantify.
- Because of this and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value of 1.25% of the volume from own sources.
- If the water utility already has well-validated data that gives a value substantially higher/lower than the default volume, this value can be entered.

Customer Water Meters

- I. Meter inventories
 - I. Size
 - II. Manufacturer
 - III. Age (years in service)
 - **IV.** Cumulative volume by meter
- II. Accuracy test data and methods
 - I. Existing meter accuracy testing procedures and results
- III. Replacement Criteria
 - I. Age, cumulative volume, or accuracy level at which a meter is replaced
 - **II.** Cost for meter replacement



DEMAND CHARACTERIZATION Meter-Master 100EL



METER-MASTER CHARACTERISTICS

FEATURES

- Quick/Easy Setup
- Portable
- Rugged
- High Resolution
- Securable
- Submersible
- Accuracy Verification
- RF Communications
- Standard Pulse Input
- Dual Memory Options
- Universal Compatibility

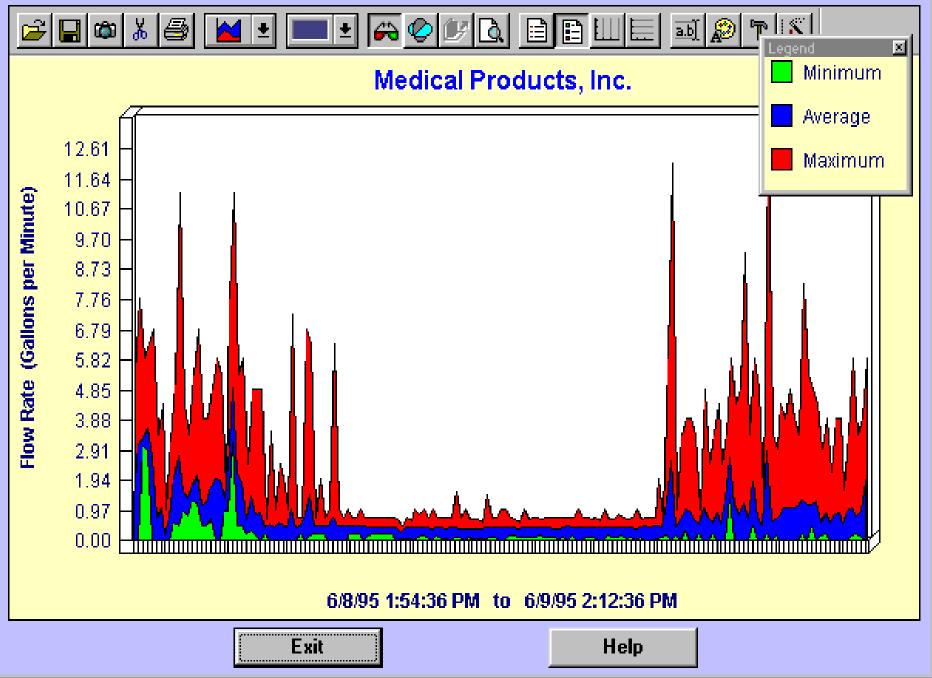
APPLICATIONS

- Customer Service
- Billing Disputes
- Meter Sizing
- Meter Maintenance
- Conservation
- Hydraulic Modeling
- Demand Monitoring
- Cost of Service Studies
- Water Audits



C:\PROGRAMF\MMV30\SAMPLE.MDB





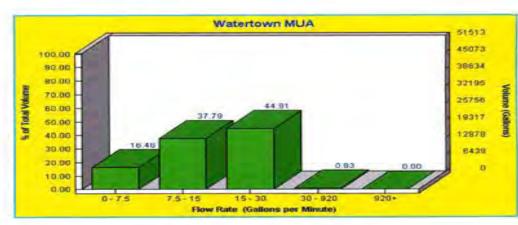
Flow Report

Location Information

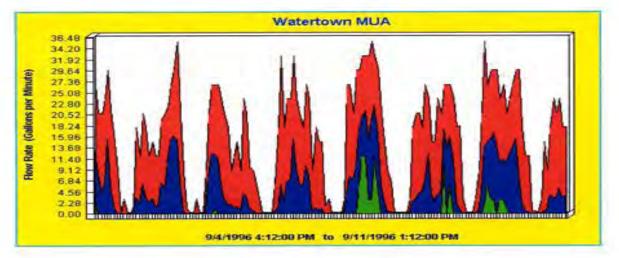
ID 11075 Name Watertown MUA Address Cooper Road City Evanston State/Prov Pennsylvania Postal Code 19002 Phone 888-388-3569 Notes Meter Size Check

Meter Information

Make	Sensus
Model	Turbo
Size	W-2000
Unit	Gallons



Flow Range	Percentage	Volume
0 - 7.5	16.46	8,480.84
7.5 - 15	37.79	19,467.85
15 - 30	44.91	23,134.25
30 - 920	0.83	429.63
920+	0.00	0.00

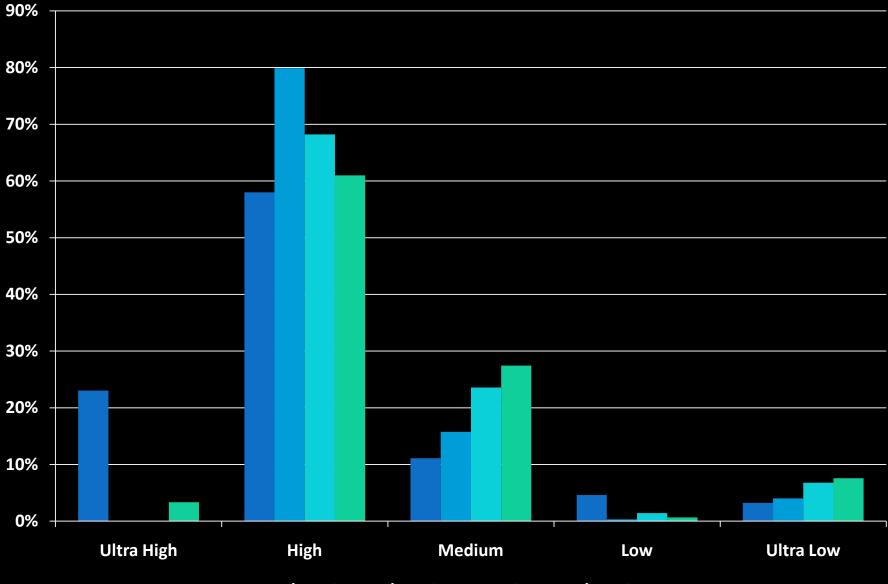


One Week Flow Report

% and Volume In each Flow Range

City of Scottsdale, AZ Residential Water Meter Study

December 2008



Percent Flow in Each Flow Range by Meter Size- Normalized Average

■ 5/8-inch ■ 3/4-inch ■ 1-inch ■ 1 1/2-inch

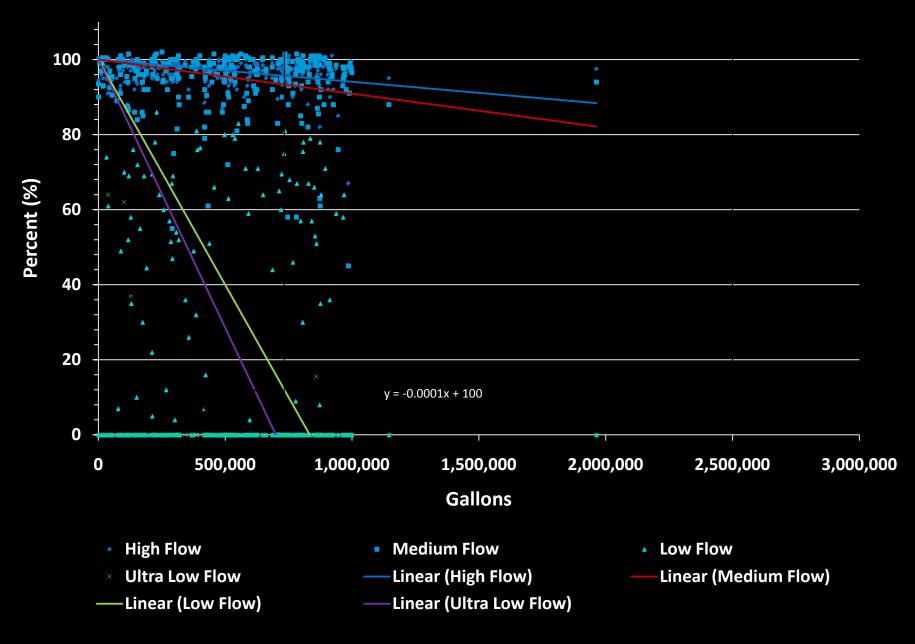


Figure 4.1: 5/8-Inch Meters Cumulative Flow vs. Accuracy

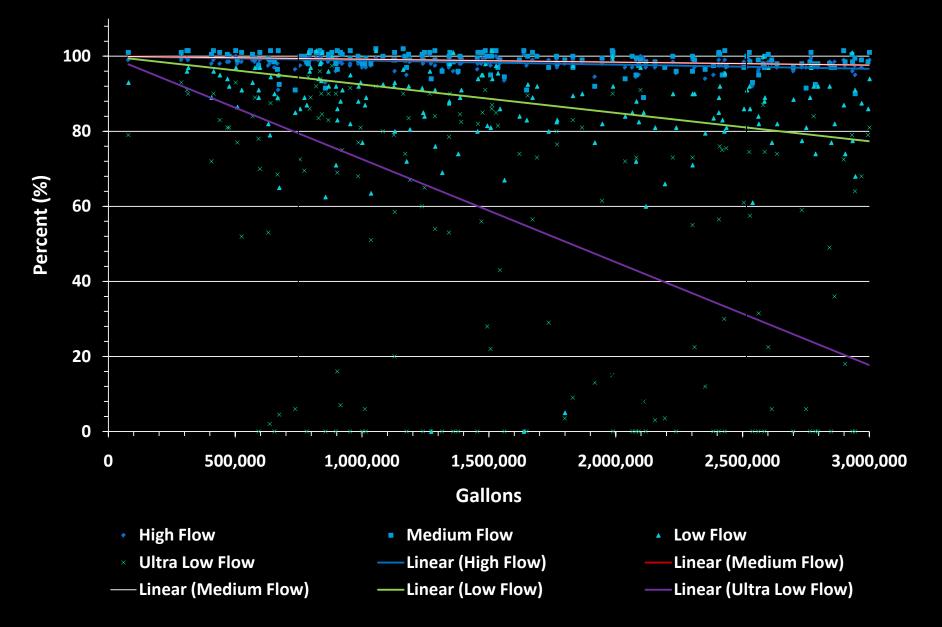


Figure 4.2: 3/4-Inch Meters Cumulative Flow vs. Accuracy

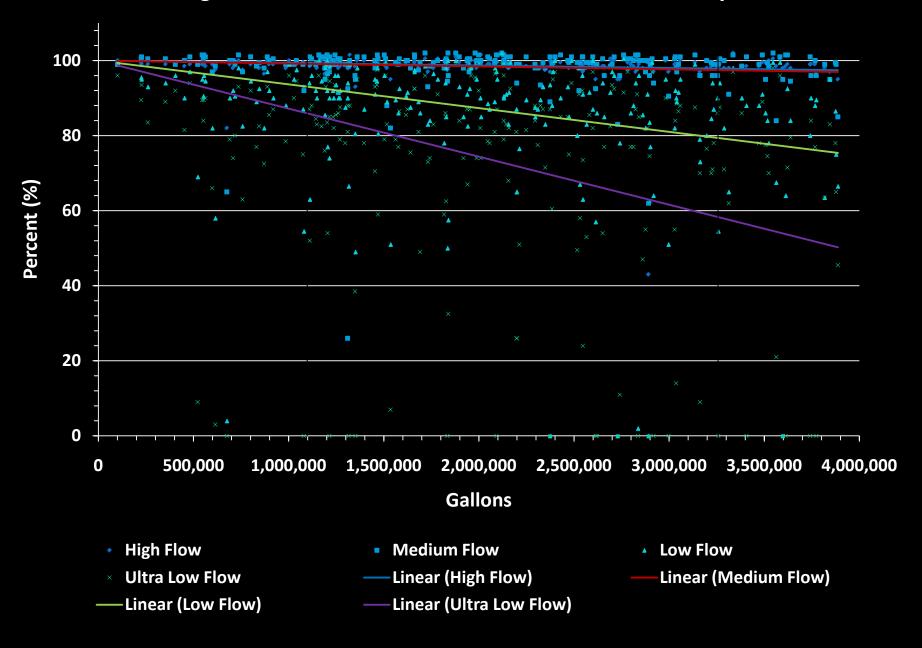


Figure 4.3: 1-Inch Meters Cumulative Flow vs. Accuracy

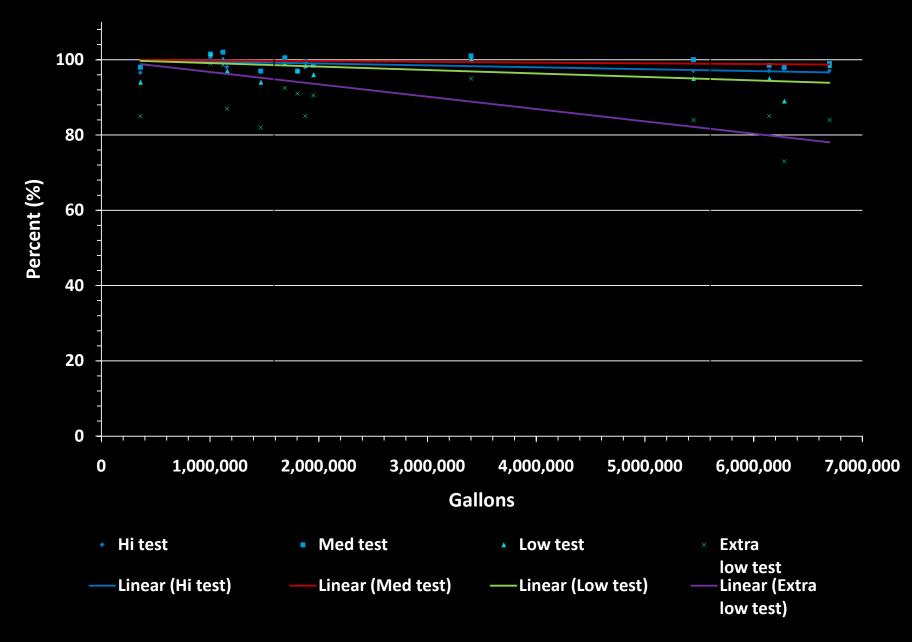


Figure 4.4: 1 1/2-Inch Meters Cumulative Flow vs. Accuracy

Next Meeting Date

January 2009?



Questions/Discussion



MWDOC Water Loss Control: CUWCC BMP 1.2 Workshop

Stephen E. Davis, P.E., BCEE Vice President Malcolm Pirnie, Inc Irvine, CA

October 13, 2009



Meeting Contents

- Project Tasks
 - Consultant To-Do List
 - Agency To-Do List
- Changes to Water Audit Methodology
 - AWWA Water Audit Software Version 4.0
 - Data Validation Scoring
- BMP 1.2 Water Loss Control- Status and Overview
- Field Work Recommendations

Contact Information

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 - sdavis@pirnie.com
- Andree Hunt, Malcolm Pirnie, Inc., Project Scientist
 - (949) 450-7939
 - ahunt@pirnie.com

Overview of Future Consultant/Agency/MWDOC Responsibilities

Task	Malcolm Pirnie	Agencies	MWDOC	
Task 1–3: Complete				
Task 4: Conduct Leakage Management Program and Systems Operation Review	 Review leak history and management information gathered from each system. Perform component analysis to model leakage volumes. Recommend improvements to each leak management program. 	 Provide requested information regarding leakage detection and management. 		
Task 5: Perform Relevant Field Measurement and Activities	 Recommend field measurement activities. Perform statistical analyses on data collected. Contract with field services firm to perform field measurement activities. 	• Recommend locations for field measurements.	 Obtain testing equipment. Approve subcontractor to perform field measurement activities. 	

Task	Malcolm Pirnie	Agencies	MWDOC
Task 6: Prepare Retail System Water Audit Reports	• Document water audit results and findings for each utility.	•Reformat in new AWWA software with data validation	
Task 7: Provide Recommendations for Follow–Up Activities for Improved Water Loss Management	• Recommend activities to reduce apparent and real water losses and to assess the economic feasibility of water loss reduction activities.		
Task 8: Complete Project Report	• Prepare a draft report documenting data collected, audit results, leakage management program assessments, and field data collection results and analysis.	• Provide comments on draft report	• Provide comments on draft report

Agency To Do List

- Complete/review spreadsheet audit
- Complete Water Audit Data Validity Score
- **Confirm field work needs**
 - Report/document existing activities

Validation of Data

- Top-down audit is considered preliminary
- Grading system assists in data validation
- Validation questions or confirms preliminary water audit data
- Assessment of results determines areas of focus

Successful water loss management requires valid data!

Spreadsheet-Based Water Loss Audit Tool

•The Old ----



•The New!



AWWA Free Water Audit Software

- April 2006 First commercial version of software 2.0
- August 2007 Second version of software 3.0
- April 2009, M36 Third Edition published
- May 2009, Software Version 4.0 published

AWWA WLCC Water Audit Software-What's New?

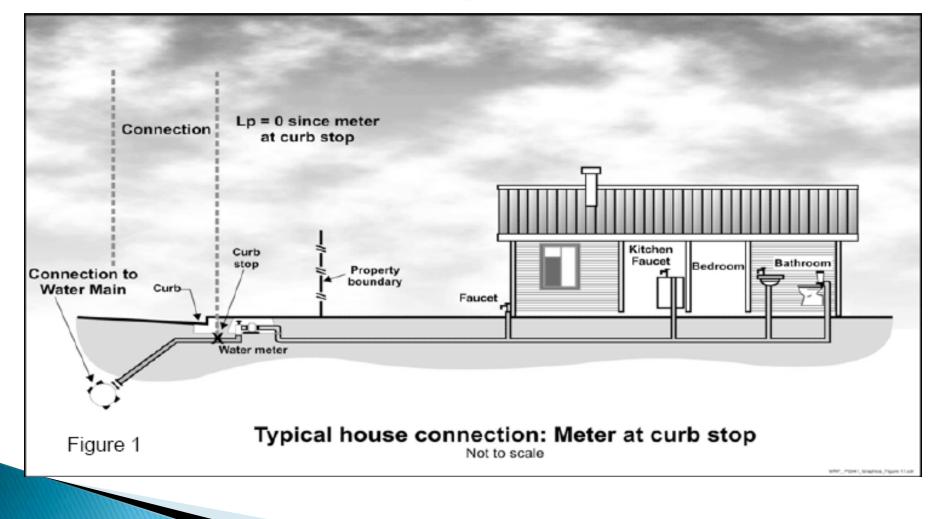
Water Audit Data Validity Score

- Provides a label for the "quality" of the data
- Data grading capability is a significant enhancement from previous versions

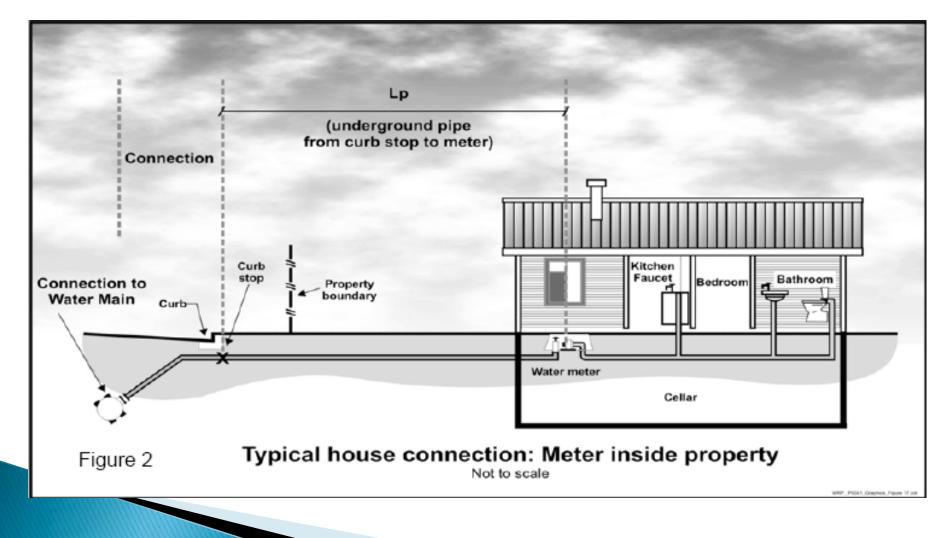
Water Audit Data Validity Score

- Grades assigned to each data component to describe auditor confidence and accuracy of input data with explicit defined criteria
- Audit accuracy improved most by improving the confidence in the following audit inputs:
 - Volume from own sources (metering)
 - Water imported (metering)
 - Billed metered consumption (metering)

Customer Service Line Diagram: Meter at Curb Stop



Customer Service Line Diagram: Meter Inside Property



Water Supplied Data Confidence

- For optimum confidence and accuracy:
- Meter 100% of production and imported sources
- Conduct semi-annual accuracy testing and calibration
- Less than 10% of source meters outside of +/-3% accuracy

Consumption Data Confidence

For optimum confidence and accuracy:

- Maintain 95% meter reading success rate, or launch AMR trials
- Implement large scale customer meter testing and replacement program
- Use computerized billing with routine auditing
- Conduct annual third party audit verification

Customer Metering Inaccuracies

- No longer a default value in Version 4.0- Need to determine based on meter data
- Consider cumulative volume, meter size, and meter type
- Longevity specific to utility water quality

Water Audit Data Validity Level/Score

- Level I (0-25)
- Level II (26-50)
- Level III (51-70)
- Level IV (71-90)
- Level V (91-100)

What Do We Do With The Audit Data?

- Don't predetermine a solution to an undefined problem.
- The audit defines the problem.
- Focus on high value losses and supply losses as determined by the audit.
- Separate apparent loss problems from real loss problems.

CUWCC BMP 1.2 Water Loss Control

- Revision to the CUWCC's water audits BMP, formerly know as BMP 3 System Water Audits, Leak Detection and Repair
- Presented at the June 11 CUWCC Plenary Meeting
- Revised by the Steering Committee on August 13th to address MOU signatory comments

Voting ended September 15th – Mods Passed

A. Implementation Sequence

- 1. Standard Water Audit & Water Balance
- 2. Validation
- 3. Economic Values
- 4. Component Analysis
- 5. Interventions
- 6. Customer Leaks

B. Implementation Schedule

- 1. For Agencies signing the MOU after Dec. 31, 2008, implementation shall commence no later than July 1 of the year following the year the agency signed the MOU
 - a. Agencies shall provide a full BMP 1.2 report for the first reporting period after implementation and for each reporting year thereafter.
- 2. A benchmark for the performance indicator in terms of water loss standard will be determined <u>after the first 4 years data collected</u> based upon the data reported by agencies. The performance indicator and benchmark will be voted upon by the Council by year 6 of this revision. Ongoing data collection and data reporting requirements will be decided upon as part of this process.

C. Coverage Requirements

1. Agencies to compile the standard water audit and balance annually using the AWWA Software. Beginning in the 2nd year of implementation, agencies to test source, import, and production meters annually.

Agencies shall improve the data accuracy and data completeness of the standard 2. water balance during the first four years of implementation. Agencies shall achieve a Water Audit Data Validity score of <u>66</u> or higher using the AWWA software no later than the end of the first four-year period and shall achieve a Data Validity Level IV no later than the end of the end of the 5th year of implementation. Estimations for data that are not directly measured should be improved using the methods outlined by the AWWA.

3. Agencies shall seek training in the AWWA water audit method and component analysis process (offered by CUWCC or AWWA) during the first four years of BMP implementation. They shall complete a component analysis of real losses by the end of the fourth year and update this analysis no less frequently than every four years.

- 4. Beginning in the fifth year of implementation, through the tenth year of implementation, agencies shall demonstrate progress in water loss control performance as measured by the AWWA software real loss performance indicator "gallons per service connection per day" (or "gallons per mile of mains per day" if system density is less than 32 service connections per mile) by one of the following:
 - a. Achieving a performance indicator score less than the agency's score the previous year (gallons per day per connection);
 - b. Achieving a performance indicator score less than the average of the agency's scores for the previous three years; or
 - c. In year 6 and beyond, reducing real losses to or below the benchmark value determined in the Council's process referenced in section B2.

- 5. Agencies shall repair all reported leaks and breaks to the extent cost effective. By the end of the second year, agencies shall establish and maintain a record-keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. By the end of the fourth year, agencies shall include estimated leakage volume from report to repair and cost of repair (including pavement restoration costs and paid-out damage claims, if any).
- 6. Agencies shall locate and repair unreported leaks to the extent cost effective.

D. Requirements for Documenting BMP Implementation

- 1. Agency shall submit the completed AWWA Standard Water Audit and Water Balance worksheets in the BMP 1.2 report form every reporting period.
- 2. For each reporting period, agency shall keep and make available validation for any data reported.
- 3. Agency shall maintain in-house records of audit results and methodologies and shall ncorporate results into future annual standard water balances.
- 4. Agency:
 - a. keeps records of intervention(s) performed, including standardized reports on leak repairs, the economic value assigned to apparent losses and to real losses, miles of system surveyed for leaks, pressure reduction undertaken for loss reduction, volumes of water saved, and costs of intervention(s); and
 - b. prepares a yearly summary of this information for submission to the Council.

Summary- BMP 1.2 Implementation

Year	Coverage Requirements
1+	 Provide Full BMP 1.2 Report Complete audit using AWWA software Repair all cost-effective reported leaks and breaks Locate and repair unreported leaks when cost-effective
2+	 Test source, import, and production meters annually Establish/maintain a record-keeping system for the repair of reported leaks
4+	 Record estimated leakage volume from report to repair and cost of repair Achieve Data Validity Score of 66 or higher
5-10	 Achieve Data Validity Score AWWA Level IV Demonstrate progress in water loss control performance as measured by "gallons per service connection per day"

Field Work- Recommendations

- BMP 1.2 is focused on real losses (real water conservation by the utility)
- Field work should focus on meeting BMP 1.2 coverage requirements.
 - Leak detection
 - Component analysis
 - Improving data validity score





Proposed Service Contractor:



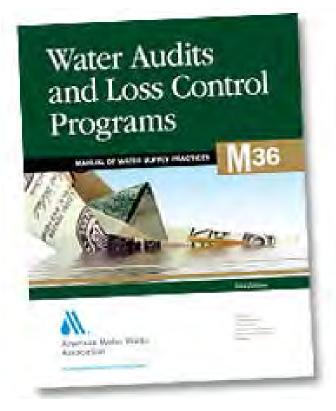
- Large water meter testing, evaluation, and maintenance
- Water Distribution System Leak Surveys and Pin-Pointing
- Valve Locating, Exercising and Computerized Mapping
- Fire Hydrant Testing
- Water Main Flushing
- Water Main Locating
- 24-hour Flow Testing, C-Factor Testing, Pump Curves and Head Loss

M36 Goals of Water Audits:

- 1. Improve water resources management
- 2. Optimize revenue recovery
- 3. Minimize operational disruptions
- 4. Increase water system integrity

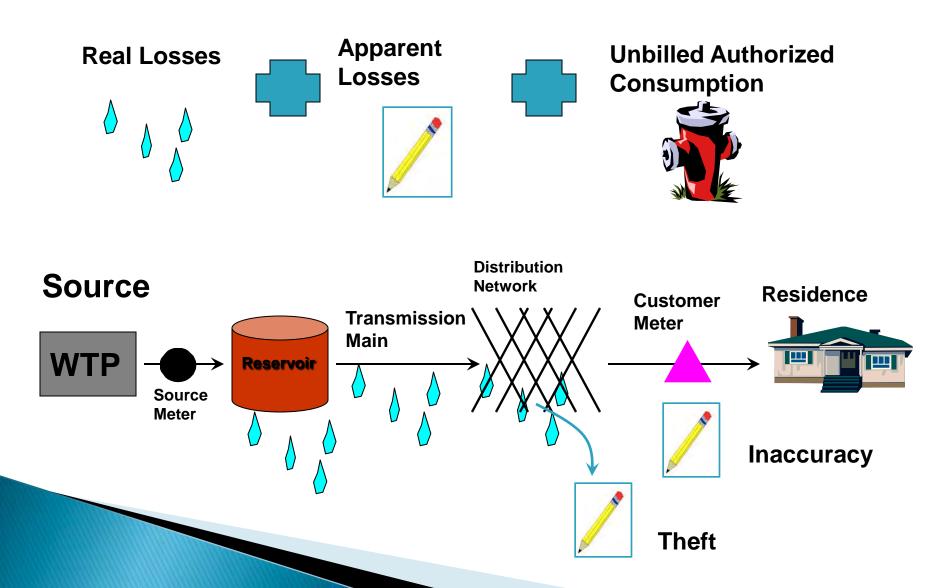
AWWA M36 Background

- First edition in 1991
- Second edition in 1999
 - Minor updates
- Third edition in 2009
 - Advances in audit methodology
 - Incorporates IWA method
 - Incorporates AWWA software



Non-Revenue Water

Unaccounted-for-Water = Non-Revenue Water (NRW) =



Conducting a Water Audit



- 1. Top-Down Approach
- 2. Component Analysis
- 3. Bottom-up Approach

Top Down Audit

- Basic "desk top" exercise
- Use of current data
- Very little field work
- Preliminary/rough draft
- Water Balance
- Typically annual



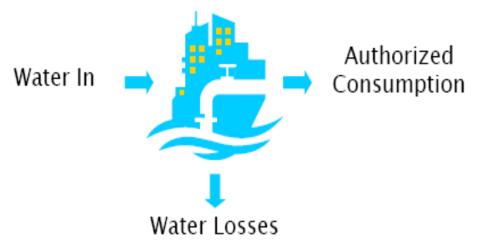
How Can the Top-Down Audit Help the Utility?

- Shows deficient areas within the utility
- Shows the need to implement the use of benchmarks or performance indicators
- Asks the question "Where in the system are we losing water?"
- Asks "How can we prevent the losses?"
- Determines value of lost water
- Can increase utility financial standing

Water Loss = Non Revenue Water

Real losses

- Reported leaks
- Unreported leaks



- Apparent losses
 - Customer meter under-registering
 - Unauthorized consumption (theft)
 - Billing adjustments and waivers

IWA/AWWA Water Balance



Apparent Losses

Unauthorized Consumption

- Fire hydrant theft
- Unauthorized connections
- Meter Inaccuracies
 - Under registering
 - Improper installation
- Accounting discrepancies
 - Non-billed accounts
 - Billing software inaccuracies
 - Waivers

Apparent Losses

- Typically are the most costly losses, since they are valued at the retail water rate
- Reducing apparent losses increases revenue but does not create new water
- Reducing apparent losses may generate sufficient new revenue to fund other necessary forms of loss control
- Typically quantified first:
 Water supplied water consumed apparent losses = real losses

Real Losses

- Physical losses from leaks, breaks, and overflows, up to the point of customer metering
- Calculated in top-down audit as: Water Losses – Apparent Losses = Real Losses
- Verified by component analysis and field measurements
- Reducing real losses creates a new resource (e.g. water conservation)

Definition of Real Losses

- The physical escape of water from the system, including:
 - Pipe breaks and leaks
 - Leakage from pipe joints and fittings
 - Reservoir and tank leakage
 - Reservoir and tank over flows
- Real losses occur prior to the point of end delivery



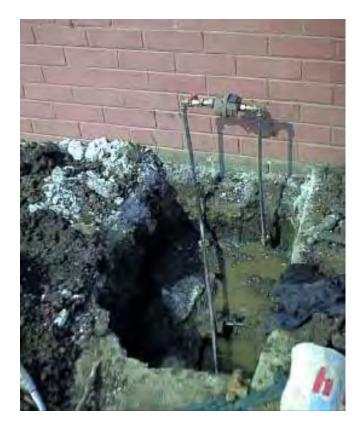
Visual Main Leaks- Reported



Hidden Main Leaks- Non Reported



Hidden Meter Set Leaks- Non Reported





Reasons for Distribution System Leakage

- 1. Poor installation and workmanship
- 2. Poor materials (pipeline, bedding, and backfill)
- 3. Mishandling of materials prior to installation
- 4. Incorrect backfill
- 5. Pressure transients
- 6. Pressure fluctuations
- 7. Excessive pressure
- 8. Corrosion (internal and external)
- 9. Vibration and traffic loading
- 10. Environmental conditions (hot and cold)
- 11. Lack of proper scheduled maintenance
- 12. Lack of leakage monitoring
- 13. Disturbance by other utilities (sewer rehabilitation)

System Storage Leaks







Reservoir and Tank Leakage



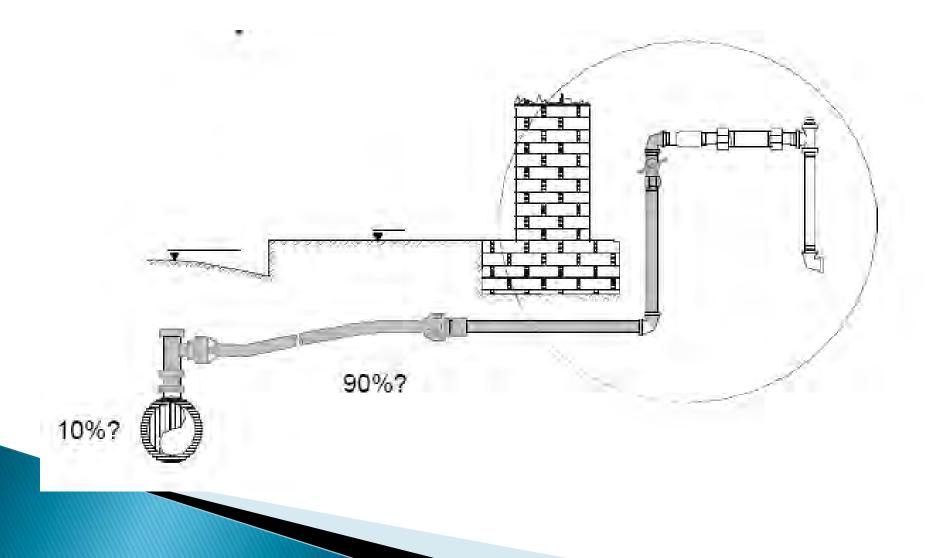








Leaks Occur at System Weak Spots



Fixing leaks has its own challenges



Component Analysis

- Validates top down results with field measurements, including:
 - Leakage losses from integrated zonal or District Metered Area (DMA) nightflows
 - Physical inspection of customer sites and meters
 - Process flowcharting of billing systems

Component Analysis Model-There are Existing Tools for the Job

surface

 Background leakage
 Un-reported leakage

 Un-reported and un-detectable
 Often does not surface but is

using traditional accoustic equipment.

Tools

- Pressure stabilization
- Pressure reduction
- Main and service replacement
- Reduction in the number of joints and fittings

Often does not surface but is detectable using traditional accoustic equipment.

Tools

- Pressure stabilization
- Pressure reduction
- Main and service replacement
- Reduction in the number of joints and fittings
- Proactive leak detection

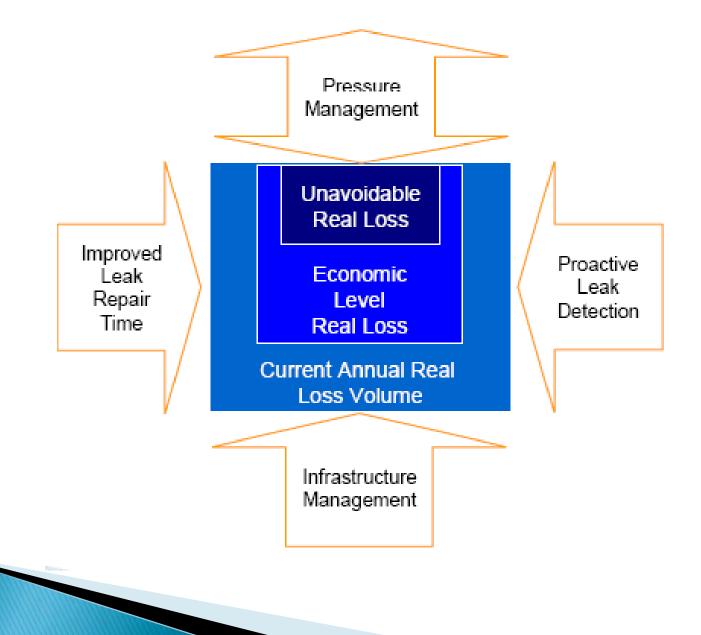
Reported leakage

Often surfaces and is reported by the public or utility workers

Tools

- Pressure stabilization
- Pressure reduction
- Main and service replacement
- Optimized repair time

Real Loss Management Tool Box



Operational Performance Indicators

Level 1 Operational PI = Real Distribution Losses in Gallons Per Service Line Per Day Per PSI of Operating Pressure

Level 3 Operational PI = <u>Annual Real Losses</u> Unavoidable Annual Real Losses (UARL)

= Infrastructure Leakage Index (ILI)

IWA Definition of Pressure Management:

- The practice of managing system pressures to the optimum levels of service- ensuring sufficient and efficient supply to legitimate uses while:
 - Reducing unwanted demands or theft
 - Eliminating transients and faulty level controls
 - Eliminating variations due to changing head loss
 - Reducing unnecessary or excess pressures

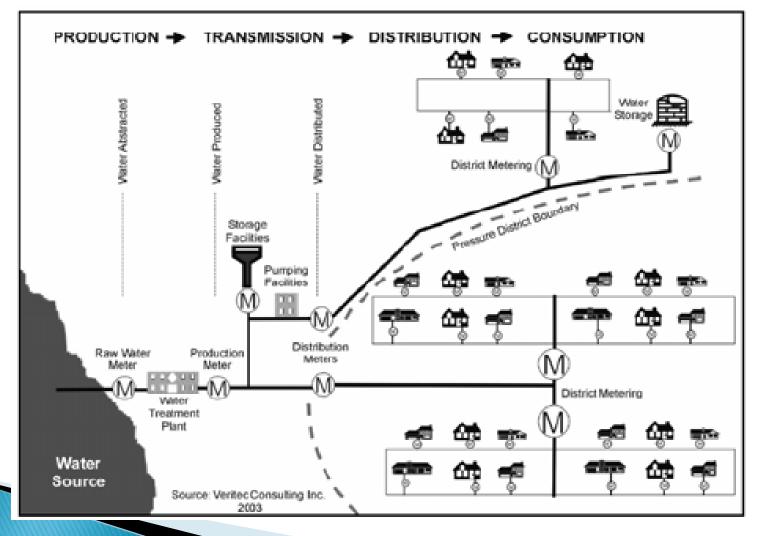
Pressure Management Tools

- Introduction of pressure-controlled areas (pressure zones)
- Fixed outlet pressure control
- Advanced flow-modulated pressure control
- Altitude and level control
- Transient control

Benefits of Pressure Management

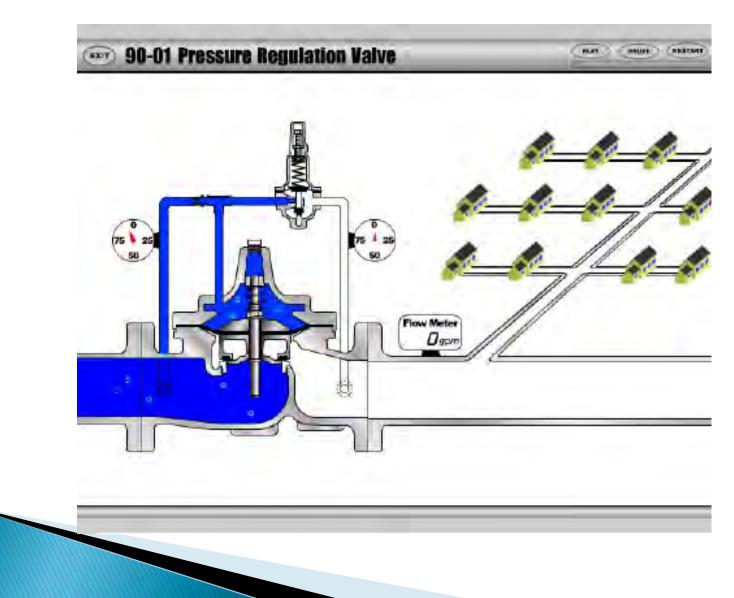
- Reduction of Real Losses
- Reduction of new leaks/breaks = extended infrastructure life
- Possible water conservation tool
- Increased energy efficiency
- Ensures minimum standards are met

Real Loss Control - District Control & Pressure Management

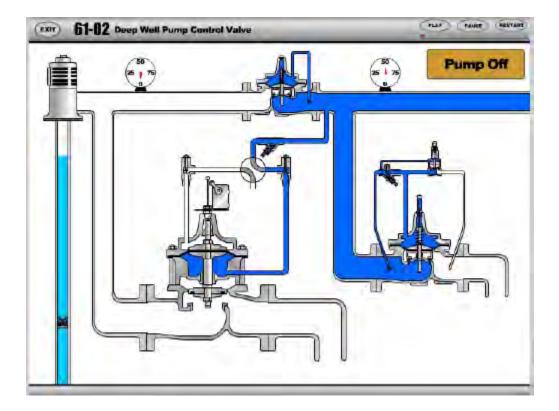


Source: Canadian Infrastructure Guide

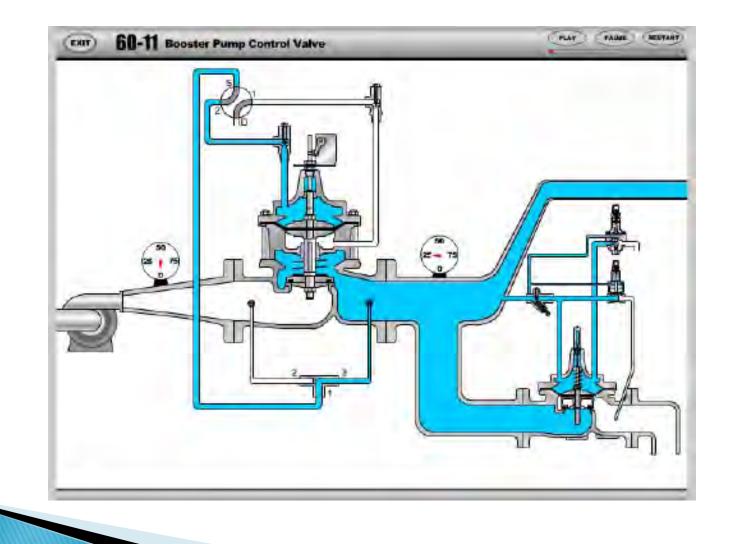
Pressure Reduction



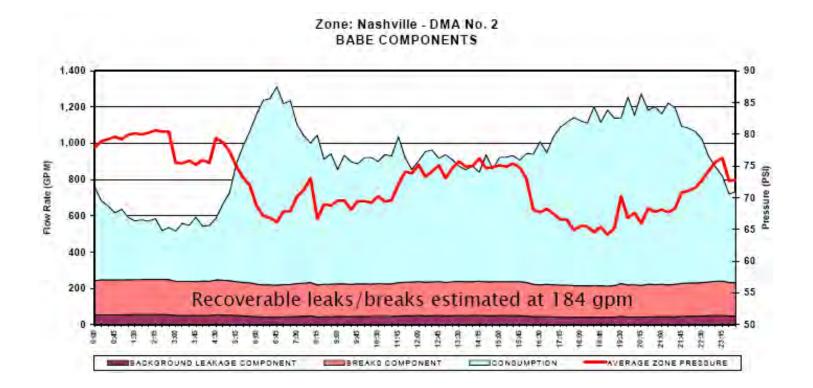
Well Pump Control



Booster Pump Control

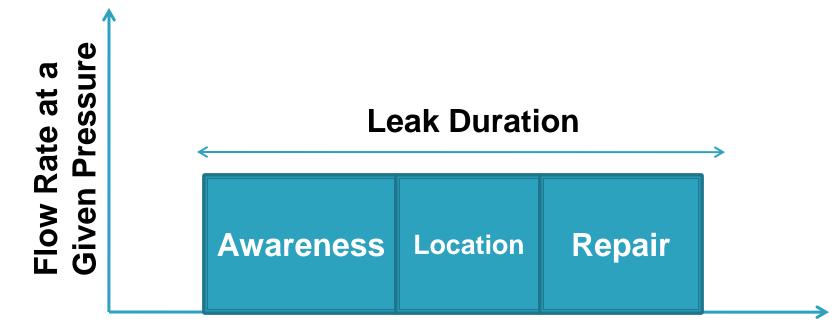


Bottom Up Measurements Before Detection and Repair



Verifies the annual data and shows immediate results for pilot interventions

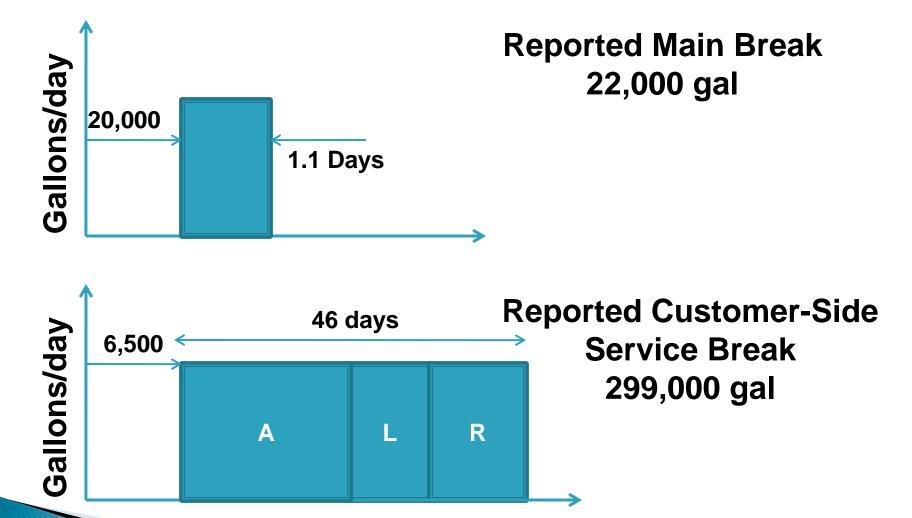
Effect of Time on Leakage Losses-ALR Concept



Time Leak Is Allowed to Run

Numerous small, hidden leaks account for the greatest overall volume of leakage losses

Leakage Losses Affected by Run Time



Leak Detection Process

Localize

- Noise logging
- Measure intensity and speed

Locate

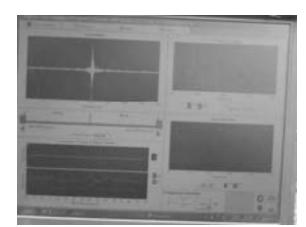
- Noise correlation
- Two or three sensors
- Measure noise arrival time

<u>Confirm</u>

- Human acoustic field confirmation

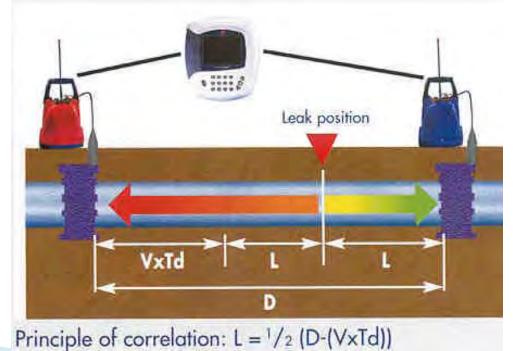
Leak Pinpointing & Repair











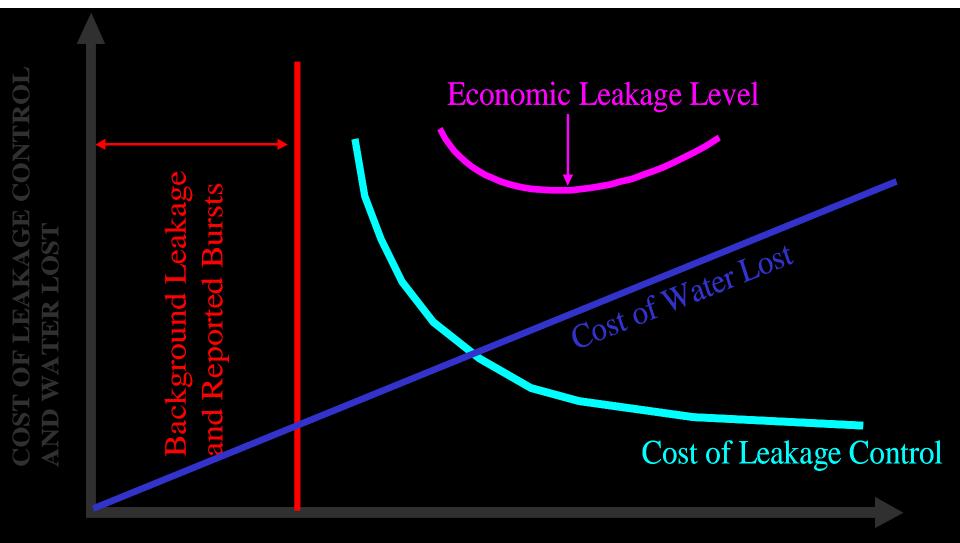
Real Loss Control: Infrastructure Management



Start with the Fastest Payback Options

- Set upset limit for annual operating expenses
- When hit, look to longer term capital investment
- Sometimes it's better to have surgery than take an aspirin
- Look at your component analysis and statistics
- Optimize value of water saved with expenses
- Make informed economic decisions

Target methods that minimize cost of leakage control and lost water



LOSSES (Ml/d)

You still need to conduct fieldwork...



..and Maintain Water Loss Reduction Strategies





Questions?

Email: sdavis@pirnie.com

Irvine Office: 949-450-7948

Appendix C

CUWCC BMP 1.2

1.2 WATER LOSS CONTROL

The goals of modern water loss control methods include both an increase in water use efficiency in the utility operations and proper economic valuation of water losses to support water loss control activities. In May 2009 the American Water Works Association (AWWA) published the 3rd Edition M36 Manual *Water Audits and Loss Control Programs.* BMP 1.2 will incorporate these new water loss management procedures and apply them in California. Agencies are expected to use the AWWA Free Water Audit Software ("AWWA Software") to complete their standard water audit and water balance.

A. Implementation

Implementation shall consist of at least the following actions:

1) Standard Water Audit and Water Balance. All agencies shall quantify their current volume of apparent and real water loss. Agencies shall complete the standard water audit and balance using the AWWA Water Loss software to determine their current volume of apparent and real water loss and the cost impact of these losses on utility operations at no less than annual intervals.

2) Validation. Agencies may use up to four years to develop a validated data set for all entries of their water audit and balance. Data validation shall follow the methods suggested by the AWWA Software to improve the accuracy of the quantities for real and apparent losses.

3) Economic Values. For purposes of this BMP, the economic value of real loss recovery is based upon the agency's avoided cost of water as calculated by the Council's adopted Avoided Cost Model or other agency model consistent with the Council's Avoided Cost Model.

4) Component Analysis. A component analysis is required at least once every four years and is defined as a means to analyze apparent and real losses and their causes by quantity and type. The goal is to identify volumes of water loss, the cause of the water loss and the value of the water loss for each component. The component analysis model then provides information needed to support the economic analysis and selection of intervention tools. An example is the Breaks and Background Estimates Model (BABE) which segregates leakage into three components: background losses, reported leaks and unreported leaks.

5) Interventions. Agencies shall reduce real losses to the extent cost-effective. Agencies are encouraged to refer to the AWWA's 3^d Edition M36 Publication, *Water Audits and Loss Control Programs* (2009) for specific methods to reduce system losses.

6) Customer Leaks. Agencies shall advise customers whenever it appears possible that leaks exist on the customer's side of the meter.

Page 2of 3 August 14, 2009

B. Implementation Schedule

1) For agencies signing the MOU prior to December 31, 2008, implementation shall commence no later than July 1, 2009.

a) July 1, 2009 through June 30, 2010 will be the first year of implementation;

b) Agencies shall provide its first full BMP 1.2 report by December 1, 2010 for years 2008-2009 and 2009-2010;

2) Agencies signing the MOU after December 31, 2008, implementation shall commence no later than July 1 of the year following the year the agency signed the MOU.

a) Agencies shall provide a full BMP 1.2 report for the first reporting period after implementation and for each reporting year thereafter.

3) A benchmark for the performance indicator in terms of water loss standards will be determined after the first 4 years data collected based upon the data reported by agencies. The performance indicator and benchmark; will be voted upon by the Council by year 6 of this revision. Ongoing data collection and data reporting requirements will be established as part of this process.

C. Coverage Requirements

1), Agencies to compile the standard water audit and balance annually using the AWWA Software. Beginning in the 2nd year of implementation agencies to test source, import, and production meters annually.

2) Agencies shall improve the data accuracy and data completeness of the standard water balance during the first four years of implementation. Agencies shall achieve a Water Audit Data Validity score of 66 or higher using the AWWA software no later than the end of the first four year period; and shall achieve data validity Level IV no later than the end of the 5th year of implementation. Estimations for data that are not directly measured should be improved using the methods outlined by the AWWA.

3) Agencies shall seek training in the AWWA water audit method and component analysis process (offered by CUWCC or AWWA) during the first four years of BMP implementation. They shall complete a component analysis of real losses by the end of the fourth year, and update this analysis no less frequently than every four years.

4) Beginning in the fifth year of implementation, through the tenth year of implementation, agencies shall demonstrate progress in water loss control performance as measured by the AWWA software real loss performance indicator "gallons per service connection per day;" "gallons per mile of mains per day;" or other appropriate indicator by one of the following:

a) Achieving a performance indicator score less than the agency's score the previous year;

b) Achieving a performance indicator score less than the average of the agency's scores for the previous three years; or

c) Achieving a performance indicator score in the top quintile (20%) of all signatory agencies reporting such performance indicator with a Data Validity Level IV; or ;

d) In year 6 and beyond reducing real losses to or below the benchmark value determined in the Council's process referenced in section B3.

5) Agencies shall repair all reported leaks and breaks to the extent cost effective. By the end of the second year, agencies shall establish and maintain a record-keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. By the end of the fourth year, agencies shall include estimated leakage volume from report to repair, and cost of repair (including pavement restoration costs and paid-out damage claims, if any).

6) Agencies shall locate and repair unreported leaks to the extent cost effective.

D. Requirements for Documenting BMP Implementation

1) Agency shall submit the completed AWWA Standard Water Audit and Water Balance worksheets in the BMP 1.2 report form every reporting period.

2) For each reporting period, agency shall keep and make available validation for any data reported.

3) Agency shall maintain in-house records of audit results, methodologies, and worksheets for each completed audit period.

4) Agency keeps records of each component analysis performed, and incorporates results into future annual standard water balances.

5) Agency, for the purpose of setting the Benchmark:

a) keeps records of intervention(s) performed, including standardized reports on leak repairs, the economic value assigned to apparent losses and to real losses, miles of system surveyed for leaks, pressure reduction undertaken for loss reduction, infrastructure rehabilitation and renewal, volumes of water saved, and costs of intervention(s); and

b) prepares a yearly summary of this information for submission to the Council, during years two through five of implementation, unless extended by the Council.

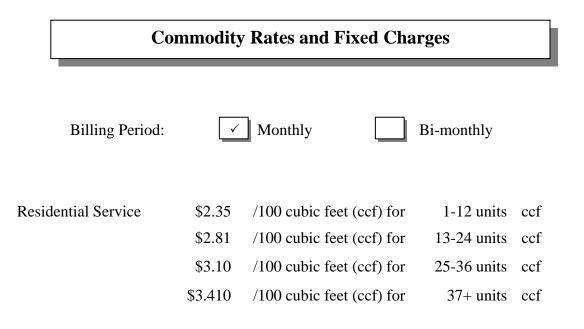
E. Water Savings Assumptions

To Be Determined

Appendix D

Retail Agency Data from OC 2009 Water Rates Report

CITY OF BREA



(See Tables 1 & 2 for more information)

The last commodity rate increase was 10/1/09; the next increase is anticipated for 7/1/10The last rate restructuring was 5/1/09; the next restructuring is anticipated for <u>unknown</u>

Brea does provide for an automatic commodity adjustment beginning July 1, 2007 when the cost of supply changes. Lifeline customers are discounted 20% from residential service rates.

Residential Fixed Charge or Customer Charge			
Meter Size	Charge	Meter Size	Charge
1/2"		3"	\$86.68
5/8"	\$5.60	4"	152.22
3/4"	5.60	5"	
1"	5.60	6"	339.45
1 1/2"	23.48	8"	601.59
2"	39.86	10"	938.63

Construction Met	Construction Meter & Fire Protection Service Charges		
Size	Fire	Construction	
2"	3.27	N/A	
3"	4.83	70.00	
4"	7.51		
6"	17.15		
8"	33.76		
10"	58.76		
12"	93.41		

General Water System Data

Population		40,176	5	
Miles of Mains (8"& larger)	166	Miles		
Annual Water Produced & Purchased	10,090.19	AF		
Less Annual Water Sales	9,712.68	AF		
Less Internal Uses (flushing, cleaning, irrigation, etc.)	100	AF		
Equals Unaccounted for Water	277.51	AF	3	% UAW
Peak Month Use Last Fiscal Year	1,096,79	AF in	Sept	2009
Average Single-family Residential Use (monthly)		15.8 c	cf	

Sources:

Local SurfaceMet40 % Wells60 % Runoff% Recycled%

(See Tables 3, 4 & 5 for more information)



All water meters 1 1/2" and larger are tested and calibrated every two years (no cf limit). They are repaired or replaced in house. All residential meters are replaced every 15—20 years regardless of cf used.

City Statement

5

CITY OF BREA ·

Financial Information

Source of Fu	Source of Funds 2008-09	
	Amount	Percent
Collected from Rate Payers (monthly or bi-monthly water bills)	\$10,344,409	90%
Other Operating Revenues	356,282	3%
Investment Income	175,626	2%
Property Taxes	0	0%
Capital Reserve Fund	679,538	5%
Total Source of Funds	\$11,555,855	100%

Use of Funds 2008-09

	Amount	Percent
Source of Supply	\$5,782,843	50%
Pumping	350,122	3%
Treatment	0	0%
Transmission & Distribution	1,621,337	14%
Customer Accounts	0	0%
Administrative	836,588	7%
Principal & Interest (all obligations)	1,342,884	12%
Capital Improvements funded by non-debt	1,212,081	10%
Other	0	0%
Transfers to City General Fund	411,000	4%
Total Use of Funds	\$11,556,855	100%
Net Source and Use of Funds	(\$1,000)	

Contact Person:

Ron Krause and Bill Gallardo Phone: 714/671-4418

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CITY OF HUNTINGTON BEACH

Commodity Rates and Fixed Charges		
Billing Period:	Monthly Bi-monthly	
Residential Service	<u>\$1.7047</u> /100 cubic feet (ccf) for <u>all</u> ccf	
(Se	e Tables 1 & 2 for more information)	

The last commodity rate increase was 10/09; the next increase is anticipated for 10/10The last rate restructuring was 10/99; the next restructuring is anticipated for 10/10

Huntington Beach provides for an automatic commodity adjustment when the cost of supply changes.

Meter Size	Charge	Meter Size	Charge
3⁄4"	\$10.70	4" FM	\$353.31
1"	21.41	6" compound	353.31
1-1/2"	32.12	6" FM	717.13
2"	53.53	8" FM	1,252.65
3"	117.77	10" FM	1,959.27
l"compound	182.01		

CITY OF HUNTINGTON BEACH

Construction	Construction Meter & Fire Protection Service Charges		
Size	Fire	Construction	
2"	\$10.00	N/A	
3"	N/A	\$70.00	
4"	20.00	70.00	
6"	30.00	70.00	
8"	40.00	N/A	
10"	50.00	N/A	
12"	60.00	N/A	

General Water System Data

Population		203,49	0	
Miles of Mains (8"& larger)	376	Miles		
Annual Water Produced & Purchased	31,630	AF		
Less Annual Water Sales	29,937	AF		
Less Internal Uses (flushing, cleaning, irrigation, etc.)	39	AF		
Equals Unaccounted for Water	1,655	AF	5.2	% UAW
Peak Month Use Last Fiscal Year	3,192	AF in .	July	2008
Average Single-family Residential Use (monthly)		12 cc	f	

Sources:

 Local Surface

 Met 30.9 % Wells 69.1 % Runoff 0 % Recycled 0 %

(See Tables 3, 4 & 5 for more information)

Meter Maintenance Program

Huntington Beach replaces 3/4" and 1" residential meters every 15 years, with the exception of high consumption meters. 1 1/2" and 2" positive displacement meters are replaced by consumption and age of meter. 2" through 10" compound and Class II meters are overhauled on a maintenance program using a factor of consumption at last overhaul date.

Mission Statement

Please see http://surfcity-hg.org/HBWeb/CityDepartments/PublicWorks/WaterOperations/

CITY OF HUNTINGTON BEACH

Financial Information

Source of Funds 2008-09

	Amount	Percent
Collected from Rate Payers (monthly or bi-monthly water bills)	\$33,992,688	95.20%
Other Operating Revenues	0	0%
Investment Income	1,135,613	3.18%
Property Taxes		0%
Other	\$580,124	1.62%
Total Source of Funds	\$35,708,425	100%

Use of Funds 2008-09

	Amount	Percent
Source of Supply	\$10,459,827	29.29%
Pumping	2,368,782	6.63%
Treatment	697,627	1.95%
Transmission & Distribution	3,051,197	8.54%
Customer Accounts	1,865,396	5.22%
Administrative	4,912,109	13.76%
Principal & Interest (all obligations)	-0-	0%
Capital Improvements funded by non-debt	1,755,239	4.92%
Other (Equipment Replacement)	1,343,651	3.76%
Transfers to City General Fund	4,388,808	12.29%
Reserves (set aside)	4,865,789	13.63%
Total Use of Funds	\$35,708,425	100%
Net Source and Use of Funds	\$ 0	

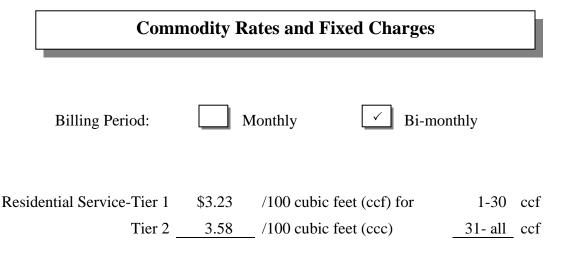
Please note: these figure are pre-audit. Fiscal year was 10/1/08 to 9/30/09. Contact Person:

Ken Dills

Phone: 714/375-5055



LAGUNA BEACH COUNTY WATER DISTRICT



(See Tables 1 & 2 for more information)

The last commodity rate increase was 07/01/09; the next increase is anticipated for 07/01/10The last rate restructuring was 07/01/09; the next restructuring is anticipated for 07/01/10

LBCWD does not provide for an automatic commodity adjustment when the cost of supply changes.

Residential Fixed Charge or Customer Charge			
Meter Size	Charge	Meter Size	Charge
1/2"		3"	\$363.06
5/8"		4"	567.28
3/4"	\$22.69	5"	
1"	56.73	6"	
1 1/2"	113.46	8"	
2"	181.53	10"	

LAGUNA BEACH COUNTY WATER DISTRICT

Augnstruction	Augnstruction Meter & Fire Protection Service Charges		
Size	Fire	Construction	
2"		N/A	
3"	N/A	\$324.00	
4"	\$16.00		
6"	24.00		
8"	32.00		
10"	40.00		

General Water System Data

Population		20,530)	
Miles of Mains (8"& larger)	132	Miles		
Annual Water Produced & Purchased	3,826	AF		
Less Annual Water Sales	3,812	AF		
Less Internal Uses (flushing, cleaning, irrigation, etc.)	7	AF		
Equals Unaccounted for Water	7	AF	0	% UAW
Peak Month Use Last Fiscal Year	432	AF in A	Aug.	. 08
Average Single-family Residential Use (monthly)		15ccf		

Sources:

Local SurfaceMet 100 % Wells% Runoff% Recycled%

(See Tables 3, 4 & 5 for more information)

Meter Maintenance Program

Laguna Beach CWD replaces meters every 20 years and maintains meter boxes every 3 years.

Mission Statement

Laguna Beach County Water District was formed in 1925 to supplement the community's existing groundwater supplies. Currently, the District relies on 100% imported supplies. The District's mission is to continue to bring reliable sources of water to the community. Since 2004, the District has been providing contract water services to the community of Emerald Bay.

LAGUNA BEACH COUNTY WATER DISTRICT

Financial Information

Source of Fu	Source of Funds 2008-09	
	Amount	Percent
Collected from Rate Payers (monthly or bi-monthly water bills)	\$6,775,685	67%
Other Operating Revenues	139,881	1%
Investment Income	1,148,863	11%
Property Taxes	2,045,421	20%
Other	97,104	1%
Total Source of Funds	\$10,206,954	100%

Use of Funds 2008-09

	Amount	Percent
Source of Supply	\$2,635,931	27%
Pumping	411,522	4%
Treatment		0%
Transmission & Distribution	1,967,677	20%
Customer Accounts	294,649	3%
Administrative	2,236,739	23%
Principal & Interest (all obligations)	-0-	0%
Capital Improvements funded by non-debt	2,166,396	22%
Other	150,518	1%
Transfers to City General Fund		0%
Total Use of Funds	\$9,863,432	100%
Net Source and Use of Funds	\$343,522	

Contact Person:

Bob Westphal Phone: 949/494-1041

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MOULTON NIGUEL WATER DISTRICT

Co	Commodity Rates and Fixed Charges			
Billing Period:	 ✓ 	Monthly	Bi-month	ıly
Residential Service	\$1.00	/100 cubic	c feet (ccf) for first	<u>10</u> ccf
	1.12	up to		<u>20</u> ccf
	1.35	up to		<u>30</u> ccf
	1.58	up to		50 ccf
	1.70	for all hig	her ccfs	
(See Tables 1	& 2 for more	information)	
The last commodity rate increa	ase was <u>06/0</u>	09 ; the r	next increase is anticip	pated for <u>6/10</u>

The last rate restructuring was 10/05; the next restructuring is anticipated for N/A

MNWD does not provide for an automatic commodity adjustment when the cost of supply changes.

Residential Fixed Charge or Customer Charge			
Meter Size	Charge	Meter Size	Charge
1/2"	N/A	3"	\$30.91
5/8"	\$7.67	4"	42.53
3/4"	7.67	5"	N/A
1"	7.67	6"	65.77
1 1/2"	13.48	8"	89.01
2"	22.78	10"	112.25

MOULTON NIGUEL WATER DISTRICT_

Size	Fire	Construction
2"	\$ 9.30	N/A
3"	13.95	58.10
4"	18.60	N/A
6"	27.90	N/A
8"	37.20	N/A
10"	46.50	N/A
12"	55.80	N/A

General Water System Data

Population	166,988
Miles of Mains (8"& larger)	740 Miles
Annual Water Produced & Purchased	41,189 AF
Less Annual Water Sales	38,123 AF
Less Internal Uses (flushing, cleaning, irrigation, etc.)	1,345 AF
Equals Unaccounted for Water	1,721 AF 4.2 % UAW
Peak Month Use Last Fiscal Year	3,596 AF in July 2009
Average Single-family Residential Use (monthly)	18 ccf

Sources:

 Local Surface

 Met
 81
 %
 Wells
 %
 Runoff
 %
 Recycled
 19
 %

(See Tables 3, 4 & 5 for more information)

Meter Maintenance Program

Residential meters are replaced every 15-20 years. At Moulton Niguel Water District, residential meters are read on a monthly basis and commercial meters are read bi-monthly. Zero or low usage is checked at the time the meter is read. If a problem appears, then a service order is completed for the meter maintenance crew. Commercial meters are tested every year and residential meters are tested every 3-5 years.

Mission Statement

Moulton Niguel Water District is a community-oriented agency dedicated to serving its customers and the environment with reliable, economical, high-quality water and sewer service. Please visit www.mnwd.com



MOULTON NIGUEL WATER DISTRICT

Financial Information

Source of Funds 2008-09									
Amount Percent									
Collected from Rate Payers (monthly or bi-monthly water bills)	\$23,828,842	58%							
Other Operating Revenues	220,105	1%							
Investment Income	2,506,823	6%							
Property Taxes	13,701,666	33%							
Other	1,109,347	3%							
Total Source of Funds\$41,366,783100									

Use of Funds 2008-09

	Amount	Percent
Source of Supply	\$20,560,501	40%
Pumping	273,876	1%
Treatment		
Transmission & Distribution	3,277,410	6%
Customer Accounts	351,151	1%
Administrative	8,887,430	17%
Principal & Interest (all obligations)	11,291,225	22%
Capital Improvements funded by non-debt	6,147,623	12%
Other	0	0%
		0%
Total Use of Funds	\$50,789,216	100%
Net Source and Use of Funds	(\$9,422,433)	

Contact Person:

Nancy Desai Phone: 949/448-4023

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CITY OF TUSTIN

С	Commodity Rates and Fixed Charges											
Billing Period:		onthly Si-month	ly									
Residential Service	\$0.49	/100 cubic feet (ccf) for first	12	ccf								
	1.56	/ccf up to	40	ccf								
	1.67	/ccf up to	60	ccf								
	1.84	/ccf for all higher 60 ccfs	60	ccf								
Construction Service	Same as above	/ccf										

(See Tables 1 & 2 for more information)

Tustin does not provide for an automatic commodity adjustment when the wholesale cost of supplies (imported and groundwater) changes.

Residential Fixed Charge or Customer Charge								
Meter Size	Charge	Meter Size	Charge					
1/2"	\$22.26	3"	333.95					
5/8"	22.26	4"	556.98					
3/4"	22.26	5"						
1"	55.56	6"	1,113.16					
1 1/2"	111.32	8"	1,113.16					
2"	178.11	10"	1,113.16					

CITY OF TUSTIN

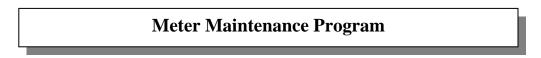
Constru	Construction Meter & Fire Protection Service Charges										
Size	Fire	Construction									
2"		N/A									
3"		\$3.00 per day plus \$700 dep.									
4"	\$70.42										
6"	\$107.04										

General Water System Data								
Population	67,706							
Miles of Mains (8"& larger)	69 Miles							
Annual Water Produced & Purchased	12,484 AF							
Less Annual Water Sales	12,117 AF							
Less Internal Uses (flushing, cleaning, irrigation, etc.)	415 AF							
Equals Unaccounted for Water	457 AF 3.5 % UAW							
Peak Month Use Last Fiscal Year	1,400 AF in Aug 2008							
Average Single-family Residential Use (monthly)	25.5 ccf							

Sources:

				Local Surface			
Met	36 %	Wells	64 %	Runoff	%	Recycled	%

(See Tables 3, 4 & 5 for more information)



Tustin maintains meters on a regular program designed to replace every residential meter within 15 years. Bad meters are replaced on an as-needed basis as determined by staff..

City Statement

Tustin is responding to new demands for additional consumption and adequate fire protection by construction of two new wells, the rehabilitation/expansion of two aging reservoirs and continuing with its "main line" replacement program.

CITY OF TUSTIN

Financial Information

Source of Funds 2008-09									
Amount Percent									
Collected from Rate Payers (monthly or bi-monthly water bills)	11,023,968	97%							
Other Operating Revenues	257,674	.2%							
Investment Income	142,363	2.6%							
Property Taxes	-0-	0%							
Other	2,283,373	.1%							
Total Source of Funds	\$13,707,378	100%							

Use of Funds 2008-09

	Amount	Percent
Source of Supply: RA, Met	\$2,495,178	19%
Pumping: Wells & booster pump stations	2,156,029	14%
Treatment	2,673,347	32%
Transmission & Distribution	1,593,553	5.7%
Customer Accounts	43,666	.8%
Administrative	1,090,159	4%
Principal & Interest (all obligations)	1,065,315	4.7%
Capital Improvements funded by non-debt	1,734,292	10%
Other	2,200	0%
Transfers to City General Fund	1,042,000	10%
Total Use of Funds	\$13,895,739	100%
Net Source and Use of Funds	(\$188,361)	

Contact Person: Phone: Larry Schutz 714/573-3062



Appendix E

Utility Audits Using AWWA WLCC Software

er Loss Control Committee (WLCC) Free Water Audit Software v4.0 Copyright©2009. American Water Works Association. All Rights Reserved.	PURPOSE: This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.	USE: The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons on the left below. Descriptions of each sheet are also given below.	LIES THROUGHOUTT: Value can be entered by user Value calculated based on input data	Please herin hy providing the following information than proceed through such short in the providing the following information then proceed through such short in the provided.	TTY: City of Brea	EAR: 2007 START DATE (MM/YYYY): 07/2006 END DATE (MM/YYYY): 06/2007	CONTACT PERSON: Ron Krause E-MAIL: Conkr@cityofbrea.net TELEPHONE: 714-990-7642	ED REPORTING UNITS FOR WATER VOLUME: Acre-feet	heet Click here: 2 for help about units and conversions	The current sheet	Enter the required data on this worksheet to calculate the water balance	The values entered in the Reporting Worksheet are used to populate the water balance	Depending on the confidence of audit inputs, a grading is assigned to the audit score	Diagrams depicting possible customer service connection configurations	Use this sheet to understand terms used in the audit process	Use this sheet to interpret the results of the audit validity score and performance indicators	Comments: Prepared by Malcolm Pirnie, Inc.		If you have questions or comments regarding the software please contact us at: wc@awwa.org
AWWA Water	<u>PURPOSE:</u> This spr distribution systems for	USE: The spreadsheet or by clicking the bu	THE FOLLOWING KEY APPLIES THROUGHOUT:	Please herin hv nrovi	NAME OF CITY OR UTILITY: City	REPORTING YEAR:	NAME OF CONTACT PER	PLEASE SELECT PREFERRED REPORTING UNITS	Click to advance to sheet.	Instructions	Reporting Worksheet	Water Balance	Grading Matrix	Service Connections	Definitions	Loss Control Planning	Comme	Add comments here to track additional supporting information, sources or names of participants	

Instructions 1

AWWA WLCC Free Water Audit So Copyright © 2009, American Water Works Asso			g Worksheet		Back to Instructions					
				WASs4.0						
Click to access definition Reporting Year:	2007	7/2006 - 6/2007								
Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (1-10) using the drop-down (ist to the left of the input cell. Hover the mouse over the cell to obtain a description of the crades										
All volumes to be entered as: ACRE-FEET PER YEAR										
WATER SUPPLIED		Enter grading in		2.4.23						
Volume from own sources: Master meter error adjustment (enter positive value):	2 10 6	7,356.000	acre-ft/yr under-registered	acre-	ft/vt					
Water imported: Water exported:	10		acre-ft/yr acre-ft/yr							
MATER SUPPLIED:		12,370.000	and the second second second							
AUTHORIZED CONSUMPTION	CHE AN				Click here:					
Billed metered: Billed unmetered:	2 10 7 10	11,174.000	The state of the second s		for help using option buttons below					
Unbilled metered:	10	281.760	acre-ft/yr acre-ft/yr	Pont:	Value:					
Unbilled unmetered: Default option selected for Unbilled unmeter			acre-ft/yr		0					
AUTEORIEED CONSUMPTION:		11,610.385		L	Use buttons to select					
		Marine Holes		pe	rcentage of water supplied					
MATER LOSSES (Mater Supplied - Authorized Consumption)		759.615	acre-ft/yr		value —					
Apparent Logget Unauthorized consumption:		20.025		Pent:	Value:					
Default option selected for unauthorized consumption:	on - a grad		acre-ft/yr lied but not displ							
Customer metering inaccuracies:	10	57.567	acre-ft/yr		0					
Systematic data handling errors:	2 10	1.000	acre-ft/yr		Choose this option to					
Apparent Losses:	2	89.492			enter a percentage of billed metered					
Real Losses				?	consumption. This is NOT a default value					
Real Losses = Water Losses - Apparent Losses:	2	670.123	acre-ft/yr							
MATER LOSSES:		759.615	acre-ft/yr		I HARRISON OF THE REAL PROPERTY OF THE REAL PROPERT					
NON-REVENUE WATER NON-REVENUE WATER:		1,196.000	acre-ft/yr							
= Total Water Loss + Unbilled Metered + Unbilled Unmetered				and the second						
SYSTEM DATA Length of mains:	2 10	162.0								
Number of active AND inactive service connections:	10	11,753	miles							
Connection density: <u>Average</u> length of customer service line:	2 10	73			curbstop and customer					
Average operating pressure:	10	63.0		er or property bo	undary)					
		The Local State		A PART						
COST DATA										
Total annual cost of operating water system: Customer retail unit cost (applied to Apparent Losses);	2 10 2 10	\$3,330,096	\$/Year \$/100 cubic feet	(acf)	State And the sea					
Variable production cost (applied to Real Losses):	10		\$/acre-ft/yr	(221)						
PERFORMANCE INDICATORS					and the second section of the					
Pinancial Indicators										
Non-revenue water as percent by with the second by with the second by th			9.1							
Annual	cost of A	pparent Losses:	\$69,3	89						
Ann Operational Efficiency Indicators	nual cost	of Real Losses:	\$320,6	54						
Apparent Losses per sei	rvice conn	ection per day:	6.1	80 gallons/conn	ection/day					
Real Losses per ser		R. C. Starten		90 gallons/conn	The state of the state of the					
		main per day*:	Contraction of the second second	/A						
Real Losses per service connection p	per day pe	r psi pressure:		81 gallons/conn	ection/day/psi					
the second se		Losses (UARL) :	and the second se	69 million gall						
[7] Infrastructure Leakage Index	(TLT) [Pos	Loggos (IINEL)		-						
* only the most applicable of these two indicators will be cal			3.	00						
WATER AUDIT DATA VALIDITY SCORE:										
*** YOUR SC	ORE TS	• 93 out of	100 ***	Assault attend						
A weighted scale for the components of consumption and w				Water Audit Pa	ta Validity Score					
PRIORITY AREAS FOR ATTENTION:			ourourorion or che	HALOI AUGIC Da	a valuery score					
Based on the information provided, audit accuracy can i	be improve	d by addressing	the following com	onents:						
1: Master meter error adjustment	and the			2						
2: Unsuthorized consumption	For	more information, o	lick here to see the Gra	nding Matrix wor	ksheet					
3: Unbliled unmetered	Land Street	A States	- Store State	- it Novers						

AWWA WLCC F	ree Water Au	idit Softwar	AWWA WLCC Free Water Audit Software: <u>Water Balance</u>	Water Audit Report For:	Report Yr:
	Copyright © 2009, American Water Works Association. All Rights Reserved.	a Water Works Association	. All Rights Reserved. WAS v4.0	City of Brea	2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 11,174.000	Revenue Water
Own Sources (Adjusted for		Authorized Consumption	11,174.000	Billed Unmetered Consumption 0.000	11,174.000
known errors)		11,610.385	Unbilled Authorized Consumption	Unbilled Metered Consumption 281.760	Non-Revenue Water (NRW)
7,466.000			436.385	Unbilled Unmetered Consumption 154.625	
	Water Supplied		Apparent Losses	Unauthorized Consumption 30.925	1,196.000
	12, 370.000		89.492	Customer Metering Inaccuracies 57.567	
		Water Losses		Systematic Data Handling Errors 1.000	
Water Imported		759.615	Real Losses	Leakage on Transmission and/or Distribution Mains Not broken down	
4,904.000			670.123	Leakage and Overflows at Utility's Storage Tanks Not broken down	
				Leakage on Service Connections Not broken down	

Water Balance 3

Back to Instructions	i audit component and n in red		10	100% of water production sources are metered, meter accuracy are metered, meter accuracy and executed are accuracy conducted semi-annually, with less than 10% found outside of 4/. 3% eccuracy	to maintain 10° Standardoz meter accuracy test frequency to an mainnau, or more frequency to rait meinna. Repair or replace metere outside of 4° 5% accuracy metering technology	Computed rack system (SCAD) A or similar) automatically balances similar) automatically balances actorages; results reviewed (abi), wass balance technique ormonares production metricata to raw (untreated) water and to raw (untreated) water and to raw (untreated) water and thereines to rack and sources between SCAD and sources meters ensures minimal data transfer error.	to matching 12: Merritor mails movembers for development of movembers for development of movembers deserved seconreads Continue to register or material accuracy arritor	LOO% of imported water sources an metanor, inder accuracy testing and/or electronic calibration conducted semi- amually, with isst than 10% found outside of 4.4 % accuracy found outside of 4.4 % accuracy	to maintain 10 Standardian meter accuracy test frequency to semi-annual, or mon frequent, for all meters. Repair or mpace meters outside of
	i to each ems show		8	Conditions between 6 end 10	enting for all cutation of +/- w meter placements t to improve	Conditions between 8 and 10	age facility taory Control m. or similar pretern, and g algorithm SCADA and	Conditions between 8 and 10	esting for all activitie of 4- activitie of 4- accoments to improve
ULASV 4.0	ting Worksheet, grades were assigned to each component of the audit to describe the confidence and accuracy of the input data. The grading assigned to each audit of the corresponding recommended improvements and actions are highlighted in yellow. Mudit accuracy is likely to be improved by prioritizing those items shown in red		8	100% of water supply sources are metered, meter ecouracy testing and electronic cultration conducted annually, less than 10% of meters are found outside of 4/ 6% accuracy	In outsith / In 10, Maintain armaal meter accuracy testing for all meters. Report or repiston meters outside of 4- de accuracy, investigatin move meters technology, plat one or more replacements with innovative meters in attempt to improve meter accuracy.	Continuous production meter data logged automataly & neweed daity. Deta adjusted to correct gross arror fron equipment arraituration is results of meter accuracy testing. Tanktorage accuracy testing. Tanktorage accuracity elesting. Tanktorage automatically used in Volume from own sources* tabulations.	In country from the country for 10: Link all production and trankforming famility interaction chance of standard stanking control a Data Acquatition (SCUA) System, or timitar a comparisation monthromybound system, and and regularity cultificate between SCUA and not regularity cultificate between SCUA and not regularity cultificate between SCUA and	100% of imported weter sources are metered, mater sources testing and/or electronic calibration conducted enrurally, less than (0% of meters are found outside of ≁/ 6% eccuracy	In the second se
	but data oved by		7	Conditions between 6 and 6	al new, or al new, or or that entire ered. Repair & accuracy.	Conditions between 8 and 8	ation pe facilities. change in rom own uction meter y confirmed	Conditions between 8 and 8	r replace d wather all meter dat meter di vi- 6%
<u>Matrix</u> ^{Reserved}	nd accuracy of the input		8	At least 75% of water production sources are metered, grei teast good, of the acures flow is derived from metered cources. Meter from metered cources a Meter accuracy testing and/or electronic calibration concluded meter Less than 25% of tested meter are found outside of 4/ 6%	to quality for 8. Conduct annual melan comparison of the second melan one, or metano distribution and antime and an antime production metars population is measured. Regart or replace during outside of +-0% accumey.	Hourly production meter data logged automatically is reviewed on at leasts weakly basis. Data adjusted to corried gross error adjusted to corried gross error trom equipment mathematical error corriented by neter accuracy testing. Tankstorega and balanced "Volume from own automatically used in calculating balanced "Volume from own automatically used in calculating balanced "Volume from own	In autality for 8. Complete installation of elevation instrumentation on all anticologic facilities. Continue to use daty net storage transge in calculating publicred Vutum from own sources' component. Adjust production metric data for gross error and inaccuracy continued by leading.	At least 75% of imported water sources the meaterum, meter accuracy treating and/or electronic calibration conducted at minually. Lass than 25% of treated meters are found outside of 4/ 6% eccuracy	bradith for discovery the second sec
ading n All Rights I	idence ar accuracy		9	Conditions between 4 and 6		Conditions between 4 and 6	the for groes Begin to interrepe a. Use daily flows in clume.	Conditions between 4 and 8	setting for all stallarition of twatter to the
Water Audit Software: <u>Grading Matrix</u> Copyright©2009 Amencan Waler Works Association All Aughts Reserved.	to describe the conf ted in yellow. Audit	Grading	4	50% - 75% of water production Sources an enserved, other sources ssiftneted. Occasional meter accuracy testing	In <u>charter</u> in <u>the cuality for B</u> . Formatize annual mole water and the statistics of maters between methors. Complete instatistics of maters on trimmistioned water production sources and complete reprincement of all obsolution/beforective methods.	Production mater data is logged automatically in electronic format and reviewed at least on a monthy basis. Volume from own sources" tabulations include estimate of dath changes in tankstrong feolities. Mere data is adjusted vitwe gross data errors occur, or occassional meter resting deams this necessary.	Roview hourly production means data for gross error on, at least, a weekly back. Begin to triatal fortunentation on the wateknaps actilies to mourd elevation changes. Use data not storage attrings to balance flows in calculating Water Suppled" volume.	50% - 75% of imported water sources a tre metered, other sources estimated. Occasional meter accuracy testing	Romatos amulto foc 6: Formatos amual meter acourary testing for al imported water meser. Contraine institution of importes on unmeter acourary water interconnections and representant of obsertabilitieches meters.
ər Audit Copyngat © 2009.	he audit highligh		8	Conditions between 2 and 4	as on maps y leating for meters on motors and meters	Conditions between 2 and 4	prment on alstorage y volume of m, "Water ranges in	Conditions between 2 and 4	
AWWA WLCC Free Water	In the Reporting Worksheet, grades were assigned to each component of the audit to describe the confidence and accuracy of the input data. the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by p		2	25% - 50% of water production sources as matered, to regular sources estimated. No regular meter accuracy testing.	In 2 subtrivition of the second secon	No automatic datalogging of production vultumes; deliy readings are sorthed on paper records. Tark/storage elevation records. Tark/storage elevation records. Tark/storage elevation records. Tark/storage elevation records. Tark/storage elevation records. Tark/storage elevation elevated corporent. Data is solucist only when grossly evident data error occurs.	Bo guality loc 3: Interial automatic datalegging equipment on production meters. Identity entrantorage sectimes and chacke estimated daily vortime da restare addred to, or automated from. Vetane Supplied volume based upon changes in storage	25% - 50% of Imported water sources are melered, other sources estimated. No regular meter accuracy tasting	<u>To autility for 4:</u> Locate all imported water sources on mape and in fauld, transh means courters for the pro- cetating metor, heap, to install means on unmeaned imported water interconnections and replace decontactive means
AWWA W	ades were assigned (recommended improve		-	Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing	to quality tor 2. Organiza efforts to begin to collect data for elemening volume from own sources	Inventory information on maters and paper records of mesured volumes in crude condition, data error cannol be determined	to conditiv for 2. Develop part to restructure recordinging agreem to capture there data, est procedure to there data, data to detect input errore	Less than 25% of imported water sources are melered, remaining sources are estimated. No regular meter accuracy testing.	In cutify (1), 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
	Worksheet, gri orresponding		n/a	Select this grading only if the water utility purchases/imports and its water real of its water resources (i.e. has no sources of its own)		Select rule only if Select rule only if to have meters on its sources of supply, either its own source, and/or imported (purchased) water sources		Select n/a if the water utility's supply is axxiushely from its own water resources (no buik purchased/ imported water)	
	In the Reporting 1 the c			Volume from own sources:	Improvements to attain higher data greating for Yokume from own Sources' component.	Manter meler error adjuntment:	Improvements to attach higher data grading to "Master melan error sajuatment" component.	Water Imported:	Improvements to stateh higher data grading for Water Imported Volume" component.

-	A REAL PROPERTY AND A REAL		Parent of			and the second s						
	10 100% of esponde water sources are redined. melor excuracy testing and/or electronic calibration conducted somi- annusity, with less than 10% found outside of 4/ 5% acouracy	Io maintain 10: Sandandan mene accuracy least requency to semi-aronual, or more inqueur (for all mellens. Repair or replace meters outside of +4. 3% accuracy. Continually investigata/plot improving metering technology		A least 89% of customers with volume-based billing from meter reads. At least 65% customers with reads. At least 65% customers infurman 80% meter reading success rate, or minimum 80% meter reading success rate. Wh Autometer Meter Reading (AMRT) trials underwey. Statetically trials and replacement program in place detailed auditing, with routing, detailed auditing, including field investigation of representative sample of accounts. Amutal audit weliferation by third party.	Io maintain LO: Pegular internation and third party auditing, and mater accuracy testing ensures that accurate customer meter relating and customer meter relating an customer meter relating and bareast of innormation Advanced Melleng innotantion (AMI) and information management. Poly testified upgrades in melengi, meter relating and biling data meter relating and biling data	Water utility policy, nequines metering, and volume based billing for all customer accounts. Lass unmained and ossist bacause unmerine installancies. The goal unusual circumstances. The goal easts to minimize the number of the til seconding to the adent the specific estimation methods.						
	Conditions between 8 and t0	ting for all tisle of +/ meter ocements improve		Conditions between B and to	methered Reading reading anning planning with order order hind perfy	Conditions between 8 and 10						
	8 100% of exported water sources are mettered, metter accuracy resting and/or electronic calibration conducted amually less than 10% or maters are found outside of 4/ 6% accuracy	<u>In classific for 10.</u> Matheman annual median accuracy testing for all metars. Respanse metars cutation of 4- 6% accuracy. Investigate new metar Bechnology; and con or means in attimute to ingrove with innovative metars in attimute to ingrove metar accuracy.		At least 97% of customers with works. At least 90% customers with reads. At least 90% customer reads. At least 90% customer metter read success rate with planning and success rate with planning and success rate and success rate that of Automatic Melaning Faading (AMF) in one or more plaid areas. Good customer meter results of suppleter meter accuracy results of computerized billing records for guides replacement of attratistical y significant number of meters each year. Yeadine auditing of computerized billing records for guide mode and detailed statistics, writind pendy.	<u>Boundary</u> (Boundary Mar. 10: Purthanas and Install metatras on unmediered accounts. Lutants Automatars on unmediered (AMT) system traits if metual metatra meating (AMT) system traits if metual metatra (AMT) system traits if metual metatra (AMT) system traits if metual (AMT) system traits if and (AMT) sys	Water utility policy requires netring and overme based billing for all customer based billing that all customer based billing Metaling a prevalent in the acting barbe and and billed accounts mean circumstances. The goal is to minimize the number of circumstances. The goal is to minimize the number of circumstances of accounts with a site specific estimation methods.						
ŀ	7 Conditions between 6 and 6	replace water il moter if +/- 6%		Conditions between 6 and 8	mitmed ess of anam for anam for anamon y bashing a based radia to party	Conditions between 6 and 8						
a	A laast 75% of exported water At laast 75% of exported water accures its mathered, mele escures its and/or electronic Lass than 25% of tested meters are found outside of 4. 5%	lo quality lot 8. Compares project to transmoment on w. or replace defective, melear on all seponds vester interconnections. Maintain annual melea interconnections. Maintain annual melea excurso y setting or all imposed water melean Repet or replace meliare outside of 4/ 6%.		At least 90% of customers with volume-based billing from make reacts, manufalling promits are estimated. Manual customer estimated. Manual customer estimated. Manual customer outborner meler reacting puccess fambed reacts are estimated. Jacquar reglacement of oldest meters. Computerized billing rescords with routine autiting of global statistics.	In cumfitr Vice E. Purchase and install meters on unmetered socourts. Means one defortencemens of Automatic Meter Passing (AMT) system for Automatic Meter Passing (AMT) system for polition or entime system; ce achieve orogoing processors rull. Fethers meter accuracy track accourse rull. Fethers meter accuracy track processors that meter. Pathen much processors that meter. Bethen rulling proceedures based upon fairly proceedures tased.	Water utility policy does require melecting and volume based billing but examption exist for a portion but examption exist for a portion buildings. As many as The buildings. As many as The buildings as any metered due to the asamption or meter hestallation difficulties. Only a group estimate of amutal consumption of the anual water audi, with no mapered individual urmetered accounts.						
u	5 Conditions between 4 and 6	sting for all stallation of water ent of	NOL	Conditions between 4 and 6	mmetaered mmetaered criture bareared andrivue to andrivue to andri	Conditions between 4 and 6						
Grading	4 SO% - 75% of exported water sources are intered, other sources estimated. Occasional meter accuracy testing	In smallh for 8. Formatine enrual mean accuracy testing for all exported water means. Contrain installation of exported water means and replacement of obsidete/deticative metians.	AUTHORIZED CONSUMPTION	At least 75% of customers with memory of the customers with reads, flat of fixed rate billed for renainder. Manual metar reading under, at least 3 and success rate, failed reads are success rate, failed reads are success rate, rate of our proper setures. Comparing metars replaced only upon metars replaced only upon billing records, but only periodic billing records, but only periodic billing records.	Processes and heading for a processes and heading that is a di- accounts. Einning that is a di- accounts. Einning that is a di- upon measured construction. Co- ther warding barriers. Econol met program. Combine metaler re- program. Combine metaler a statisfica.	Water utility policy does require metric and vorter and based billing but lacts written procedures and employe casual oversight, employe casual oversight, and accounts belaved to be accounts belaved to be the annual event accounts is included in the annual event activity in no inspection of individual unmelaved accounts.						
	Conditions between 2 and 4	n maps and sting for eters on ections and eters			between 2 and 4	metered row meter formation formation anthroad of uter/and	Conditions between 2 and 4					
·	2 25% - 50% of exported water 25% - 50% of exported water acures estimated. No regular meter accuracy testing	<u>To suelth for 4:</u> Locate ef experied water exurase on mape and in field, uncom heter socrame/ pasting for existing meters. Longer to hetel meters on unmetered exponed water interconnections and reptors deviate/offect/re meters				At least 50% of customens with hourb-based billing from meler reads: flat or flags from meler reads; flat or flags drain aneler reading used, less than 50% read success rate, tailed customer indec ustomer meler records, in o regular meler testing or replacement. no regular meler testing of tailhing data maintaindo on paper mecords, with no auditing.	 Purchase and freadily for 4: Purchase and freadil meters on unmetered counts. Impose and freadil meters on unmetered reading accounts. Option of the impose meter adming meter meters with the loading meters of meters for accurracy, treated computationd meters for accurracy, treated computationd fields epidem. 	Water utility policy does not require customer melening: flat or flaad fee billed. Some metered system (plot areas or District system (plot areas or District excorded Areas) with consumbon recorded Areas) with consumption recorded Areas or District area used to intra consumption recorded Areas armate meter system (customer population for the total customer population are area for intra areas area and for unusual buildingswater uses.				
-	Less than 25% of exported Less than 25% of exported water cources are matered, remained. No requirer meter estimated. No requirer,	to cualify for 2. Review bulk wathr eaker agreements with perform angiver.contin perform requirements for use a uploage of accurate metering. Identify mends to install new, or replace detective meteries as mended.								Less than 50% of customers with volume-based billings from meler readings flat or fixed rate billed for the majority of the customer population	In Quality for 2 In Quality for 2 Conduct Investigations or traits of customs meller models appropriate meller or appropriate traiterations. Investigations other based webs rate shoutcame.	Water rullity policy does not require customer metenting, its collected fee billed. No data collected on customer consumption. Cmy estimates eventables are derived from data estimation methods using average interure count multiplied by number of connections, or similar approach.
a)u	rva Select n/a if the water utility selis no bulk water to bulk water neighborng water utilities (no exported water sates)					Select tria only fi Select tria only fi population is not metered, and is metered, and is serve on a valar thead rate basis	If this associated bocustare the counterment metator uppetiation is unmeatered consider and consider and construer population and entitive present volumes.	Select n'à if it is the project of the water utility to meter al customer by detailed auction by detailed auction of indeed have a water meler i.e. no unmetered				
	Water Exported:	Improvements to attain higher data grading for "Water Esponed Volume" component		:peratering	Improvements to attain higher data grading for "Baad Meterand Consumption" component:	Billed unmetered:						

	-				and the second se
	10 1 10 1 1	Io maintain 10: Continue to refine estimation methods for ummetred consumption and expore means to establish metering, for as many bled unmetered accounts as is accnomically teastible.	Clearly written polloy identifies the types of eccounts given a billing exemption. In the mybasis on learning such accounts to a minimum. Castoner mater management and mater reading for these accounts is given proper Ployting and is tablely conducted. Ployting and itably conducted and water constrained on the Ployting and a billing on the ployting and accounts the billing accounts is tablen from reliable readings from accurate maters.	Io maintain 10: Reasesse photocophy in allowing any varier uses to go 'unblacy" for is possible to meter and bit an eccornts, even the free free charged for water consamption is reacted and billing all accounts or wheel. Metering and billing all accounts or wheel. Metering and water versamption is included and water versamption is included heaks is detected and minimized	Clear policies exist to identify urmeaned fashon, with the urmeaned fashon, with the Intention of minimizing this type of constrimption. Sood records document each occurrence and constrimption is quantified via formulae (time typical flow) or use of temporary meters.
	8	terilation h a good to Sustain the th access th access stall water • water	Conditions between 8 and 10	th (meter ment) and ed the same the engoing to that water and provided	Conditions between 6 and 10
-	8	Routing to the second s	Written policy identifies the types of accounts granted a billing of accounts granted a billing management and meter reading the consident account reading procifies, but meter reading to procifies, but meter reading to conducted at least annually to conducted at least annually to conducted at least annually to the annual water audit. High level auditing of billing records ensures that a reliable ensure of such accounts exists.	to cualify tor 10: Ensure that mean management (meter accursy testing, mater replacement) and meter reading activities are accorded the anne- phonty as balled accounts. Extending requires priority as balled accounts. Extending provided and provided of the arrural watter audit provise.	Clear policies and good eccordisepting axist for some usess registering consumption), but not uses or impolationous uses of ire hydramits have limited are of well quantified use such as from formulae quantified use such as from formulae quantified use a relatively aubjective estimate of relatively aubjective estimate of relatively aubjective estimate of relatively aubjective estimates of relatively aubjective estimates of relatively aubjective estimates of
	2 -	cale basis. edures to a municipal meters. n relative ed accounts n.	Conditions between 6 and 8	n policy mplement accounts of accounts and verity scheduled s.	Conditions between 6 and 8
	. 8	In customer methers on a full scale basis. Finature customer methers on a full scale basis. Faither methers parker and provedures to resume that all accounts, mountain menable properties, and existentiate for memory properties are existentiated accounts aveiting meter installablon.	Written policies regarding billing exemptions exist but acherence in provide a construction with the and make reading for municipal buildings is mithe but sporadic for other unbilled matered accounts. Periodic auditing of accounts. Periodic auditing of where available, but the majority where available, but the majority of the consumption is estimated.	to sufficient for an intervention of the second second second second many proper second many procession and mislement procession and mislement procession and mislement and second many that second in unsuffield material and area scheduled for the second and an adding to the second material material readings.	Coherent policies axist for some consumption but others avait consumption but others avait consumption. Reasonable consurvation for the managed uses axists and allows for amunal volumes to be quantified by interence, but unsupervised uses interence, but unsupervised uses
	2	4 base of the state of the stat	Conditions between 4 and 6		Default vatua ot vztua ot system input volume is employed
Grading	4		Dated written procedures permit billing southon for specific accounts, such as municipal accounts, acth as manicipal accounts, where reading is given tregratific centar other types of consumption is quantified from meter reading whis consumption turmetered accounts must be setmated along with consumption	to constitution of Death a new written policy negating balling composition to accommence rithted allowing this occumment. Assign encources to util mater records and billing records to obtain centers of unbilled methoned accounts.	Edent of unbilled, urmelered consumption is partially known, and procedures easts to document centain earts such as microlinatous tire hydrart use. Formules is used to quarity the consumption from such events (time running vrybial flowriab x number of events)
	9	cy requiring it metering meter types, onomic onomic on others. at to devise on volumes.	Conditions between 2 and 4	and policy unts to be unts to be it a written it a speel of a minimum.	Conditions between 2 and 4
	2	D statific file. 5 In points a new water utility pointsy requiring customer a new water utility pointsy requiring staty to incude several different near types which will provide allow the economic sessement of full acute meaning options. Assess then with acute meaning options. Assess the with acute antifficulties to device means to obtain water consumption volumes.	Billing practices exempt certain accounts, such as municipal buildings, but only scattered, alled written three-trees acst to justify this practice. A reliable count of unbilled metered accounts is unavailable. Sporad- meter replacement and meter meter replacement and meter bess. The total annual water bessed upon approximating the number of accounts a ad- assigning consumption from actively bieled accounts of same	Preview history within for 4: Review history within directives and policy documents allowing seriain accounts is to billing assembly. Dark an outfine of a writish policy for the an averydon, with a polic of that grants an averydon, with a polic of the grants an averydon, to a minimum.	Clear extent of unbilled. Clear extent of unbilled. Unknown, but a number of avents are motiony documented each extent confirming addance of such consumption, but without sufficient documentation to quarity an accurate estimate of the annual volume consumed.
	· • • • •	to cualify for 2, threestigata a new water withy policy to arream monthing of the customer population, and accounts. Conduct plat accounts and accounts and detailonging the water consumption.	Billing practices exampt certain accounts, such as municipal accounts, such as municipal buildings, but written policies on or askis, and a subba count of urbilied meterand accounts is unaveilable. Meter updrege and meter poor recordsrepting and lack of auditing, water consumption for all such accounts is purely guestimated.	In autiful to 2. In autiful to 2. Researces the wather carry a policy allowing one-hundring accounts in the granting policy (or billing assemptions, with accounts around be assemptions from billing, and with the accounts around be assemption from billing, and with the materials (or longe) the manufact of accounts of a manufact of the accounts of a manufact of accounts of a manufact of the accounts of a manufact of account accounts of a manufact of account accounts of a manufact of account of a count of a count of account of a count of account of a count of account of a count of account of account of a count of account o	Extent of unbilled, ummetered consumption is unknown due to uneter policies and poor to consumption is quartified besed upon a purely subjective besed upon a purely subjective
	, m/a'		select n'a if all billing-axempt consumption is unmetered		
		Improvements to stitaln higher data grading for "Billed Unmetered Consumption" component:	Unblied metered:	Improvements to attain higher data granding for "Unbled metaoor Communglion" component:	Unbilled unmetered:

		A the state		ali addst cciess a	59 440	and ng for ep	
	10 ,	Iomaintain.10: Contruus to retine policy and conductus to mitmeritan of reducing the number of allowable uses of watar in umbiand and uses of watar in umbiand and can free to some tabled and can free thoused to converted eventually.		Clear policies exist to identify all trown unsubrotzad uses of water. Staff and procedures exist to provide entrocoment of policies and detect violations. Each occurrence is quantified via formulae (time x typical flow) or similar methods.	In melitratin 10: Continue as retries policy and continue as retries policy and propodues that alow or satisfu- propodurage unathrotoched construction unathrotoched construction unathrotoched construction and evidocennent efforts.	Good records of number, type and size of customer melans, type and melar replacement occurs. Regular melar cocursory testing gives reliable measure of the system. New melanng technology is embraced to keep overall accursory improving.	Romaintain 10: Increase the number of meters meter accuracy test data. On the section of the section of the of new technology in Advanced free technology in Advanced of new technology in Advanced and the section of the grasp opportunities for greater accuracy in metering and customer consumption data.
	: 0	na that all na overseen ranaged by to polloy to we value in arred spitus		Conditions between 8 and 10	gn staff to uthorized ad evices, signorion. isumption.	Conditions between 8 and 10	oopulation bypes and types and manorem
	8	Io <u>cueffic for 10:</u> Retine with <u>cueffic for 10:</u> Retine with a create an overacen by a cuefficient, urmeliande matier are overacen by a cueffic for a cueffic for a cueffic for wheth with personnel. These uses there wature in being converted to billed and/or metered status.		Clear policies and good recorditacpting asist for cartain metansis, cut another cocumences have imited over cocumences have consumption is a combunition of volumes from tomudae (time x typical flow) and subjective estimates of uncontinned consumption	Io quality for 10. Refine writen procedures of easign staff to seek out likely occurrences of watchords consumption. Explore moliciting devices, monitors and uption. Explore moliciting devices, monitors and uption transforciand consumption detect and threat unauthorizad consumption	Ongoing meter replacement and accuracy result areault in highly accurate customer meter accurate or customer meter a samples of meters at varying filespans to determine optimum replacement time for various types of meters.	In <u>contrast of the contract o</u>
	7	podures to leased for 		Conditions between 6 and 8	the that all rized d that all thread	Conditions between 8 and 8	atting to umber of umber of utilitioally ng meture
	9	Is suttified for 8. Assess water utility pathy and procedures to ensure that the hydrant partial are suard for use by persons outlies of the utility. Create within procedures for use and documentation of the hydrants by water utility personnel.		Coherent policies exist for some forms of unauthorized consumption but others avait coser evaluation. Reasonable exist for occurrences that fail under the policy. Volumes evantilied by inference from these records. Unsupervised uses are guessifirated.	In <u>cueffic for B</u> : Assess water utility policies to ensure that all forom courrences of unsumforciard consumption run courteners of unsumforciard consumption as they are uncovered.	A reliable electronic recordeeping system for meters of new high performing meters of new high performing meters and dated meters with suppect accuracy. Routine, but inhied, accuracy. Routine, but inhied, accuracy accuracy and replacement occur, inaccuracy volume is quantified using a mix of reliable and less certain data.	to cueffy for 8: Expand annual meter accuracy learing to evaluate a statisticulty significant number of motor matusehmodels. Expand meter replacement forgan to poor performing meters agrithant number of poor performing meters
	5	to suath, for a cranth for a cranth of the cranth of field of field of field of field of the cranth and/or a great wourne of such use of such use of such use of		Default value of 0.25% of system input votume is employed	In cualify for 0.01 cualify for 0.01 cualifier of find of field of	Conditions between 4 and 8	noter Information Neating and Ing rosults.
Grading	4	ho <u>Duality for 5:</u> Utiline accepted default velue of 1.25% of argainar input velues of accepted frames to gain a reservable quantification of a area unative difference of the velue auditing process.	APPARENT LOSSES	Procedures exist to document some unsubrate consumption such as observed unsubrationate fre hydram openings. Use formulae to quantify this consumption (time unining x typical forwate x number of events).	by <u>autifity for S</u> . Utilities accorption definant when of 0.25% of system input wurne of according or autimeter reasonable or prain a reasonable or prain a such use. This is particularly autor auto activity process.	Reliable recordiceping exists: meter information is improving as meters are replaced. Meter accuracy testing is conducted accuracy testing is conducted meters. Limited number of oldest inters replaced each year inters replaced each year interied testing data.	In summitty for 3: Standardica procedurans for meler recordseeping with the electronic information system. Accelerate means accuracy leading and mean replacements guided by waiting reading
	ы	1.25% of rif means to all this use. If this use. Apps (arc for rithmathers to room files		conditions between 2 and 4	ystiem input water uses t consider t coorrentee beeringe)	Conditions between 2 and 4	y system for by using a, or part of, bastomer basters,
	2	In the second of a second from the second of the second of the second se		Unauthorizad consumption is a known occurrence, but is extent is a mystery. There are no requiraments to document observed events, but periodic field observed events, but periodic field approximated consumption is approximated from this limited data.	Lee accepted detaul of 0.25% of system input volume Proviou visit of 0.25% of system input volume Bandin of 0.4 system case are considered unauthorizand, and consider are considered unauthorizand, and consider banding a small sample of one such occumence (or: unauthorizand file hydrarit openings)	Poor record/sequing and melar oversignt is recognized by water uitity management worh has alloted staff and funding record/seging and start metar records gathered and organized records gathered and organized to provide unsory disposition of melar population.	 Inglement a reliability. Nor.4: Inglement a reliability. Nor.4: Catabrare a reliability. Nor.4: Catabrare a reliability. Nor.4: Catabrare a reliability. System for a reliability. Reliability. Experiment methods by corport of catabrare per brown of methon.
	1	to cualify for 5: Uters accorpted otherut value of 1.25% of system right wouns as an exponential qualification of the use. B. cualify for 2: Exhibitin a policy regreting what vater uses should be any value any value and unmented. Consider thermap a minit sempte of one auch an misit sempte of one auch		Extent of unauthorized consumption is unknowm due to unciest policies and poor to condisepting. Total unauthorized consumption is guesstimated.	In summer of the second second second second second second register in the publicy regarding with publicy regarding with the publicy regarding with second s	Customer melers adat, but with understand paper necords on melers, no meler accuracy testing or meler replacement program. Workflow is driven characterin by customer comparing with no prosoftve management. Loss volume de los aggregate meter inaccuracy is guesstimated.	Rubanith for 2 Gather evellables motor Gather evellables motor purchase arourds. Jon day purchase arounds, the pro- meter and and the motor motor motor and and motor management.
	n/a					select n/a only if the customer population is unmelered	If it is a strategic contract of the strateg
		Improvements to attain higher data prime) or "Unabled Ummetened Construction" component:		Unauthorizad consumption:	Interventions to attain hyber data grading for "Anauthorizad Consumption" component:	Customer malaring inaccuracias:	Improvements to attain higher data garde for "Casteriore mate inaccurrent volume" component:

	-		80 80	-		7.0		
	10	Sound policy exists for permitting of all customer billing accounts of all customer billing system gives high functionality and reporting capabilities. Assessment of policy and data handling enrore cuducted by third party enrored a undired by third consamption lost to billing lapses is minimized and detected as it occurs.	In the second se		Sound policy axits for managing water mains antensions and patter mains densions and replacements. Geographic informations system (clas) data and asset management clasbases agree and ranch of databases.	lo méintain t0: Continue det validationatistration random rite validationation and random de validation in Improve Knowedge of system.	Sourd pointiting policy and well managed and audited policy and well managed and audited poceedures ansure relatable management of any and any and any any any management greatm and Geographic information agree (side (GS) rinformation agree (side (addates). Count of connection balleved to be in error by less than 1%.	to maintain 10 Continue vito maintaint 2010 and random hield validation to improve knowledge of system.
	8	Conditions between 8 and 10	at allow d, or data internal		Conditions between 6 and 10	(GIS) and uct field	Conditions between 8 and 10	Link Link di system GIS) and nation nation tation of tations s and
	60	Permitting and biling policy reviewed at east bahrualiy, reviewed at east bahrualiy. Includes an array of reports to contimutide and reported the production of the product third party audit. Accountability must party audit. Accountability third party audit. Accountability third party audit. Accountability there and reducing bases. Seasungtion lost to biling bases.	Case policytonotam to popoles that allow Case policytonotam to popoles that allow earns catherner accounts to go the half allowed handling errors to eact. Ensure that half and handling errors to eact. Ensure that half and handling errors to eact.		Sound policy and proceedures exist Sound policy and proceedures exist new water mains. Electronic Bo weater mains. Electronic Bo management system are used to store and manage data.	Ib autility for 10: Link Geographic Information System (135) and asset management databases, conduct field verification of data.	Permitting policy and procedures reviewed at least bianually. Well managed computerized information managed computerized for the second second second second second and internal system audits allows counts of connections that is no more than 2% in error.	In <u>Constitution</u> (Constitution) Constitution to portionation that allow maintainton to portionation that allow computational information management system computational integration and information of a with Geographic processes. Documentation of themation addition processes. Documentation of a system audition processes. Documentation and a system audition processes. Documentation audition processes. Documentation audition processes. Documentation audition processes. Documentation processes. Documentat
	-	Conditions between 8 and 6	ng and apability mulics e of data		Conditions between 8 and 8		Conditions between 8 and 8	policy checks creports settaed
	9	Policy for permitting and billing is adequate and reviewed adequate and reviewed periodicarity. Computerized billing available. Any freet of billing available. Any freet of billing adulations to measured consumption volumes is well understood. Infamal checks of billing data error conducted put after consumption volume for billing datasers obtained.	Formatize regular trefere of fermiting and building pradices regular trefere of fermiting and building pradices. Entration reporting reading around segurar auding processes to reveal scope of data paguar auding process to reveal scope of data a building error.		Sound policy and procedures solat for permitting and commissioning new water mains. Higher of the accurate paper records with could field with asset management system in good condition. Includes system condition. Includes system	to settify to 8: Launch random field clean of limited number of locations. Convert to electronic distances with backup as justified.	Permitting policy and procedures are adouting the fragment periodically. Computerized Information management system & aboncoments totalaid. Very is aboncoments totalaid. Very is multis Erry in our or number of service connections to believed to be no more that 3%.	Rounding to summer the second
	6	Conditions between 4 and 8	y policy otunity for otunity for otunity for the value za internal		Conditions between 4 and 8	officy and aning new of records rrect any	Conditions between 4 and 6	ancy with service tetrofe al clude al udit year.
Grading	4	Policy and procedures for permitting and iming wats but needs relinement. Computerized billing system exists, but is dated to takas needor functionally. Penodic, imited netwart audits conducted and confirm with approximate accuracy the consumption volumes (ost to billing lapses.	In the second se	SYSTEM DATA	Sound policy and procedures for mething and occumenting new water main instaliations, but gaps in managenem result in in managenem result in tabulation of mains length.	In character and the second se	Permitting policy and procedures surger, but wing and procedures performance and oversight. management system is being brought online to replace dated brought online to replace dated Besonaby accurate tracking of Reasonaby accurate tracking of abandoments; but count can be up to 5% in enor from actual total	In the procedure to ensure consistency with the procedure to ensure consistency with permitting party to ensure consistence connections or decemmission satisfing connections. Improve process to include all totals for at least the years prior to audit year.
	~	Conditions between 2 and 4	k nitterg and billing. Lustioner billing of hilling records ons.		Conditions between 2 and 4	of water a for a Review rhing and stion and	Conditions between 2 and 4	itting and diserping bin or nections.
	2	Policy for permitting and billing adds but not every every every Billing data maintained on paper records or insufficiently capable electronic vatabases. Only periodic unstructured auding periodic unstructured auding periodic unstructured auding data handling efficiency. Volume of unalide water due to billing itapees is a guess.	In sum the first first first first first first first for per instalmental a contrainticat system. Conduct initial analt as part of this pro		Paper records in poor condition (no annual tracking of installations a abandoments). Poor procedures to ansure that new versier mains installed by developers are eccurately developers are eccurately	boundity for 4: Compares Investigations & main main instabilitions & autoinforments for a number of years prior to autif year. Review pullity and prove water motin installation and policy and prove water motin installation and abandomments.	General permitting policy extess but paper records, procedurel contracts, and weak correction result in questionable total for number of total extual count.	In 2018 for the second
	-	Vague policy for permitting (reacting new customer accounts) and billing. Billing data maintenid on paper records which are in disarray ho audits condured to confirm hilling data handling difficiency. Unknown number of customers escape rothing process lack of billing process oversight.	In constitution of the constitution of the constitution of the comparation of the compara		Poorty assembled and maintained pager as-built records to existing water main installations makes accurate determination of system page length impossible. Langth of mains is guessimated.	Bo analih' lor 2: Assign personnal to inventory current as abult monota and gradian resolution and hyway patana seamshab policy optimisting and analihing documents regurding permitting and obulking documentations by the attra and beammation.	Vague permitting (of new service connections) policy and poor paper recordivesping of customer result in connections/billings result in connections of the subsect of service connections. Which may be 10-15% in error from actual count.	In country for 2 by country for policy and proceduration for permitting and planting. Presention and collect builting. Presention and pare records of translationes & abandomments for services years prior to audit year.
*	na	select r/a only if the customer customer population is billed atta or frader rate charge that is not besed upon besed upon measured volmes of writer consumption population)						
		Systematic Data Handling Error:	Improvements to attain higher data grading for "Systematic Data Manding Error valume" oomponent:		Length of mains.	Improvements to statish higher data gnelog for "Langth of Water Meiner Component:	Number of active AND Inactive service connections:	Improvements to statish higher data grading for "humber of Active and inactive customer anviae compatients" component:

			281 be 0 110: untrationar into into into into into into into into	ition and improve	ure System a across the prive densive, od data.	draulic system with 1, and 1, and
	10		Either of two conditions can be mail to obtain a random of 10: a the customer water meter is possible outside of the customer building adjacent to the currenting or boundent sequentiality for the serves connection points. In the Reporting Vordshatewith a serves connection points, in the Reporting Vordshatewith a serves connection points. In the Reporting of 0. b) Literon evaluations are or the properiode customer building or the properiode customer building or the properiode customer building or the properiode customer to thom it of the random for the relevance of the properiode structure or the properiode area and a con- tinemer of contrained by from the customer water median are or the properiode customer buildings.	lo maintain 10: Continue with annibardication and random field validation to improve knowledge of system.	Weit-managed pressure districtiones SCADA yostem and hydrautic model acts by over the value of the material actinos the value of the value of actions verage system pressure is verage system pressure is reliable, and cross-checked data.	lo maintain 10: Continue to refine the hydraulic model of the distribution systam and consider instang if with SCADA System for eaa-bine pressure data calibration, and averaging.
	8	connection a typical first	Conditions between 8 and 10	ment system tem (GIS), fication of	Conditions between 6 and 10	n hydrautic at has been in the water med in em data.
	8	Gradings 1-8 apply if customer properties are unmetered, if customer melore sats and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection piping from the water main to the customer building. In any of these cases the average distribution curcisop or boundary separating utility/customer responsibility for service connection piping, and the typical first piping from the water main to the customer building. In a customer met be quaritied. Grander separating of the unset to grandity first exponsibility the value. (See the "Sarvice Connection Diagram" worksheet)	Clearly worded policy standardizes and mellen bocation of curststops and mellen which are inspected upon installetion. Accurate and well maintained electrotic reactors act with periodic riad reaches to confirm locations of service lines. Dications are properties from the pits. An accurate number of pits. An accurate number of puts an accurate number of puts man accurate number of puts man accurate and well puts an accurate and well puts an accurate and accurate pits and accurate and accurate pits and accurate and accurate pits and accurate and accurate pits and accurate accurate accurate accurate pits accurate accurate accurate accurate pits accurate accurate accurate accurate pits accurate accurate accurate accurate accurate pits accurate accurate accurate accurate accurate accurate pits accurate accurate accurate accurate accurate pits accurate accurate accurate accurate accurate accurate accurate pits accurate accurate accurate accurate accurate accurate accurate pits accurate a	In the customer information runaragement system and Geographic information System (GIS), standardize process for field verification of data.	Weil-managed, discrete pressure zones exist with genereity predictable pressure fluctuations. A current tutue caute SCADA System mats to monitor the water System and collect data. Including real thing pressure across the system mar collect data. Trapical statemined atta.	<u>to cuellin for 10:</u> Debain average pressure dat from hydrautio model of the distribution system that has been calibrated via dat measurements in the water distribution system and confirmed in compartnens with SCADA System data.
	7	owns and is r sponsibility to s to quantify th	Conditions between 6 and 8	É	Conditions between 6 and 8	vd Dette hitor system Set nogular matiton to boursette seuro data provide seuro data provide
	6	g premises, or if the water utility or under re- undary separating utility/customer re- ed to grade the validity of the mean orksheet)	Clear policy axists to define utility/customer responsibility for service connection pulping Accurate, well-maintained pager or basic electricitor recordreaping or paste exists. Pendod fead checks confirm piping lead recks confirm piping lead rescha confirm piping	to natify for 8: Implement an electronic means of recondencing, typestormer filling system Standardian the process to contect field checks of limited number of locations.	Reliable pressure controls separate distinct pressure controls separate distinct pressure zones; boundary verves are ancountered that breach pressure zones. Well- correct elevenery monitoring of the distribution system logs destronically. Pressure gathered by gauges/dataloggens at fine prossure compating at itso, and prossure compating at itso, and furting the flow accompating attes, and hump the prossure to compating the flow pressure to compating the system fulling the glow gathered fulling the glow accompating the flow during the glow accompating the system fulling the system accompating the system fulling the system accompating the syste	In Qualify for 8 In Qualify for 8 hostell a Supervisory Carrol and Data Acquisition (SCUOJ) System to monther agate permanenar and countrel operations. Set modular calibration activation deter instrumentation to instrum data accuracy. Obtein accuraci to provide a accuracy to pressure averaging- controlme, mildele data for pressure averaging-
	ß	omer buildin urbstop or bo of 1-9 are us on Diagram" w	Conditions between 4 and 6	ensure that antion and consensus distiment of a ment system.	Conditions between 4 and 6	are to gather es or aneas. r data to contrastante se, attitude se, attitude se, attitude se, attitude se, attitude se, attitude se, attitude
Grading	4	st and are located inside the cust te average distance between the c eter must be quantified. Gradings (See the "Service Connecti	Good policy requires that the curbatop serves as the delineation point behaven water diffy wmership and curbatops are wereating and the service connection pping. An expension provenally includes as readed and are an estimated are of the evaluability of paper records.	Is custify for (s) the sense of the sense of the point of the sense of	Effective pressure controls separate direm thressure availation moderate pressure variation across the system, corsactivat open houndary variation corressing system, corsactivation discovered that breech pressure discovered that breech pressure data discovered that breech pressure data admining when kwn pressure data admining when kwn pressure datable tropographical data exists. Avarage pressure is calculated using this mix of data.	In summer of presume Expand the use of presume grandprojecting and a myoresenthre as grandprojecting and a myoresenthre as Umilian provide presume acress or ansat Umilian presume activity presume and determine supply haid entering each presume determine supply haid entering each presume determine supply haid entering each presume control (presume mouting) when, attitude waives, partially open boundary varies) to waives, partially open boundary varies to activides to greater from these activides to greater to an
	3	mer meters ex these cases t he customer m	Conditions between 2 and 4	y delineating or service or of paper angle of sample of ocation to a ment system data.	Conditions between 2 and 4	ressure to gather am events coperational flow data at <i>h</i> athlade <i>b</i> athlade <i></i>
	2	properties are unmetered, if custor the cuetomer building. In any of point of use (ex faucet) or t	Policy requires that the curbstop serves as the defineation point serves as the defineation point and customer ownership and customer ownership and customer ownership and customer ownership and customer to the curbstop is the propering from the curbstop is the propering from the curbstop is the propering from the curbstop is the propering from the customer. Most curbstop are building is owned by the customer. Their location that advocuments. Their location warks widely from site-b-site, and an satinate of its distance is based upon the infolgy of a small group of locations measured in the field.	to cualify for 4: Formatize and communicials policy delineating connection policy, Assess accuracy of appre- records by field impendion of a small sample of enviole connection suing the becarins as any accuracion of the potential impediation to a service connection suing the becarins as the computatized information management system. to store service connection data.	Limited telemetry monitoring of static pressure data, which is static pressure data, which is recorded in handwritten togbooks. Fressure tab is gathered at indrivduat sites only when fow pressure control is gathered by avenzging relatively crude data, by avenzging relatively crude data, system had of by spitterant variation in ground elevations, pressure control at points in the distribution system.	In customer and the second sec
	-	Gradings t-9 apply if customer piping from the water main to	Vague policy exists to define the defineation of water utility ownearship and customer ownearship and customer ownearship of the sands are porcived at she breakpoint but these have are porcived at she breakpoint but these have of breakpoint but these have observed. Their location or observed. Their location wates widely from atte-posite, and eatimating this ditatione is autilitary due to the unknown location of many cubstops.	to Quality tor 2: Research and other poper monote a earlier in restations, import earlier states in the field amy pope decisions in the field amy pope decisions in the service of this amal astropic of connections in this mane.	Available records are poorly assembled and maintained paper records of supply pump characteristics and water distructions. Average pressure conditions. Average pressure the information and ground elevations from crude to pressure and provident pressure and or undulating pressure calcuettion.	Is gualfy for 2 Employ presume pauging and/or generating pauging and/or generating measurements from fro hydramit. Looses accurate hydramit. Looses accurate hydramit. Looses accurate hydramit. Research pump data absets to find pump data absets to find pump pressuratine characteridics
	n/a		In customer water metaors are located outside of the customer building and adjacent to the curbishop or to uthishop or to boundary uthity/customer responsibility for the service connection piping (by connection piping) (by connection piping (by connection piping) (by connection piping			
			Average length of customer service line:	Improvements to athein higher data gradie for "Average Length of Customer Sandos Line" component:	Average operating pressure:	Improvements to attain higher data grading for "Average Operating Pressure" component:

	T		Exact	õ _H ø		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		2
	10		Reliable electronic, industry- standard cost accounting system place, with al pertinent water system operating costs tacked. Data audited annually by diffy personnel and by third-party CFA.	to meintain pour, say abreast of Maintain pourtin, say abreast of expenses subject to entrate costs changes and budget/frack costs proactively	Third party revewed weighted average composite consumption rate (includes restential, commercial industrial, etc.)	Io maintain 10. Io maintain 10. Io addressing the water utility in addressing the water utility revenue needs. Update the calculation of the customer unit rate as new rate components. Customer classes, or other components are modified	Either of two conditions can be metric obtain a grading of 10: 1) Third party CPA audit of all primary and escendary cost components on an annual basis. 2) Water supply is entrely purchased suck imported ware, and unt purchase cost serves as the veriable production cost.	lo maintain 10. Maintain program, sity abreast of expenses subject to erratic cost changes and budget/nack costs proectively
	8		Conditions between 8 and f0	uci a third-	Conditions between 6 and 10	lit of water sestifications the structure.	Conditions between 8 and 10	ot a third- an annual
	8		Reliable electronic, industry- standard cest accounting system in place, with all pertinent water system operating cests tracked. Data audide at least amualy by utility personnel, and periodically by third-perty CPA.	to quality for 10. Standardies the process to conduct a third- party financial audit by a CPA on an annual basis.	Effective weller rate structure is in force and segred rateaby in billing operations. Composite customer rela is determined using construmbotor rate, houding consumption rate, houding and any other customer classes within the water rate structure.	Bo gradith (not 10). Conduct a parkedic third-party audit of water used in each usage block by all desetherations of users. Multiply volumes by full rate structure.	Reliable electronic, industry- standard cost accounting system in place, with all pertinent variable locubetion cost tracked. Data audited at least annualty by utility personnel, and periodicality by	to availity for 10. Standardiae the process to conduct a third- party finencial auto 10 y a CPA on an annual basis.
	7		Conditions between 6 and 8	uct routine beets	Conditions between 8 and 8	Contraction of the local division of the loc	Conditions between 8 and 8	to include attment) as liability. et periodic
	9		Reliable electronic, industry- standard cost accounting system in place, with all pertinent water system operating costs tracted. Data audido pendicalty by utility personnel, not a Certified Public Accountant (CPA).	to qualify for 4: Standardae the process to conduct routine financial audit on an annual basis.	Clearly written, up-to-date water rele structure is in force and is applied relative. Composite customer operations. Composite customer rate is determined using a weighted everage residential rete using volumes of water in each using volumes of water in each	Ito <u>Duelitik Inc 8</u> . Evaluativ volume of vation used in each usage block by sui classifications of users. Mutitiply volumes by fuil rate structure.	Reliable electronic, industry- reliable electronic, industry- in place, with all pertinent water Pertinent additional costs tracted. Pertinent additional costs beyond residuals management, etc.) are included in the unit variable production cost. Data audited at heat annualty by utility personnel.	Formation the accounting process to include formations the accounting process to include must your components gladility. The secondary component gladility. The secondary component gladility. The secondary component gladility.
	ß		Conditions between 4 and 8	mel euclit of tity cost deta acting these	Customer population unmeltered. Fixed fee chargle single composite number derived from muttiple customer classes.	Metter. customens. erod chance. rates based uccon watter. voolumes	Conditions between 4 and 6	
Grading	4	COST DATA	Electronic, industry-standard cost accounting system in place. Gaps in data known to evat, periodic internal wrewes conducted but not internal extructured audit.	In custification in the second	Straight-forward waler rate Straight-forward waler rate actoucture in use, but not updated in several years. Builing perators rateby employ the rate structure. The composite billing rate is derived from a single ustomer dates such as ratedential effect of different rates from varying outstomer classes.	No guality for 8: Evolution volume of water used in each usage flock by resolution users. Munity volume. rate structure.	Electronic, industry-standard cost accounting system in place. Electric power and treatment costs are reliably treatment costs are reliably treated and are accutation of unit variable production costs based on these two inpus onity. All costs are audited intermaty on a	Is availing for 6. Formations process for regulater frammals another additional productions oncess. Assesses whether additional costs (flashligh), residuals management, etc.) should be included to calculate a more accurate vertable production occi.
	3		Conditions between 2 and 4	counting conting es	Conditions between 2 and 4		Conditions between 2 and 4	
	2		Reasonably maintained, but Reasonables, part or electronic accounting provides data to estimate the major portion of water system operating costs.	to quelly for 4: Implement an electronic cost ancounting system, structurad according to accounting standards for water utilities	Dated, cumbersome water rate structure, not ahways employed consistently: in actual billing consistently: in actual billing billing rate is known to differ from the published water rate structure, the published water rate structure, determined, allowing a composite billing rate to be quantified.	Is <u>availity for 4</u> . Review the water for structure and update/formatics as nondord. Assess billing operations to ensure the statistication water reperations incorporate the statistication of water rate structure.	Reasonably maintained, but incompete, paper or electronic accounting purches data to roughly estimate the basic organisations costs and treatment costs and calculate a unit variable production cost.	In summer the second se
	-		Incomplete paper records and lack of documentation on marky operating functions making calculation of water system operating costs a pure guessifinate	to outsility for 2: Garther eventschie records, Rathur aver procedures to regularity onited and audit basis cost data of most important operations functions.	Antiquated, cumbersome water mate structure is use, with periodic historic amendments and implemented, resulting an inductorization charges. The actual composite billing thromostation charges. The actual composite billing rate likely finders significantly from the published water rate structure, but a lack of auditing leaves the degree of enci- laves the degree of enci-	In Quality for 2 Formulas the process to implement vestor rates, implement vestor rates, commentation providence. Create a current, formal vestor rate document and gain approval from all substandence.	Incomplete paper records and lack of documentation on primary opartier your testiment (electric power and testiment cests most montanely mates production costs a pure guessifinate	In south for 2 Gather evaluable records, institute new procedures to regularly order and audit basis cost data and most important operations functions.
	n/a						If the water utility the water utility the entire water suppy, then enter cess of the bulk water supply in the Reporting WReporting grading of 10	
	- - -		Total annual cost of operating water system:	Improvements to attain higher data grading for Trotal Annual Cost Operating the Water System* component:	Customer retail unit cost (applied to Apparent Losses):	Improvements to attain higher data grading for "Customer Pasal Unit Cost component.	Variable production cost (applied to Real Losses):	Improvements to staaln higher data grading for "Variable Production Cast component.

AWWA WLCC Free Water Audit Software: Customer Service Line Diagrams

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Average Length of Customer Service Line

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

Figure 1 shows the

configuration of the water meter outside of the customer building next to the curbstop valve. In this configuration Lp = 0 since the distance between the curbstop and the customer metering point is essentially zero.

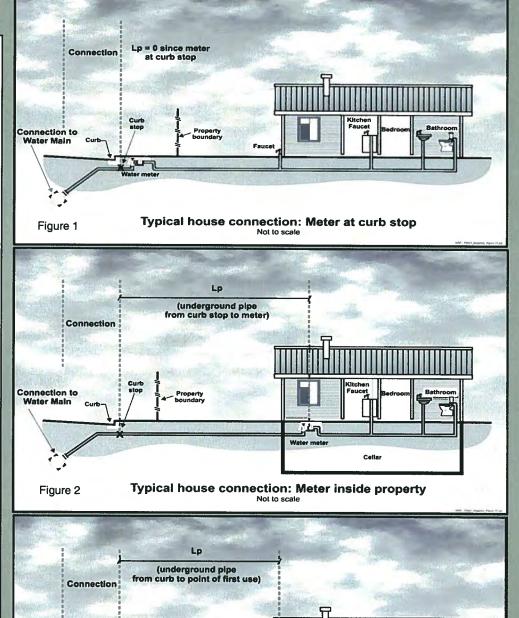
Figure 2 shows the

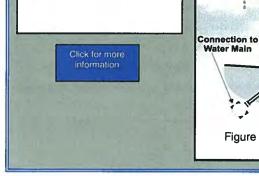
configuration of the customer water meter located inside the customer building, where Lp is the distance from the curbstop to the water meter.

Figure 3 shows the

configuration of an unmetered customer building , where Lp is the distance from the curbstop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.





Water Main

Figure 3

Cu

Property

Fauce

Typical house connection: Unmetered Not to scale

		udit Software: <u>Definitions</u> <u>Back to Instructions</u>
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Item Name		Description
Apparent Losses	Find	= unauthorized consumption + meter under-registration + data handling errors Includes all types of inaccuracies associated with customer metering as well as data handling errors (meter reading and billing), plus unauthorized consumption (theft or illegal use). NOTE: Over-registration of customer meters, leads to under-estimation of Real Losses. Under-registration of customer meters, leads to over-estimation of Real Losses.
AUTHORIZED CONSUMPTION		= billed metered + billed unmetered + unbilled metered + unbilled unmetered The volume of metered and/or unmetered water taken by registered customers, the water supplier and others who are implicitly or explicitly authorized to do so by the water supplier, for residential, commercial and industrial purposes. This does NOT include water sold to neighboring utilities (water exported). Authorized consumption may include items such as fire fighting and training, flushing of mains and sewers, street cleaning, watering of municipal gardens, public fountains, frost protection, building water, etc. These may be billed or unbilled, metered or unmetered.
Average length of customer service line	Find	This is entered for unmetered services and in cold or other areas where meters are installed inside homes and buildings. It is the length of customer service line either between the utility's service connection (often at the curbstop) and the meter, or to the building line (first point of customer consumption) if customers are unmetered. Note that the length of service connection between the main and customer service line is owned by the utility and its length and potential leakage is accounted for in the UARL formula by the number of service connections. What role does the "Average Length of Customer Service Line" parameter serve in the Water Audit? In many water distribution systems the water utility has maintenance responsibility for a portion of the customer service piping from its connection point at the water main to the curbstop valve located midway to the customer building. The customer is responsible to maintain the customer service piping water utilities responsibility. Leak durations are longer on the customer service piping than the utility-maintained piping. The total length of pipe maintained by customers is one of the components of the Unavoidable Annual Real Loss (UARL) equation and is determined by multiplyin Click to see Service Connection Plagram maintained pipe. Lo by the number of customer service connections. The customer customer beam and the service connection beam of the service of the service of the service of the maintained piping maintained pipe. Lo by the number of customer service connection bagram
Average operating pressure	Find	The average pressure may be approximated when compiling the preliminary water audit. Once routine water auditing has been established, a more accurate assessment of average pressure should be pursued. If the water utility infrastructure is recorded in a Geographical Information System (GIS) the average pressure at many locations in the distribution system can be readily obtained. If a GIS does not exist, a weighted average of pressure data can be calculated from water pressure measured at various fire hydrants scattered across the water distribution system.
Billed Authorized Consumption		All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information.
Billed metered consumption	Find	All metered consumption which is billed. This includes all groups of customers such as domestic, commercial, industrial or institutional. It does NOT include water sold to neighboring utilities (water exported) which is metered and billed. The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lagtime, however additional analysis is necessary to determine the adjustment value, which may or may not be significant.
Billed unmetered consumption	Find	All billed consumption which is calculated based on estimates or norms but is not metered. This might be a very small component in fully metered systems (for example billing based on estimates for the period a customer meter is out of order) but can be the key consumption component in systems without universal metering. It does NOT include water sold to neighboring utilities (water exported) which is unmetered but billed.
Connection density		=number of connections / length of mains

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Item Name		Description
Customer metering inaccuracies	Find	Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters will wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register. The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Alternatively, if the auditor has substantial data from meter testing to arrive at their own volumes of such losses, this volume may be entered directly. Note that a value of zero will be accepted but an alert will appear asking if the customer population is unmetered. Since all metered systems have some degree of inaccuracy, then a positive value should be entered. A value of zero in this component is valid only if the water utility does not meter its customer population.
Customer retail unit cost	End	The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied to the components of apparent loss, since these losses represent water reaching customers but not (fully) paid for. It is important to compile these costs per the same unit cost basis as the volume measure included in the water audit. For example, if all water volumes are measured in million gallons, then the unit cost should be dollars per million gallon (5/mil gal). The software allows the user to select the units that are charged to customers (either \$/1,000 gallons, \$/hundred cubic feet or \$/1,000 litres) and automatically converts these units to the units that appear in the "WATER SUPPLIED" box. Since most water utilities have a rate structure that includes a variety of different costs based upon class of customer, a weighted average of individual costs and number of customer accounts in each class can be calculated to determine a single composite cost that should be entered into this cell.
Infrastructure Leakage Index (151)	Find	The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). The ILI is a highly effective performance indicator for comparing (benchmarking) the performance of utilities in operational management of real losses.
Length of mains	Find	Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as: Length of Mains, miles = (total pipeline length, miles) + [((average fire hydrant lead length, ft) x (number of fire hydrants)] / 5,280 ft/mile] or Length of Mains, kilometres = (total pipeline length, kilometres) + [((average fire hydrant lead length, metres) x (number of fire hydrants)] / 1,000 metres/kilometre]
Master meter error adjustment	Find	An estimate or measure of the degree of any inaccuracy that exists in the master meters measuring the Volume from own sources. Please also indicate if this adjustment is because the master meters under-registered (did not capture all the flow) or over-registered (overstated the actual flow). All systems encounter some degree of error in their Master Meter data. Please enter a positive value.
HON-REVENUE WATER	Find	= Apparent Losses + Real Losses + Unbilled Metered + Unbilled Unmetered Water which does not provide any revenue to the utility
Number of <u>active AUD inactive</u> service connections		Number of service connections, main to curb stop. Please note that this includes the actual number of distinct piping connections including fire connections whether active or inactive. This may differ substantially from the number of Customers (or number of accounts)
Real Losses	<u>Frild</u>	Physical water losses from the pressurized system and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.
Revenue Water		Water which is charged to customers to provide revenue to the utility.
Systematic data handling errors		Apparent water losses caused by systematic data handling errors in the meter reading and billing system.
Total annual cost of operating the water system		These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the system, such as repayment of 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.

Item Name		Description
Unauthorized consumption	Find	Includes water illegally withdrawn from hydrants, illegal connections, bypasses to consumption meter or meter reading equipment tampering. While this component has a direct impact on revenue, in most water utilities the volume is low and it is recommended that the auditor apply a default value of 0.25% of the volume from own sources. If the auditor has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value then this value can be entered. However, for most water utilities it is recommended to apply the default value. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system.
		UARL (gallons/day)=(5.41Lm + 0.15Nc + 7.5Lc) xP, or UARL (litres/day)=(18.0Lm + 0.8Nc + 25.0Lc) xP
Unavoidable Annual Real Losses (UARL)	Find	<pre>where: Lm = length of mains (miles or kilometres) Nc = number of service connections Lc = total length of customer service lines (miles or km) = Nc multiplied by the average distance of customer service line, Lp (miles or km) P = Pressure Click to see Service Connection Diagram The UARL is 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. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). It is not necessary that water utilities set this level as the target level of leakage, unless water is unusually expensive, scarce or both.</pre>
		NOTE: The UARL calculation has not yet been fully proven as effective for very small, or low pressure water distribution systems. If, <u>in gallons per dav:</u> (Lm x 32) + Nc < 3000 or P <35psi <u>in litres per dav:</u> (Lm x 20) + Nc < 3000 or P < 25m then the calculated UARL value may not be valid. The software does not display a value of UARL or ILI if either of these conditions is true.
Unbilled Authorized Consumption		All consumption that is unbilled, but still authorized by the utility. See "Authorized Consumption" for more information.
Unbilled metered consumption	Find	Metered Consumption which is for any reason unbilled. This might for example include metered consumption of the utility itself or water provided to institutions free of charge. It does NOT include water sold to neighboring utilities (water exported) which is metered but unbilled.
Unbilled unmetered consumption	Find	Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes items such as fire fighting, flushing of mains and sewers, street cleaning, frost protection, etc. In most water utilities it is a small component which is very often substantially overestimated. It does NOT include water sold to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value of 1.25% of the volume from own sources. Select the default percentage to enter this value. If the water utility already has well validated data that gives a value substantially higher or lower than the default volume, then the auditor should enter their own volume. However the default approach is recommended for most water utilities. Note that a value of zero is not permitted, since all water utilities have some volume of water in this component occurring in their system.
Units and Conversions		The user may develop an audit based on one of three unit selections: 1) Million Gallons (US) 2) Megalitres (Thousand Cubic Metres) 3) Acre-feet Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units from the yellow unit boxes): Enter Units: Convert From 1 Million Gallons (US) (conversion factor = 1)

Item Name		Description
Use of Option Buttons	Find	To use the percent value choose this button To enter a value choose this button and enter the value in the cell to the right Pent: Value: 1.255 © O NOTE: For unbilled unmetered consumption and unauthorized consumption, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of water supplied and are recommended for use in this audit unless the auditor has well validated data for their system. Default values are shown by purple cells, as shown in the example above. If a default value is selected, the user does not need to grade the item; a grading value of 3 is automatically applied (however, this grade will not be displayed).
Variable production cost (applied to Real Losses)	Find	The cost to produce and supply the next unit of water. (E.g., \$/million gallons) This cost is determined by calculating the summed unit costs for ground and surface water treatment and all power used for pumping from the source to the customer. It should also include the unit cost of bulk water purchased as an import if applicable.
Volume from own sources	Find	The volume of treated water input to system from own production facilities
Water exported	Find	Bulk water sold and conveyed out of the water distribution system. Typically this is water sold to a neighboring water utility. Be sure to account for any export meter inaccuracy in reporting this volume
Water imported	Find	Bulk water purchased to become part of the water supplied. Typically this is water purchased from a neighboring water utility or regional water authority. Be sure to account for any import meter inaccuracy in reporting this volume
WATER LOSSES	Find	= apparent losses + real losses The difference between System Input and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission or distribution systems, or individual zones. Water Losses consist of Real Losses and Apparent Losses.

4

Back to Instructions		A CONTRACTOR OF A CONTRACT OF	Level V (91-100)	s Annual water audit is a reliable gauge of year-to-year water efficiency standing	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation	Continue incremental improvements in short-term and long-term loss control interventions	Evaluate and refine loss control goals on a yearly basis	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service	ed.
Loss Standing WASvao	de	I / Score	Level IV (71-90)	Refine data collection practices and establish as routine business process	Refine, enhance or expand ongoing programs based upon economic justification	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Performance Benchmarking - ILI is meaningful in comparing real loss standing	better data validity is achiev
Determining Water Loss Standing ccaton All Rights Reserved.	Water Loss Control Planning Guide	Water Audit Data Validity Level / Score	Level III (51-70)	Establish/revise policies and procedures for data collection	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Establish long-term apparent and real loss reduction goals (+10 year horizon)	Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	nould not be focus areas until
Software: ercan Water Works Asso	Water Loss Con	Water A	Level II (26-50)	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.			50 or below, the shaded blocks should not be focus areas until better data validity is achieved.
Water A Copyright ©			Level I (0-25)	Launch auditing and loss control team; address production metering deficiencies	Research information on leak detection programs. Begin flowcharting analysis of customer billing system				For validity scores of 50 c
AWWA WLCC Free			Functional Focus Area	Audit Data Collection	Short-term loss control	Long-term loss control	Target-setting	Benchmarking	

Loss Control Planning 16

Once data has been entered into the Reporting Worksheet, the performance indicators are automatically calculated. Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control real losses that exist in the system, then the lower the ILI value will be.

The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is <u>Note:</u> this table offers an approximate guideline for leakage reduction target-setting. useful if such an assessment is not possible.

and the second se	and the second second where we have not the second s		
	General Guidelines (without doing a full economic	for Setting analysis of	a Target ILI leakage control options)
Target ILI 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 Existing water supply inf purchased at reasonable expense; capability is sufficient periodic water rate increases can be long-term demand as long feasibly imposed and are tolerated reasonable leakage manage by the customer population.	Existing water supply infrastructure Water resources are believed to be capability is sufficient to meet long-term needs long-term demand management intervention. (leakage management, water controls are in place. long-term planning.	Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term planning.
-5.0 - 8.0	Cost to purchase or obtain/treat water is low, as are rates charged 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 ILI greater than 8.0, leakage is not an effective utilization of water as a resource. Setting a target level greate other than as an incremental goal to a smaller long-term target - is discouraged.	nsiderations may allow a long-term ILI great on of water as a resource. Setting a target a smaller long-term target - is discouraged.	G-term ILI greater than 8.0, such a level of Setting a target level greater than 8.0 - is discouraged.
Less than 1.0	If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI 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.	Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities e maintaining your leakage at low levels in a class with the top worldwide performers in b) A portion of your data may be flawed, causing your losses to be greatly understated. you calculate a low ILI value but do not employ extensive leakage control practices in you cch cases it is beneficial to validate the data by performing field measurements to confirm oduction and customer meters, or to identify any other potential sources of error in the	for your system is 1.0 or less, two possibilities in a class with the top worldwide performers in causing your losses to be greatly understated. employ extensive leakage control practices in your data by performing field measurements to confirm ify any other potential sources of error in the
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AWWA WLCC Free Water Audit Sc Copyright@ 2009, American Walter Works Asso			g Worksheet	Back to Instructions
Click to access definition Water Audit Report for:		la Water Departme	and the second sec	
Reporting Year:	2008	7/2007 - 6/2008		
Please enter data in the white cells below. Where available, metered values shou input data by grading each component (1-10) using the drop-down list to the left of All volume	of the Input cell.	Hover the mouse over the	ilable please estimate a value. Indica the cell to obtain a description of the g LONS (US) PER YEAR	te your confidence in the accuracy of the rades
WATER SUPPLIED	and the second second	Enter grading in		
Volume from own sources:	7	94,536.900	Million gallons (US)/yr (M	3/Yr)
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Water imported: Water exported:	2 n/a 10	7,100.400	MG/Yr MG/Yr	
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Customer metering inaccuracies:	8	190.300	MG/Yr	O 🜒 190.300
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WATER LOSSES:		26,650.600		
ion-revenue mater Non-revenue water:	7	27,414.800	MG/Yr	
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YSTEM DATA				
Length of mains: Number of <u>active AND inactive</u> service connections:	2 9 7	3,137.0 547.932	miles	
Connection density:		175	conn./mile main	
<u>Average</u> length of customer service line:	7	12.0	ft (pipe lengt) meter or pro	between curbstop and customer operty boundary)
Average operating pressure:	10	55.0	psi	
Total annual cost of operating water system:		4010 100 220		
Customer retail unit cost (applied to Apparent Losses):	2 10 2 9	\$219,182,339 \$4.97	\$/Year \$/1000 gallons (US)	
Variable production cost (applied to Real Losses):	9		\$/Million gallons	
ERFORMANCE INDICATORS				
inancial Indicators Non-revenue water as percent by	volume of	Matan Gunaldad.		
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AWWA WLCC Free Water Audit S			g Worksheet	Back to Instructions
Copyright © 2009, American Water Works As			WAS v4.0	
Click to access definition Water Audit Report for Reporting Year		Municipality of Po 1/2008 - 12/2008		
Please enter data in the white cells below. Where available, metered values shu input data by grading each component (1-10) using the drop-down list to the left All volumes to be a	it of the input cel	ii. Hover the mouse over the	liable please estimate a value, indicate please estimate a value, indicate precedent to obtain a description of the grad ND CUBIC METRES) PER YEAR	your confidence in the accuracy of the des
WATER SUPPLIED		< Enter grading in		
Volume from own sources		213,977.000		
Master meter error adjustment	Statement of the local division of the local	0.000		ML/Yr
Water imported: Water exported:	Sector Se	0.000	ML/Yr ML/Yr	
WATER SUPPLIED		187,519.500		
AUTEORIERD CONSUMPTION				
Billed metered:	: 🔽 7	163,665.000	ML/Yr	Click here:
Billed unmetered	and the second second	433.900	ML/Yr	buttons below
Unbilled metered: Unbilled unmetered:		1,768.400	Contract of the second s	Value:
		230.100	ML/Yr	0 230.100
AUTHORIEED CONSUMPTION:	. 71	166,097.400	M./Yr	Use buttons to select
				percentage of water supplied OB
WATER LOSSES (Water Supplied - Authorized Consumption	1000	21 422 100		- <u>QR</u> value -
Apparent Losses	1)	21,422.100		John Party Prover The Top
Unauthorized consumption:	: 🔽 5	886.800	Pcnt:	Value:
		000.000	Mb/II	0 9 886.000
Customer metering inaccuracies:	: 🔼 7	2,851.000	ML/Yr	O 2,851.000
Systematic data handling errors:	Statement of the local division of the local	0.000	ML/Yr	4
Systematic data handling errors are likely, ple		and an other states and the states of the st		Choose this option to
Apparent Losses:	: 2	3,737.800	ML/Yr	billed metered
Real Losses				consumption. This is NOT a default value
Real Losses = Water Losses - Apparent Losses:		17,684.300	ML/Yr	
WATER LOSSES		21,422.100		
			They at	
NON-REVENUE WATER NON-REVENUE WATER	2	23,420.600	17 /17-	
= Total Water Loss + Unbilled Metered + Unbilled Unmetered	Contraction of the		ML/II	
SYSTEM DATA	So land	THE REAL PROPERTY OF		THE REAL PROPERTY OF THE PARTY OF
Length of mains:		4,161.0	kilometers	
Number of <u>active AND inactive</u> service connections:	Sectional Concession	287,905		
Connection density: <u>Average</u> length of customer service line:		<u>69</u> 16.0	conn./km main metres (pipe length b	petwsen curbstop and customer
			meter or prope	rty boundary)
Average operating pressure:	: 🚺 6	58.4	metres (head)	
			The standard and the standard and the	CALL STREET, ST
COST DATA	1-1.1	and the second sec		
Total annual cost of operating water system:		\$100,000,000	\$/Year	
Customer retail unit cost (applied to Apparent Losses): Variable production cost (applied to Real Losses):	: 2 10 : 2 10		\$/1000 litres \$/Megalitre	
Retail costs are less than (or equal to)	production			Arv
PERFORMANCE INDICATORS			VIEW WIN COLLECT AL MODELL	ary
Pinencial Indicators				
Non-revenue water as percent by	v volume of	f Water Supplied:	12.5%	
Non-revenue water as percent by	y cost of a	operating system:	15.0%	
		Apparent Losses:	\$2,399,668	
	Annual cost	t of Real Losses:	\$11,353,321	
Operational Afficiency Indicators		and a state of the	NAMES AND POST OF THE OWNER	
Apparent Losses per (SALE OF COMPANY	pat-	/connection/day
Real Losses per se	ervice conr	nection per day*:	168.29 litres/	/connection/day
Real Losses p	er length o	of main per day*:	N/A	
Real Losses per service connection per day				/connection/day/m
		al Losses (UARL) :		
	Alinuta	IL DOBBED TOTAL,	8,960.91 cubic m	eters/year
Infrastructure Leakage Inder	x (ILI) (Re	Bal Loeses/UARL}:	1.97	
* only the most applicable of these two indicators will be	calculated		Entresht on some state	
the second s	10000			CONTRACTOR OF STREET, ST
NATER AUDIT DATA VALIDITY SCORE:	2 104 A.S.T.	ELLA COMPANY	ALCONTRACTOR	Constant of the second second second
*** YOUR 8	SCORE I	S: 64 out of	100 ***	
. A weighted scale for the components of consumption an	d water los	s is included in the	a calculation of the Water Aud	lit Data Validity Score
PRIORITY AREAS FOR ATTENTION:				
Contract dependences of the second	the demonstra			De state a la salarse
Based on the information provided, audit accuracy ca	n be impro	ved by addressing	the following components:	Change Strange (Strange
1: Volume from own sources				
2: Master meter error adjustment		or more information, c	lick here to see the Grading Matri	ix worksheet
3: Billed unmetered	12 1 SE		STATISTICS IN STREET, SOL INC.	

AWWA WLCC Free Water Audit Software: <u>Acknowledgements</u>

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Version 4.0 Developed by the Water Loss Control Committee of April 2009 the American Water Works Association AWWA Water Audit Software

Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a down", water audit. It is recommended that users also refer to the 3rd Edition AWWA M36 This software is intended to serve as a basic tool to compile a preliminary, or "topcomprehensive, or "bottom-up", water audit using the same water audit methodology.

Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272 - Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water GEORGE KUNKEL, P.E. Philadelphia Water Department DAVID GOFF, P.E. Goff Water Audits & Engineering DAVID SAYERS, Delaware River Basin Commission DEVELOPED BY: ANDREW CHASTAIN-HOWLEY, Miya Water ALAIN LALONDE, Veritec Consulting REFERENCES:

- Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65

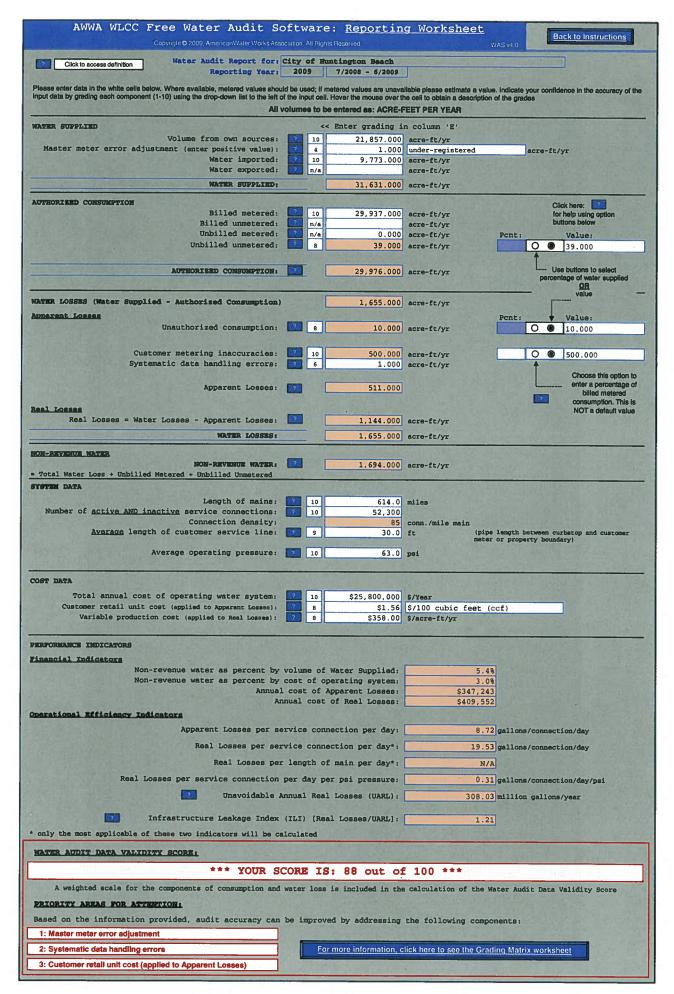
- AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009

- Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

AWWA Water Loss Control Committee

: Loss Control Committee (WLCC) Free Water Audit Software v4.0 Copyright© 2009. American Water Works Association. All Rights Reserved.	spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water ems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.	USE: The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons on the left below. Descriptions of each sheet are also given below.	S THROUGHOUT: Value can be entered by user Value calculated based on input data These calls contain recommanded default mallood	Please begin by providing the following information, then proceed through each sheet in the workbook:	: City of Huntington Beach COUNTRY: USA	: 2009 START DATE (MM/YYYY) : 07/2008 END DATE (MM/YYYY) : 06/2009	E-MAIL: kdills@surfcity-hb.org TELEPH	Ext. EXT. PLEASE SELECT PREFERRED REPORTING UNITS FOR WATER VOLUME: Acre-feet	t	The current sheet	Enter the required data on this worksheet to calculate the water balance	The values entered in the Reporting Worksheet are used to populate the water balance	Depending on the confidence of audit inputs, a grading is assigned to the audit score	Diagrams depicting possible customer service connection configurations	Use this sheet to understand terms used in the audit process	Use this sheet to interpret the results of the audit validity score and performance indicators	If you have questions or comments regarding the software please contact us at: wc@awwa.org
AWWA Water	<u>PURPOSE</u> : This spreadsheet-based water distribution systems and identify areas format, and is not mear	USE: The spreadsheet cont or by clicking the button	THE FOLLOWING KEY APPLIES THROUGHOUT:	Please begin by providing	NAME OF CITY OR UTILITY: City	REPORTING YEAR:	NAME OF CONTACT PERSON: Ken Dills	PLEASE SELECT PREFERRED I	Click to advance to sheet.	Instructions	Reporting Worksheet	Water Balance	<u>Grading Matrix</u>	Service Connections	Definitions	Loss Control Planning	<u>Comments</u> Add comments here to track additional supporting information, sources or names of participants

Instructions 1



AWWA WLCC F	ree Water A	AWWA WLCC Free Water Audit Software:	re: <u>Water Balance</u>	Water Audit Report For:	Report Yr:
	Copyright © 2009, Americar	Copyright © 2009, American Water Works Association. All Rights Reserved.	. All Rights Reserved. WAS v4.0	City of Runtington Beach	2009
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 29,937.000	Revenue Water
Own Sources (Adjusted for		Authorized Consumption	29,937.000	Billed Unmetered Consumption 0.000	29,937.000
known errors)		29,976.000	Unbilled Authorized Consumption	Unbilled Metered Consumption 0.000	Non-Revenue Water (NRW)
21,858.000			39.000	Unbilled Unmetered Consumption 39.000	
	Water Supplied			Unauthorized Consumption	1,694.000
	100 163 16		Apparent Losses	10.000	
and the second se			000.1110	200.000	
				Systematic Data Handling Errors	and the second
A STREET AND		Water Losses	and the state of the state of the	1.000	
Water Imported		1,655.000		Leakage on Transmission and/or Distribution Mains	
			Real Losses	Not broken down	The second second second
9,773.000			1,144.000	Leakage and Overflows at Utility's Storage Tanks	
and the second				Not broken down	
				Leakage on Service Connections Not broken down	

Water Balance 3

Back to Instructions	i audit component and n in red		10	100% of water production sources an entered. In their accuracy testing and electronic calibration testing and electronic attration less than 10% (ound outside of 4). 3% accuracy.	Is maintain 10 Burnardia main excurse yest frequency to semi-annual, or more frequency to sami-annual, or Plapar or replace means outside of 4.73% accurst. Preventigate/plati improving matering technology	Computerized system (SCADA or similar) automatically balances in thew from allower band and thew from allower band scharges; reviewed daily wass balance bechnique owneares contrasted) water and to raw (untreated) water and to raw (untreated) water and to raw (untreated) water and the annual in the second between SCADA and sources between SCADA and sources there and the annual data transfer error.	Ib methodin 10: Monther mode interventione for development of more accurate development of more accurate and tess expension formation. Continue to register or methor as they perform outside of desired accuracy innts.	100% of imported water sources are mainted, maker sources tasking and/or electronic calibration conducted semi- amualy, with less than 10% found outside of +/ 5% accuracy	<u>It melinteni 10</u> Standardian mena accurany test frequency to sami-annual, or mon trougunt, for all melins. Repair or replace menar outsido of +- 3% accuracy. Continually mestigratiopoli improving metering technology.
WASP 4.0	The grading assigned to each wioritising those items show		8	00% of water supply sources are mered, market accuracy testing and decronic calibration and decronic calibration conductos annually, lass than to 4 + 6% accuracy of +1 6% accuracy	Nathratin arread mole could be 10. Maintain arread mole countery bentling for al restance. Tengato or malener countello of 4. 6% anostanos, investigata new moler technology (sold ono or reprosements with investigate malene in attempt, to impore- menter accuracy.	Continuous production meter data logged automically & neweword daily Data adjusted to correct gross error from edupment mathurotion a results or inter facility dischorchages are automatically used in "Volume from own sources" tabulations.	Its cautifier from 10: that will production and tambitoting healthy elevation caution and tambitoting healthy devotion caution go data to a supprevision of entities a Data Acquisition (SCUOA) System, and comparativation constraining aspectation and regularly exaitments between SCAOA and extra meters.	100% of imported water sources as meteory meter sources as material meter accuracy as and/or electronic calibration conducted annually. Band 10 less than 10% of meters are less than 10% of meters are lound outside of 4, 6% accuracy	Nativita in the second seco
<mark>Matrix</mark> Reserved	ting Worksheet, grades were assigned to each component of the audit to describe the confidence and accuracy of the imput data. The grading assigned to each audit component and the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red		8 7	Al least 75% of water production sources are melered, gr is thesis 90% of the source flow is derived from metered sources. Mater from metered sources. Mater from metered sources is and 8 Lass than 55% of lessed amulaby. I Lass than 55% of lessed amulaby. are lound outside of 4/-9%	Conduct annual magnetity for 8. Conduct annual mean accumacy testing on at maters. Complete project in maters and that entry or reptices defective existing, means and hat entry production meter population is meanway. Repair or reptices meters outside of 4. 6% accuracy.	Hourly production meter data logged automatically a twikewed on et least a weakly basis. Data adjusted to corrrect gross error. From equipment mathurction and from equipment mathurction and accuracy testing. Tabylonge a and 6 automatically used in exclusion balanced "Volume from own ecuras" component.	In calify for 6 Compare Incalify for 6 Compare Installation of develor treatmentation on distinctioning includes Continue to use daily not storage drange in calculation abstracted "Values form con calculation abstracted "Advise form con calculation" component. Advist production mean data for gross error and heading.	At least 75% of imported waiter sources are melaned, melar accuracy testing and/or electronic Conditions accuracy testing and/or electronic Conditions calibration concluded and wirally. between Less than 55% of itselar melans 6 and 8 are found outside of 4- 6%	In complete project to install violation for a complete project to install important and important and important antitude matter and important antitude matter meter accuracy testing for all important antitude antitation
Water Audit Software: <u>Grading Matrix</u> Copyright©2009. Amencan Water/Works Association All Pights Reserved	to describe the confidence a ited in yellow. Audit accuracy	Grading	4 5	50% - 75% of water production sources are metered, other between sources estimated. Occasional meter accuracy testing 4 and 6	Formatian untrain the state of	Production meter data la logged aufomatical y in electrorio la logged aufomatical y in electrorio format auto forvieved al latast on a monthy yaasa, "Votime format aetorate o daty changes in estimate o daty changes in tantesforege facilities. Mater data la adjusted when gross data errors occur, or occasional meter testing deems this necessary	Review hourly <u>to Quality lot 6</u> . Review hourly production mater data tor gross error en, at least, a weekly basis. Begin to install result instructionation or transfessorage tacillates to record elevation changes. Use daty net storage change to balance flows in calculating Water Suppleof volume.	50% - 75% of imported water 50% - 75% of imported water sources ere melenod, other sources estimated. Occasional meler accuracy testing meler accuracy testing	In casely for 8: Formulae annual mean accuracy testing for at imported water means. Comma imatilation of means on unmaterianed soported water minimorumations and replacement of obsolete/defective meters.
Free	o each component of the audit ments and actions are highligh		2 3	25% - 50% of water production Sources are melened; other sources estimated. No regular meler accuracy testing. 2 and 4	Locatin al vetter production courses on mage Locatin al vetter production courses on mage and in field, baurd mether courses and mether origing mether, bary to intell mether on vetterand vetter production acures and replace any deadeter/defectre meters	No automatic datalogging of Production volumes, datalo production volumes, datalo madinga are scribed on paper records. Tank/storege elevation calculating "volume from own calculating "volume from own calculating "volume from own a calculating "volume from own a calculating of volume from own a calculating of volume from own a calculating of volume from own a volume fro	No characterization (No characterization) Instant automatic datalengging equipment on the conduction means. Alemitity tenice/atengoe featilities and include estimated any volume testim redder to or automation from. Vetare Supplied Volume based upon charapes in Supplied Volume based upon charapes in Supplied Volume based upon charapes in	25% - 50% of imported water 25% - 50% of imported water sources are melaned: other cources estimated. No regular meter accuracy testing. 2 and 4	To qualify for 4:
AWWA WLCC	grades were assigned to ng recommended improveme		-	Less than 25% of water Less than 25% of water production sources are melered. No regular are estimated. No regular meler accuracy testing.	In gualify for 2. Organiza effect to begin to colored data. for determining volume from own sources	Inventory information on measure and paper records of measured volumes in crude condition, data error carnot be determined	In continue to continue the 2 Develop part to methodore the methodore to methodore the methodore of the methodore to the term to be detect input errore to detect input errore	 Less than 25% of imported water sources are metered, immahing ources are estimated. No regular meter accuracy testing. 	Routellihrlic 2 Review bulk wetter purchase agreements with purchase agreements with purchase agreement returns methening, Josenthy needs for needs for wester of accurate with goal to methe after with goal to mether after with goal to mether with source.
	In the Reporting Worksheet, gr the corresponding		n/a	Volume from own sources. Patient own sources and of the water resources (Lo Maria	Improvements to attain higher data grading for "Volume from own Sources" component:	Select n/a only it Belect n/a only it to have water utility fails to have meters of its cources of suppy, either imported (purchased) water sources	Improvements to attain higher data grading for "Master meter error adjustment" component.	Select rval if the water utility's supply the water utility's supply is acclusively from the month. Water imported: the prunchased imported water)	Improvements to attain higher data greading for "Wetter imported Volume" component:

	4		-	and the second sec		100 million (100 m
ş	10 100% of exported water sources are meleted, meter accuracy testing and/or electronic calibration conducted som- anually, with less than 10% found outside of 4.7% accuracy	Lo maintain 10: Standardan man ecouracy test requency to sent-armal, or requency to sent-armal, or Repair or replace maine outside of 4-5% secures. Continually investigation/pilot traporving matering sectionology.		A least 95% of customers with volume-based billing from meter neads. At least 95% of customers neads. At least 95% of customere neads. At least 95% of customere neads. Whith Autometer meter neading success rate, or minimum 80% meter neading who regulated and the program of regulated and the program investigation of representative sample of accounts. Amutal audit verification by third party.	(<u>B melinian 10</u> ; Regular internal and third party tacking, and meni rocuratory tacking, and meni rocuratory tacking and reacting the basis customer meline. Say to volume based billing. Say abreast of internet as the basis abreast of internet as the basis abreast of internet as the basis (AM) and information. (AM) and information. (AM) and information. (I usified upgrades in menting, inter reading and billing data menagement.	Weter utility policy requires metering and volume besed billing for all customer accounts. Lass for all customer accounts. Lass unmetived and exist bocause unmeter discrimination is hindered by unresultation is hindered by unresultation of consumption are existing to consumption are obtained at these accounts with exist site specific estimation methods.
d	9 Conditions between 6 and 10	eting for all utbloc of 4) meter acoments b improve		Conditions between 6 and 10	metered r Reading er navding r achieved var meter var meter file cycle at third party third party	Conditions between 8 and 10
a	8 100% of exported water sources are metered, meter accuracy testing and/or electronic calibration conducted amually, less than 10% of metern are found outside of +/ 5% accuracy	In author 10. In a subtry for 10. Maintain arrunal meak execution for al metain. Regent or replace meakers unterlay of the accuracy. Investigate new metain the horizong for one or mean mature with investigate measure in attimute to improve with investigate accuracy.		At least 97% of customers with volume-based billing from meter reads. At least 90% customer meter reads. At least 90% customer meter and success rate, or minum 80% read success rate, with planning and budgeling for fraat of Automote. Metering and budgeling for areas. Good customer meter resting guides replacement of meterscally againteant number of meterscally againteant number of attraction and end eatailed resords for guides replacement of attraction and eatailed	Purchasa and for admith for 10. Purchasa and forabil member on unundered accounts. Lauroch Automatic Metau Pasading (AMT) system trais if mesual metar meding (AMT) system trais if mesual metar meding (AMT) system trais if mesual metar (AMT) system trais if a loss (S) of a contrast meding program. Contrus a within a fine-year program. Contrus a and budgeting for tages actio metar and budgeting for tages actio metar and budgeting for tages actio metar and budgeting for tages actio metar metal metal during action routine auding and require arread that party to the automatine auding and require arread that party routine auding and require arread that party routine auding and require arread that party fr	Water utility policy requires metering and vume based billing for all customer accounts. Metering is prevater in the acting because meter biled accounts unmetered and restating because meter instatisticn is hindrend by unusual citicumatances. The geal is to infinitize number of unmetered accounts. Faliable of unmetered accounts with a specific estimation with the specific estimation with the specific estimation
ŀ	Conditions between B and B	replace 1 water al meter ber meters. di +/- 6%		between 6 and 8	metamed metamed new of program program program program program to the new of the program the the the the the the the the the the	Conditions between 6 and 5
4	At least 75% of exported water sources are metered, meter sources are metered, meter calibration condicted annualy. Less than 25% of tested meters are tound outside of +/- 5% are tound outside of +/- 5%	Io cutifity for 8: Complete project to Instant may an endine diffection, metion on all appoint variant interconnections. Maintain amain motor measures y testing or all impointed water motions. Repet or replace metions cutients of 4-0% accuracy.		At least 90% of customers with volume-based billing from meter estimated. Manual customer estimated. Manual customer estimated. Manual customer estimated. Manual customer customer meter records. Initied meter accuracy testing, rate, failed reads ere estimated customer meter records. Initied meter accuracy testing meters. Computer/and billing records with routine auditing of global statistics.	to guality krs. Purchase and install methers on unmethered accounts. Meases costs directiveners of Automatic Weaker Passing (AMR) system for Automatic Weaker Passing (AMR) system for Automatic Weaker Passing (AMR) system for Automatic Weaker Passing (AMR) system for properating at mean regulation of party production of mean system for the party guidanno.	Water utility policy does require metering and volume based billing but examption asist for a pontion but examption asist for a pontion buildings. As many as 1%s, of buildings. As many as 1%s, of building accounts are unmetered due to this asamption or meter hastallation of the automated or consumption of an unmeter consumption of a tunnel provide stantiat water autit, with no inspection of individual unmetered accounts.
	Conditions between 4 and 8	esting for all stallation of a watter nent of s.	NOLI	Conditions between 4 and 8	mentaered my and chure based ordine based ordine based ordine based and based accuracy deconent	Conditions between 4 and 6
Grading	4 50% - 75% of exported water sources are melerard, cheir sources selimated. Occasional meler accuracy testing	A Formular small for \$ a guilt for \$ a country wethor for all exponent wethor measure. Small register address of the second water of matter on more and explanament of the obtained in formation and registerement of obtained in formation and registerement of the obtained in	AUTHORIZED CONSUMPTION	At least 75% of customers with volume-based billing from melar reads; fat or fixed rate billed of menander. Manual merar neading used, at least 55% melar read success rate, railed reads are success rate, railed reads are success rate, railed reads are complete item. Computation metars replaced only upon metar replaced only pended hilling records, but only pended hilling records.	Doubling C. Strandbrock C. Purchase and Install methors on unmediend accounts. Etiminate that fee balling and accounts. Etiminate that fee balling and upon measured constructions to structure accounty upon measured constructions accounts in monoign partners. Expend measured of dobat accounts in monoign partners accounts the active values accounts of the structure active of dobat accounts in the active. Conduct multiple.	Water utility policy does require memory and written procedure based biling but lacks written procedures and employs casual oversight, resulting in up 20% of biled accounts beleved to be accounts is included in the annual consumption for all the annual wells.
	Conditions between 2 and 4	n maps and sting for etters on ections and eters		Conditions between 2 and 4	materned motor meter formation parmodal of umber of utilized	Conditions 2 and 4
	25% - 50% of exported water 25% - 50% of exported water sources atermeteration, No regular meter accuracy testing	To quality loc 4: Locate all experied water sources on maps and need, summer besting for existing melene, begin to install meters on unmelened exported water interconnections and reptace obsoleta/defective meters		At least 50% of customers with cume-based into from meter reads: fait of haod mate billed for reads: fait of haod mate billed for semigration for the semigration semigration for the semigration reads are estimated. Intel customer meter records, with or replacement. Billing data animalined on puper records, with no auditing.	B Durchase and Install makes on unmetaned Purchase and Install makes on unmetaned accurati. Tingtoment policies on byprove makes moding access. Catalog makes information during makers withis to daming agreed makes for accurany. Install computationd billing option.	Water utility policy does not require customer metering: flat or fhad fee billed. Some metered system (plot areas or bistric) excernts easily with consumption recorded on portable datalogers. Data from these sampte meters the total customer population for the total customer population area and for unsual buildingswater uses.
	Less than 25% of exported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	In grant has a second by the 2. Review buth wetter sales agreements with pather angreements for use A updace of excernish metaning, Udenthy to metak to instit in own, or replace defective metans as needed.		Less than 50% of customers in with volume-based billings u from meter reacings, fitst or fixed rate billed for the majority of the customer population	In Quality for 2 Conduct Investigations or this of customer means to anior appropriate means to model auroget transfer the mean values bened vester reb studentes.	Water utility policy does not require customer melandra; the or thard fee billed. No data collected on customer consumption. Only estimates estimation methods using estimation methods using average thaure count multiplied by unmeer of connections, or similar approach.
-	Va Select n/a if the water utility selfs no butk water to neighboring water utilities (no exported water sales)			Select r/a only if Select r/a only if the customer population is not metered, and is metered, and is service on a task service on the basis	If riva is eelected bocurane fro customer make uppoundan is uppoundan a consider consider a new policy to make the population and employ water trans beand uppon customer	Select na if it is the Collect na if it is the utility to maler all customer connections and it has been contimed by detailed usiding by detailed usiding by detailed usiding ob indeed have a wurmetred accounts exist
	Water Exported	Improvements to attain higher data greding for "Water Exported Valume" component.		Billed metaed:	Proprovements to attain higher data grading for "Billed Meterad Consumption" component:	Billed urmelared.

		and the second second					
	10 1 10 10 10 10 10 10 10 10 10 10 10 10	to maintain 10: Continue to militree attimation mathods for unmeatend consumption of explore means to establish meaning, for as mary billed unmethend executs as is economically feasible.	Clearly written policy identifies the types of accounts given a billing asomption. This emphasis on keeping such accounts to a liminium. Customer meter management and meter reading for these accounts is given proper proving and is allably conducted. Plagutar auditing contines this rocursts taken from reliable readings from accurate melers.	Ro Institution 10: Reasess photocophy in submorps any water uses to go "undinac" it is possible to meter and bill of the two consumption is and billing all accounts around and water weater from photochild basis is detected and minimized.	Clear policies actst to identify permitted use of water in unbilled, unreatorsd stathon, with the inheriton of minimizing this type of consumption. Good records consumption is quantified via consumption is typetal flow) or use of temporary meters.		
	8	alletton a good to barbain the h access stall water water	Conditions between 8 and 10	(mether nem) and of the same that water of provided cess.	Conditions between 6 and 10		
	8 8 8	In guality (ar. 10: Continuo cuatomer media installation throughour the annive area, whin a goal to minimute unmellened accounts, suban the offert to investigate accounts with accoss effort to investigate accounts with accounts effort to investigate accounts with accounts effort to investigate accounts with accounts effort to investigate a	Written policy identifies the types of accounts granted a billing of accounts granted a billing management and meter reading management and meter reading protorities. but meter reading to conducted at least annually to conducted at least annually to conducted at least annually to the annual water evolt. High level auditing of billing records ensures that a recounts exists.	b) Constitution 10: Ensure that meter measurement Ensure that meter measurement and accuracy testing, meter replacement accuracy testing activities an exocorded the annu- priority as based accounts. Establish provided and provided activity provided and provided to the annual water audit process.	Clear policies and good recordingenting sats for some uses recordingenting sats for some uses registering consumption), but offer uses (ar. interstatemedus oversight. Total consumption is a mix of well quantified use such as riton formulae (time 4 typical fow) or femporary meters, and relatively subjective estimates of relatively subjective estimates of relatively subjective estimates of relatively subjective estimates of		
	. 7	cale basis. eduras to eduras to marten. metern. et eccurts n.	Conditions between 6 and 8	a policy mplement account of accounts a and verify echeduled	Conditions between 6 and 8		
	. 6.	In supervise the second	Written policies regarding billing exemptions exist but acherence in part mater reading for municipat and mater reading for municipat for other unbilled but sporadic for other unbilled but sporadic accounts. Periodic auditing of acch accounts is conducted. Water consumption is estimated where available, but the majority of the consumption is estimated.	In 2008/11/16/6 Commutation billing encryption policy throughout the organization and implement proceedings that annual proper second management. Conduct implementance of account management. Conduct implementance of account the account mether solid and are serviced the routine mether readings.	Coherent policies exist for some forms of unbiled, unmelered forms of unbiled, unmelered costsumption. Reasonable closer evaluation for the managed uses exists and allower for annual volumes to be quantified by inference, but unsupervised uses in guesstimated.		
	9	few billing repetites. bunding motions to untranstantic	Conditions between 4 and 6	ling billing us criteria us criteria resources to counts.	Default value of 1,25% of system finput volume is employed		
Grading	4	Round the second	Dated written procedures permit billing caractitis in mulcipal accounts, such as municipal accounts, where reading is given regarding caratian char types of two priority and is sportadic. Consumption is quantified from metri reading with consumption transformed along with consumption volumes.	In county for the second secon	Extent of unbilled, unmetered consumption is partially known, and procedures sets to cournent procedures sets to cournent miscellaneous fire hydran uses. Formulas is used to quartify the consumption from such events (time running x typical flowrate x number of events).		
	2 0 0	y requiring (matering mater types, promic promic promic promic promice in volumes	Conditions between 2 and 4	and policy unts to be a written thy criteria a goel of a minimum.	Conditions between 2 and 4		
	2	to guality for 4: transforment a new weak utility policy requiring customer meaking. Expand plat newsering allung's involute seven different inter types which is provide after a connection essentiment of his acade methoding options. Answer then with access difficulties to devise means to obtain water communifier volumes.	Billing practices exempt certain accounts, such as municipal buildings, but only acattered, ideal written interview sock to justity this practice. A reliable count of unevaliable, Sponder mater replacement and meter mater replacement and meter mater replacement and meter bess. The total annual water besset upon approximating the unmerer of accounts is addimed. bessed upon approximating the assigning consumption from actively billed accounts of same	Device hato: unafficients Review hato: unitant encourts to be documents allowing sentain accounts to the billing search. Brait an outline of a written polity for its an encourts to a so of the ports an exercedor, with a goal of leaping this number of accounts to a minimum	Clear extent of unbiled, unmelered consumption is unmelered consumption is are randomy documented each year. confirming existence of such consumption but without sufficient documentation to quantify an accurate estimate of the annual volume consumed.		
		Io could's for could by for 2 three webs a new webs utility pointy to transmission of the customeral exclusions of unmunitient exclusions. Control of plot metering project by restalling webs metering and address a small catadomera a small excmpt of customera accurate and dutadonging the webs	Billing practices exempt certain accounts, such as municipal buildings, but written policies on or exist, and a naliable control or unbilled meter accounts is unaveilable. Meter accounts is unaveilable. We to provide and both of these accounts is ray and ack auditing, water consumption for al such accounts is purely guestimated	Bould Michael Constitution of the second	Edent of unbilled, urmalered consumption is unknown due to unclear policies and poor recorderapity. Total consumption is quantified besed upon a purely subjective besed upon a purely.		
	n/a		select n'a if all billing-asampt consumption is unmetered				
		treprovements to attain higher data grading for "Blaid Unmalmed Consumption" component:	Unbilled metored:	Improvements to attain higher data grading for "Nabled metaered Comunitation" component:	Unbiled unmetered:		

	-		_	++ 0	and a second sec	7	
	10	Io matinatin 10: Commus to retrine policy and proceedures with interaction of proceedures with interaction of restarts in wetker in wetkend uses of wrater in wetkend and can feasibly become allowd and conferend should be converted eventually.		Clear policies exist to identify all known unsufficitad uses of water. Staff and proceedures axis to provide enforcement of policies and detect violations. Each occurrence is quantified via formulae (time x typical flow) or similar methods.	to maintain 10: Continue to retine policy and continue to retine policy and propositional any logophotes that allow or mahy boghotes that allo	Good records of number, type and size of ustomer melers, cropping meler reglescontent occurs. Regular meter accuracy teating gives related measure of gives related measure of accordosts instruction to composite inter- ter system. New molering technology is embraced to keep overall accuracy improving.	Io metrication 10. Increase the number of metans theato and represented as justified by theato and represented setting of merivative monto: development of mevitation and the setting metanometric primates for greater grease or consumption data.
	: 6	e that all e cherabet aneged by e oticy red status		Conditions between 8 and 10	in staff to devices. signed to sumption.	Conditions between 8 and 10	opulation sting and press and stomer mproving
	8	Refine write <u>to catelity for 10</u> . Refine write procedures to ensure that all uses of unblack, unmotiend wate are contracen by a structured permitting process managed by water rutin permonne. It does use have value in being converted to billed and/or melened status.		Clear policies and good Clear policies and good events (ar: Empropring with vector areas and a contrain animidor oreauments have consumption is a combination of volumes from formulae (thm or volumes from formulae oreaumet of unconfilmed consumption	Io <u>nuality lor 10</u> Refine writen porcedures of useign staff to seak out Relay occurrences of unalthorized consumption. Explore into Victing devices, monitors and other lichmologies designed to detect and threat unauthorized consumption.	Orgoing meter replacement and accuracy teach replacement and accuracy teach real in high accuracy accuracy as and accurated accuracy as any accurated of on samples of meters at varying replacement time for various types of meters.	Ro Ostellih for 10: Contrare affront to manage means population with reliable scondarspin, mean resoling and replacement. Exakato new reside the the resolution on more viges in 5-10 customer accounts seach year in order in paid i improving meaning lactmology.
	7.	odures to edures to mentaritorio mentaritorio econnel.		Conditions between 8 and 6	that all traded to that all traded to the set of the se	Conditions between 8 and 8	ting to miber of motor fretonity g meters
	6	In 2009/11/10/8: Assess water utility policy and procedures to arear that the hydrorit partials an issued for use hy persons outside of the utility. Create within procedures for use and documentation of the hydrarits by water utility personnel.		Coherent policies exist for some forme of unanhorizad consumption but othere swatt costser requiration. Passonable closes requiration for coordinephing sust for occurrences that fail under the policy. Volumes quantified by Inference from these records. Interpret and guessimated.	B. Statility Ior S. Rasess wather unfilty policies to ensure that all forwar constructions of unstatithorized consumption are outseved, and that appropriate and consumentation of various occurrencess of unsubhorized consumption as they are unscovered.	A reliable electronic recordiesping system for melans of new right performing metans of new right performing metans accuracy. Fourthe, but imited, accuracy. Fourthe, but imited, accuracy replacement occurr. Insecuracy volume is quantified using a mix of reliable and lease certain data.	To gualify for 8: Expand annul mana course waining to evaluate a catiditicatly apprilicant number of mater rabitementodes. Expand meter replacement program to replace statistically significant number of poor replace statistically significant number of poor replace
	2	to sualth for the constitution of the constitution of the constitution of the constitution of the constitution of the constitution the constitution of the constitutio		Default value of value of system input volume is empicyed	In cualify for E. or curatify for E. or curatific entropy and checks. Properties and/or exists and/or exists and/o	Conditions between 4 and 6	etter Metter Morrmation Ng results.
Grading	4	In <u>a commentation</u> In <u>commentation</u> (Utiline accorpted default victo of (1.55% of wysterin party volume as accordent means to gain a reasonable quantification of al according to vatur utilities who expenditing process.	APPARENT LOSSES	Procedures exist to document some unsuthrorized consumption such as observed unsuffyorized for hydras to quanity this consumption (time unning x typical flowrate x number of events).	In <u>Constitution</u> In <u>Constitution</u> Utilities eccepted distantification (Utilities eccepted and in the input volume as eccepted and inter utilities in particularly experiment for each use writer auditing process.	Raliable recorditesping axists; meter information is improving as an enters are replaced. Meter accuracy feating is conducted an unually for a small number of meters. Limited number of oldest mess replaced acth year. Incacuracy volume is largey an estimate, but refined based upon invited testing data.	In calling for the second and the formation of the second and the material second and the second second and the second second and the second
	е 1	25% of timeters to the use. It is that have usedors to con fire con fire		between 2 and 4	stem input exter uses consider cocuration entingel	Conditions between 2 and 4	by using the second sec
	2	Dutine according for E. Utine according detailing the of 1.25% of epidem input volume as an expedient means to gain a reasonable quantification of the use. Leavable the documentation of events that have been observed. Neet with user groups (cc for for hydramits - the departmentation of according their heat mean for water from the according their heat mean of the value from the hydramits.		Unauthorized consumption is a known occurrence, but is avlant is mystery. There are no is a mystery. There are no requirements to document observed events, but periodic field to observed events, but periodic field to the second averation consumption is approximated from this limited data.	Date in the second seco	Poor recordisaping and meter oversignt is recording and meter allored staff and innoing allored staff and innoing recordisaping and staff meter recordisaping and staff meter recordisaping and staff meter recordis gathered and organized to provide cursory disponsition of meter population.	In contract a million forced in the second systems for the phononest a million exocord inserting systems for the second systems and to, or part of a customer material system of customer and the customer and the customer system of the customer system of the second system. Expand runser sociality in the second systems.
	-	Io guality for £: Lutana accorption defautir value of 1.25% of system input wournes as an expendent memory opartification of the use. Do guality for 2 Examiter to pointy value what water uses evoluted and unmemoral. Consider mechange.		Extant of unsuthorized consumption is unknown due to unniaar policies and poor recordisepting. Total unsuthorized consumption is guesstimated.	b anality for £ be accepted detaut of 0.25% of system input volume. Review utility policy regarding with volume insues and considered unautimitation, and considered one auch considered one auch construction operating fire hydrast operating)	Customer melens exist, but with unorganized exper recurds on melens; no mele accuracy teshing or melen accuracy teshing or melen worklacement program. Workflow is driven chaodically by customer compating with no proscrive management. Loss volume due to aggregate meler inteccurecy is guesstimated.	In Quality for 2 and the result of the second Carther available mean purchase around a conduct testing on a remain number of the conduct to be the most the conduct of method and the meaning product of method the meaning the meani
	n/a					select rva only if the customer population is unmetared	If only the processing of the processing from the processing from the processing from the processing of the processing o
		Improvements to attain higher data granding tor "Undated Unnetened Construction" component:		Unauthorized consumption:	Improvements to attain higher data grading for "Unsuffortaed Consumption" component:	Customer matering Inaccuracies:	Improvements to attain higher data grando for "Castanee mate insocuraty volume" component:

	-	2	2 29-72		8 . 8 8	2 g		
	10	Sound policy exists for permitting of all customer billing probust computerized billing system gives high functionality and reporting capabilities. Assessment of policy and data handling errors councied internality and audited by third panty armality and audited by third consumption lost to billing lapses is minimized and detected as it occurs.	Ch. Indicating and the second seco		Sound palley asts for managing water mains admissions and replacements. Goographic indomation Streim (cish) data and asset management clashass agree and random field validation proves buth of databases.	Contraus with a standardization at a contraus with a standardization at random field with a standardization a throwedge of system.	Sound permitting policy and well managed and audited procedures resure reliable management of serve correction population. Computerized information and Geographic information and Geographic information System (GIS) information spress. feed (GIS) information spress. feed databases. Count of connections believed to be in a rror by less than 1%.	io maintain 10 Continue with standardization and random fladabon to improve knowledge of system.
	8	Conditions between 6 and 10	that allow ed, or data ti htternal 1 armually.		Conditions between 8 and 10	(GIS) and duct field	Conditions between 8 and 10	t allow Link off system for and mation of mation of mections te and
	8	Permitting and billing policy reviewed at least blannally, reviewed at least blannally, reviewed at least blannally includes an array of reports to contim billing age the and the and reviewed and periode and notice and reviewed is well quantified and reducing year-by-year.	<u>Bo cuality for 10:</u> Class policytorodam to botholes that allow earlier accounts to go untilliad, or data herafting errors to each. Ensure that harmal and third party audia are conducted amusity.		Sound policy and procedures exist promitting and commission or we water mains. Bectonic new water mains. Bectonic exortheoing and asset management System are used to store and manage data.	In guality for 10: Luk Geographic Information System (GIS) and comme with and addrased on order (Bid) and analytic information System (Bid) and wortherition of data.	Permitting policy and procedures reviewed at least blamually. Welk managed computatized managed computatized and routine, periodic field checks and internal system audits allows counts of connections that is no more than 2% in error.	Radial for 10: Close any proceedual looped to the allow finalized of the purification of the allow comparison in the purification of the allowed of the a
	-	Conditions between 6 and 8	ting and capability omalize ppe of data		Conditions between 6 and 8	d number atobases	Conditions between 6 and 8	g policy d checks op reports utertand m.
	89	Policy for permitting and billing is addrquate and reviewed addrquate and reviewed penodicarily. Computarized billing available. My refer of billing available. My refer of billing available. An massured consumption volumes is well understood. Immal checks of billing data error conducted quartification of consumption volume lost to billing datases obtained.	Remains regult for 8 Formalize regular reverting and billing practices. Enhance reporting capability of computantial billing system. Formalize regular auditing process to meal scope of data		Sound policy and procedures exist for permitting and commissioning new water matins. Highly, accurate paper records with sogular relation, or electronic records and asset management is pood condition. Includes system	In such that a sublick that a faunch random find that a such that the sublick of the such that the sublick of the such that the sublick of the sublick of the such that the sublick of the such that the sublick of the subli	Permitting policy and proceedures are advanced and revewerd are advanced and revewerd information management system is habandoments installations is abandoments inclaided is abandoments inclaided is abandoments and imiled field verifications and imiled field verifications and is exprise connections is believed to be no more that 3%.	Formation regulation for 8: Formation regulate review of permitting policy and providents. Laurah machon readed reviews of immute of locations. Develop reports and auditing mechanisms for computerized information management system.
	2	Conditions between 4 and 8	Mures and N policy ontumity for a customer fity - ensure foe internel		Conditions between 4 and 6	policy and coning new y of necords orrect any	Conditions between 4 and 8	terricy with service adding nctude all sudit year.
Grading	4	Policy and procedures for periling and procedures for needs refinement. Computarized billing system exists, but is dated or clacks needed functionally. Pendol: Imited internal audits conducted and contime with sproximate accuracy the consumption volumes (ost to billing tapsea.	Refine permitting and binding recordings and ensure consistency with the utility policy ensured activity and minimum opportunity to pulling system for needed functionality - ensure billing system for needed functionality - ensure of contamption vultures. Proceedures internal annual audit process.	SYSTEM DATA	Sound policy and procedures for mitting and commenting new weter main installations, but gaps in management result in a part uncertain degree of error in tabulation of mains length.	In static spatiality for S. Finalize updatestifyprovenents to policy and provedures or permitting polymorphy one and instatistican. Commissions, or insorthy to the years proc to suid year, correct any errors or omissions.	Pamilting policy and procedures add. but wind more gats in performance and oversight. Computational information management system is being brought online to replace dated brought online to replace dated brought online to replace dated brought online to replace dated brought online to replace to the abendonments, but count can be up to 5% in error from actual total	Butter proceedures to ensure considency with Refine proceedures to ensure considency with permitting pointly to ensure a considence connections. Improve process to inducte at behas for at least five years prior to suith year.
•	~	Conditions between 2 and 4	and billing, we billing ng records		Conditions between 2 and 4	s of water the for a Review onling and action and	bonditions between 2 and 4	ntting and rdseeping atem or nove areadons.
	N	Policy for permitting and biling adds but near entiting and biling Billing data maintained on paper records or insufficiently capable periodic unstructured adding periodic unstructured adding periodic unstructured adding afficiency. V olume of unbiled water due to billing alapses is a guess.	In guality for 4: Pradraw writen policy for american and billing, trepferment a computational cuationine hilling system. Conduct initial audit of billing records as part of this process.		Paper records in poor condition (no annual tracking of instatlations & abandomns). Poor procedures to means the new water mains installed by developers are accurately developers are	to complete involution of the first of the first of the first manufactory of particle of the first manufactor of the first of the control of the contro	General permitting policy axists but peper records, procedural gaps, and waso versight reauth in gaps, and waso versight reauth and reations, which may vary 5- 10% of actual count.	Rethe policy and provide the 4: Rethe policy and provide the termiting and builing. Research compactuates treamleaving system (Customer Elling System) to improve Customer Elling System) to improve documentation format for service connections.
·	-	Vague policy for permitting (recaling new customer accounts) and billing. Billing data maifained on paper records which are in clasmay, ho audits condurated to confirm billing data handling difficiency. Uhiknown number of customers escape nother billing due to lack of billing process lack of billing process oversight.	In constitution of the second		Poorly assembled and maintained paper ab-but mocords of existing water main installations makes accurate determination of system pipe langth impossible. Langth of mains is guessimated	Is aught for 2 Aways perconnel to investory current analysis perconnel to investory compare with customer billing peaker most and highway pitam. Assemble policy documents regarding percitings and bolomentations of wath matalons by the why and building documentation.	Vague permitting (of new sames connections) policy and poor paper recordivacing of customer connections bhilings result in support of service connections. Which may be 10-15% in error from actual count.	to availy for 2 Dent not policy and protocurse for participand protocurse for participand participant for events availability for avoid year.
4	N/a	select rida only if the customer population is billed after or frace based upon based upon measured volumes of water consumption population)						
		Systematic Data Handling Erron	troprovements to attain higher data grading for "Systematic Data Hending Error volume" Data component:		Length of mains	triprovements to attain higher data grading for "Langth of Weite Mains' component:	Number of active AND Inactive service connections:	Improvements to stabil higher data grading for Yhamber of Active and methics customer anvies connections" component:

	9	Ethist of two conditions can be	The unacting of the customer late a) The customer water meller is located outside of the customer building adjacent to the customer or boundary separating or boundary separating or boundary separating the Reporting Vorkenee with a parding of 10. D. Customer water responsibility for this case entrie a value of zero in the Reporting vorkenee with a parding of 10. In the properties are unmelling, or the properties are unmelling, for the properties are unmelling.	to metrican 10: Continue with statutidization and random field walkation to improve forowhodys of system.	Weit-managed pressure districts/zones. SCADA System and hydraufic mode exist to give the water distribution system. Average system pressure is reliably calcutated from extensive, reliable, and cross-checked data.	<u>to matriation 10</u> . Contrue to refine the hydrautic model of the discholton system and consider limiting it with SCADA System for real-time pressure data calibration, and averaging.
	8 9	asponalitie for the entitie service connection service connection piping, and the typical first is value.	Clearly worded policy standardizes the location of standardizes the location of utstopps and melets, which are inspected upon release, which are alectronic records asize, which conditions periodic field checks to confilm between constome release a confilm phils. An accurate number of phils. An accurate number of customer billing system allows for reliable averaging of this length.	<u>to stalih (or 10:</u> and Geographic Information management syatam and Geographic Information System (GIS), standardza process for field wertikation of data.	Weil-managed, discrete pressure zones oxist with prenerally predictable pressure fluctuations. A current line zace SCU in the actes distribution system and concist distribution system and collect between data, incjuring neal time pressure accoss the system. The average system pressure is determined from reliable SCADA System from reliable SCADA System	In contrast of the second seco
	8 7 7	Gradings 1-8 spby if customer properties are unmetered, if customer meters exist and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection pipeling from the water main to the customer building, in any of these cases the everage distributions for each of the entire service connection pipeling from the water main to the customer building, in any of these cases the everage distributions for each of the entire service connection pipeling from the water main to the customer building, in any of these cases the everage distributions of the customer building from the water main to the customer provide and the customer everage distributions in any of these cases the everage distributions of the anean to quality this value. (See the "Service Connection Diagram" worksheet)	Clear policy exists to define utility/customer responsibility for serves commercino piping. Accurate wei-mathatined paper basis electronic recorditions or basis electronic recorditions or basis electronic recorditions system exists. Principia langths for a sample of customer properties.	In <u>Datify In 2. and the Constitution</u> Implement an adectrotate means of monoclustory, Synchus V a customer Information system or caracteres bing system. Standardisch an process to conduct field checks of limited number of locations.	Reliable pressure controls separate district pressure controls only work constantion of pressure zones; boundary valves are anoncunhend that breach pressure zones. Well- covered learning with the pressure data waters pressure gathered by paugesticitation system data waters pressure gathered by paugesticationgoine at fire by paugesticationgoine at fire by paugesticationgoine at fire by paugesticationgoine at fire by paugestication system datamined by using this mix of network at all and pressure to datamined by using this mix of network at all and datamined by using this mix of	to suttich that is head a buowley that is head a supervisory orating and Data autometers and control operations. So it reputs estimation actionation for instrumentation to instant data accuracy. Ottobin accurate beoggnitised from finds accurate are proposed from field surveys to provide addresive, reliable data for pressure averaging
Grading	4 5	st and are located inside the customer building premise be everage distance between the customer value of o grad (See the "Service Connection Dilagram" worksheat) (See the "Service Connection Dilagram" worksheat) (See the "Service Connection Dilagram" worksheat) point between water utility open between and the lemination connection plint; Clear wommahip and customer connection plint; Clear between connection plint; Clear between the resonaby rocumented. Thei Dockin, and an satimate of this distance is hindered by from a reliability of paper records.		Establish coherent procedures to ensure that procedures to ensure that procedures to ensure that on the coherent procedures of a commensate and the the value utility for the establishment of a computantial information management system.	Effective pressure controls separate different pressure controls apparate different pressure variation moderate pressure system, cocasina open boundary variation open boundary variation discovered that breech pressure discovered that breech pressure adsovered that breech pressure adsovered that breech pressure adsovered that breech pressure adsovered that breech pressure adstrongere at the hordrants or pathenen dry gauges or detailogere at the hordrants or buildings when low pressure adstrongere at the hordrants and by gauges or detailogere at the hordrants and the pressure facta arists. Average pressure is calculated using this mix of data.	haddlight for a Expand the use of pressure compressionsgring expressions to applier contrared pressure data of a representative as distar, based upon pressure zones or areas Ultisa programme supply head entering each to barmme supply head entering each pressure controls (pressure and entering valves, athtude where, particulty open boundery valves) is each dides to generate addated pressure and value areage pressure.
	2 3	operties are unmetened. If customer metens avia the customer building, in any of these cases the point of use (ex faucet) or the customer rm	Policy requires that the curbatop serves as the defination point between water utility commarship between water utility commarship and customer commercient pipeling. This and customer the property for curbatop are property up the curbatop are property up the truthing is commed by the water utility and the pipeling from the curbatop the curstomer be customer. Most curbatops are customer Most curbatops are customer Most curbatops are an estimated are are not well-documented. The location are all the find fact are and group of locations measured in group of locations measured in area of the find.	In cutality ifor 4: Formatica and communicatin policy defineating diffycustomer megonetables for service connection pping. Assess accuracy of poper records by field impostom of a small ample of records of the service of the policity of the service connection data.	Umited talemetry monitoring of actitation data provides are actitation data provides are associated in transhifting in copoolds. Pressure data is gathered at Individual sites only which iow pressure compatibilities that Average pressure is determined. by averaging relatively crude data. Py averaging relatively pressure averaging relatively crude data. Py averaging relatively crude data. Py averaging relatively pressure averaging relatively pressure averaging relatively crude data. Py averaging relatively pressure averaging relatively pressure averaging relatively crude data. Py averaging relatively pressure ave	Is squith for 4: Formalize a proceedant to use pressure pauging/datainagaing equipment to use pressure pauging/datainagaing equipment to use pressure pauging/datainagaing equipment to use pressure pauging the part of the participating pressure controls (pressure controls) with pressure controls (pressure reducing) whithis and different from regimes. Identify whithis pressure controls (pressure reducing) whithis and pressure reducing whithis and pressure reducing verices and part to pressure data from these affinds and pressure data from these affinds and pressure data from these affinds and pressure data from these affinds
	1		Vague policy axists to define the delineation of water utility wmership and customer wmership and customer owneship of the service connection prime. Therefore are periored as the connection of the service connection of the service connection of the unknown and restingting this distance and restingting this distance and restingtion of many curbatopa.	In callify by 2 Present of and collect paper installations. Inspect partice installations. Inspect partice installations of the ford using pape potent to ford using pape toother to ford using pape toother to ford using pape toother to ford using pape toother to ford using paper toother to ford using paper to for the forget of the small marrier.	Available records are poorly paper records of supply pump characteristics and maintained characteristics and water characteristics and water conditions. Average pressure conditions. Average pressure guestimated based upon this information and pround elevations from crude to guestimated base to avoid distribution system thand loss and weakformatic pressure controls lumph system hand loss and weakformatic pressure pressure calculation.	In court for the second
	n/a	If customer water	A statute of the customers are located outside of the customer building and adjacent to the curbatop of separating utility/customer responsibility for the service a separating the service a value the service a value the service of zero in the the order a value of zero in the Worksheet with a grading of 10.			
			Average length of customer service line :	Improvements to ettain higher data genting for "Awango Langth of Custamer Sevice Line" component:	Average operating pressure:	truprovementa to attain higher data grading for "Average Operating Pressure" component:

	T		E	7		1 -		-
	10		Reliable electronic, industry- standard cere accounting system in place, with all periment water system operating costs tracked Data audied annually by utility personnel and by third-party CPA	lo maintain t0: Maintain program, sitay abraast of expenses subject to antatic costs changes and budget/track costs proactively	Third party reviewed weighted average composite consumption rate (includes restential, commercial, industrial, etc.)	lo mainten 10: Keep version rates structure current in adviserable the varier utilitys revenue needs. Update the calculation of the customerts, castomert classes, or other components are modified.	Either of two conditions can be mith to damin a grading of 10: 1) Thirt party CPA audit of all primary and secondary cost components on an ammuel basis. 2) Water supply is entinely purchased as built imported water, and unit purchase cost serves as the verifiable production cost.	to metinatin 10: Maintan program aution 10: axpanses autions to sar changes and budgethrack costs proactively
	6		Conditions between 8 and 10	uct a third- an ennual	Conditions between 8 and 10	lit of water ussifications the structure.	Conditions between 6 and 10	et a third- en annual
	8		Reliable electronic, industry- standard cest accounting system in pace, with all pertinent water system operating cests tracked. Data audited at least amusity by utility personnel, and periodically by third-perty CPA.	io cuellity for 10: Standardiae the process to conduct a third- party financial sudf by a CPA on an annual basis.	Effective water rate structure is in building operations. Compacties building operations. Compacties customer rate is elenamiaed using a weighted areap compactie consumption rate, maching and any other customer classes within the water rele structure.	Conduct a periodic bith (or 10: Conduct a periodic bitht-party audit of vater used in each usage block by all classifications of usans. Multiphy volumes by full rate structure	Reliable electronic, industry- standard cost accounting system in place, with all pertiment variable production costs transled Data audited at least annually by utility personnal, and pendically by	to guality for 10. Standardze the process to conduct a third- party financial audit by a CPA on an annual basts.
	7		Conditions between 6 and 8	ect routine pasis.	Conditions between 8 and 8		Conditions between 8 and 8	to include estiment) as tlability. Int periodic
	9		Reliable electronic, industry- standard cost accounting system in place, with all portnent water system operating cost tracked. Data audiad penoticality by utility personnel, not a Cartified Public Accountant (CPA).	to quality for S. Standardza the process to conduct routhe Theandal sudd on an annual basis.	Clearly written, up-to-date water rate structure is in torce and is applied relation. Composite customer operations. Composite customer rate is determined using a weighted average residential rate using volumes of vater in each rate block.	Realistity volume of water used in each usage block by all classifications of users. Mutiply volumes by full rate structure.	Reliable electronic, industry- in place, with all pertinent water system operating costs tracked. Power and treatment (ex: labelity, residuals management, etc.) are production cost. Data audited at least annually by utility personnel	Formulas the accounting process to include from a second of the process to include that y out a component (tablity, residuals management, etc.) Conduct periodic tradiculas management, etc.)
	5		Conditions between 4 and 8	mai audit of thy cost data adding these	Customer population unmetered. Fixed free charged: single single composite number from multiple customer classes.	Metter. Eustromens. and charge rates beand upon welter. volumes	Conditions between 4 and 8	
Grading	4	COST DATA	Electronic, industry-standard cost accounting system in place. Gaps in data known to exist, periodic inlenat reviews conducted but not a structured audit.	to <u>constitute</u> for <u>the second second</u> of Extractions process for periodic internal audit of water system operating costs; lateratify cost data gape and institute procedures for tracking these page and institute procedures for tracking these outstanding costs.	Shalght-Ioward water rate Shalght-Ioward water rate in several years. Billing in several years. Billing in several years. The composite rate structure. The composite rate structure as or an served from a single customer accounts, neglecting the effect of different rates from varying customer classes.	Its Datability Mort (S. Eveluation redurnes of water used in each usage block by readformata usars. Multiply volumes by full rates. make structure.	Electronic, industry-standard cost accounting system in place. Electric power and treatment costs are textureled and allow accurele calculation of unt allow accurele calculation of unt on these two inputs ont/. All costs are audited internally on a periodic basis.	By <u>cutoffich flot (8)</u> Formatize process for regulate tritemal audite of production mosts. Assess whither additional costs (flability), residuals management, etc.) anould be included to calculate a more accurate variable production cost.
	3		Conditions between 2 and 4	counting counting sec	Conditione between 2 and 4	n and ars billing a billing abort water	Conditions between 2 and 4	counting cocounting as
	2		Reasonaby maintained, but Reasonable, perior or electronic accounting provides data to estimate the major portion of water system operating costs.	to supply that 4: Inglement an electronic cost accounting system, which and accounting to accounting standards for water utilities	Dated, cumbersome water rate structure, not always employed consistently. In actual billing consistentions. The actual composite billing rate is known to differ from the publichand water rate attructure, the publichand water rate attructure determined, allowing a composite billing rate to be quantified.	to qualify for 4: Review the water review structure and updathformatize as needed. Assess billing operations to ensure that actual billing operations incorporates the extabilities water	Reasonably maintained, but hncompete, paper or electronic accounting provides data to coughly estimate the basic operations costs (pumping power costs and treatment costs) and calcutate a unit variable production cost.	In gally for 4 Implement an weather cost accounting system, structured according to accounting standards for water utilities
	1		Incomplete paper records and tack of documentation on many operating functions making cabulation of water system operating costs a pure guesstimate	In stallift for 2 Cather realisting records, institution revolutions to regularly collect and audit tessic cost data of most important operations functions.	Antiquated, cumbersome water are structure is use, with periodic historic antendments that were porty documented and implemented; resulting in classes of customer being billed forostistent charges. The actual composite hilling rest likely threas spiniteantly from the published water rate likely compared billing threat the published water rate likely foromer building threat the published water rate likely foromer building threat the published water rate likely foromer building threat the degree of auctime indeterminate.	In summer the process to including the process to including a secure documentation procedure. Create a current, journal water rate document and gain approval from all stabaholders.	incomplete paper records and lack of documentation on primary operating functions (electric power and teatment costs most importantly) makes calculation of variable production costs a pure production costs a pure	to autility for 2. Gather realizable neorods, institute new procedures to regularity collect and audit base cost data and most here cost data and most important operations functions.
	n/a						If the water utility purchases/imports its entre water suppty, then enter the unit purchase cost of the bulk water suppty in the Reporting Worksheet with a grading of 10	
			Total annual cost of operating water system:	Improvements to attain higher data grading for "Total Annual Cast of Openthing the Water System" component:	Customer retail unit coet (applied to Apparent Losses):	Improvements to attain higher data greating for "Customer Peeel Unit Cost" component:	Variable production cost (applied to Real Losses):	Improvements to attain higher data grading for "Variable Production Cast" component:

Back to Instructions			Level V (91-100)	 Annual water audit is a reliable gauge of year-to-year water efficiency standing 	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation	Continue incremental improvements in short-term and long-term loss control interventions	Evaluate and refine loss control goals on a yearly basis	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service	.06
Loss Standing WASV4.0	de	I / Score	Level IV (71-90)	Refine data collection practices and establish as routine business process	Refine, enhance or expand ongoing programs based upon economic justification	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Performance Benchmarking - ILI is meaningful in comparing real loss standing	better data validity is achieve
Determining Water Loss Standing scation. All Rights Reserved.	trol Planning Gui	Water Loss Control Planning Guide Water Audit Data Validity Level / Score	Level III (51-70)	Establish/revise policies and procedures for data collection	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Establish long-term apparent and real loss reduction goals (+10 year horizon)	Preliminary Comparisons - can begin to rely upon the Intrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	ould not be focus areas until
it Software: <u>Det</u> . American Water Works Association.	Software: erican Water Works Asso Vater Loss (Level II (26-50)	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.			50 or below, the shaded blocks should not be focus areas until better data validity is achieved.
Free Wa			Level I (0-25)	Launch auditing and loss control team; address production metering deficiencies	Research information on leak detection programs. Begin flowcharting analysis of customer billing system				For validity scores of 50 c
AWWA WLCC			Functional Focus Area	Audit Data Collection	Short-term loss control	Long-term loss control	Target-setting	Benchmarking	

Loss Control Planning 16

Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and Once data has been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control real losses that exist in the system, then the lower the ILI value will be.

The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is <u>Note:</u> this table offers an approximate guideline for leakage reduction target-setting. useful if such an assessment is not possible.

Target ILI Range 1.0 - 3.0 >3.0 -5.0	or or be	Ing a full economic analysis of leakage control options)Ing a full economic analysis of leakage control options)ConsiderationsOperational ConsiderationsAre costly to are costly to are trates is of existing infrastructure and/or additional water resources to meet the demand.Water Resources ConsiderationsConsiderationsOperations (the system leakage above and or environmentally unsound to develop.Water Resources are greatly imited and are very difficult and/or environmentally unsound to develop.can be developed or somble expense:Existing water supply infrastructure and are tolerated 	Ieakage control options)leakage aboveWater Resources considerationsderationsWater Resources are greatlyderationsWater Resources are greatlyleakage aboveAvailable resources are greatlyexpansionImmited and are very difficultlimited and or environmentally unsound tocces to meetImmited and are very difficultdevelop.Immited and are very difficultinfrastructureMater resources are believed to beint to meetNater long-term needs,ut dementInterventions(leakage management, waterlong-term planning.
4 5 0	Cost to purchase or obtain/treat s water is low, as are rates charged it 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.
	Although operational and financial considerations may allow a long-term ILI greater than 8.0, leakage is not an effective utilization of water as a resource. Setting a target level greate other than as an incremental goal to a smaller long-term target - is discouraged.	6	ig-term ILI greater than 8.0, such a level of Setting a target level greater than 8.0 - is discouraged.
	If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI 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.	lculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibiliti. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in control. b) A portion of your data may be flawed, causing your losses to be greatly understated. .ikely if you calculate a low ILI value but do not employ extensive leakage control practices in y is. In such cases it is beneficial to validate the data by performing field measurements to confi acy of production and customer meters, or to identify any other potential sources of error in the	n is 1.0 or less, two possibilities 1 the top worldwide performers in 5585 to be greatly understated. 7e leakage control practices in your 1.ming field measurements to confirm 50tential sources of error in the

AWWA WLCC Free Water Audit Soft	tware: <u>Report</u>	ing Worksheet	Back to Instructions
Copyright © 2009, American Water Works Associate			ASV10
Click to access definition Water Audit Report for: 72 Reporting Year: 2	iladelphia Water Dep 2008 7/2007 - 6/2		
Please enter data in the white cells below. Where available, metered values should be input data by grading each component (1-10) using the drop-down list to the left of the	te used; if metered values are	unavailable please estimate a value.	Indicate your confidence in the accuracy of the
to be a second of the second o		over the cell to obtain a description of GALLONS (US) PER YEAR	If the grades
WATER SUPPLIED		ng in column 'E'	
Volume from own sources:	7 94,536	.900 Million gallons (US)/	
Master meter error adjustment: Water imported:	2 10 2,779 7 n/a	.300 over-registered MG/Yr	MG/Yr
Water exported:	10 7,100		
WATER SUPPLIED:	84,657	.200 MG/Yr	
AUTHORIERD CONSUMPTION			Click here:
Billed metered:	2 7 57,242	The same same and a set of the set of the set of the set	for help using option buttons below
Billed unmetered: Unbilled metered:	n/a n/a	MG/Yr MG/Yr	Pcnt: Value:
Unbilled unmetered:		.200 MG/Yr	O • 764.200
		AND PROPERTY AND	
AUTHORIZED CONSUMPTION:	58,006	.600 MG/Yr	bercentage of water supplied
			OR value —
MATER LOSSES (Water Supplied - Authorized Consumption)	26,650	.600 MG/Yr	
Apparent Losses	2 086	202	Pont: Value:
Unauthorized consumption:	8 2,086	.300 MG/Yr	0 2,086.300
Customer metering inaccuracies:	2 8 190	.300 MG/Yr	0 190.300
Systematic data handling errors:	2 5 4,674	And the second se	
	6.053	and the second second	Choose this option to enter a percentage of
Apparent Losses:	6,931	.000 MG/Yr	billed metered
Real Losses	Summer and the		Consumption. This is NOT a default value
Real Losses = Water Losses - Apparent Losses:	19,699	.600 MG/Yr	
WATER LOSSES :	26,650	.600 MG/Yr	
NOR-REVENUE RATER			
NON-REVENUE WATER:	2 27,414.	.800 MG/Yr	
SYSTEM DATA	C. Standaller March		A WARD AND A REAL OF A REAL OF
Length of mains:	2 9 3,13	37.0 miles	
Number of active AND inactive service connections:	7 547,	,932	
Connection density: <u>Average</u> length of customer service line:	and the second se		length between curbstop and customer
		meter	or property boundary)
Average operating pressure: 🗾	2 10	55.0 psi	
COST DATA .	and the second states and the		a tradition of the second states of the second states of the
Total annual cost of operating water system:	2 10 \$219,182	339 \$/Year	
Customer retail unit cost (applied to Apparent Losses):		4.97 \$/1000 gallons (US)	The second s
Variable production cost (applied to Real Losses):	2 9 \$21!	5.50 \$/Million gallons	
PERFORMANCE INDICATORS			
Financial Indicators Non-revenue water as percent by vo	olume of Water Suppl:	ied: 32.4%	and the state with the state of
Non-revenue water as percent by con	ost of operating syst	tem: 17.8%	The second second second second
	cost of Apparent Loss al cost of Real Loss		the state of the second s
Operational Efficiency Indicators			
Apparent Losses per serv:	vice connection per (dav: 34.76	gallons/connection/day
Real Losses per servio	CONSTRAINED BY		gallons/connection/day
THE OF THE PARTY AND A	length of main per da		ACCESSION IN THE REPORT OF THE REPORT OF
	A CONTRACTOR OF A CONTRACTOR OFTA CONTRACTOR O		and the second second second second second
Real Losses per service connection per	STUDENT COLOR		gallons/connection/day/psi
Unavoidable Ann	ual Real Losses (UAN	(L): 2,178.15	million gallons/year
Infrastructure Leakage Index (II	LI) [Real Losses/UA)	RL]: 9.04	
* only the most applicable of these two indicators will be calcu	ulated		
WATER AUDIT DATA VALIDITY SCORE:	Part State State State	F-F-State #	A DOLLAR DE LA DELARIZA
*** YOUR SCO	DRE IS: 82 out	of 100 ***	
A weighted scale for the components of consumption and was	ter loss is included i	n the calculation of the Wa	ater Audit Data Validity Score
PRIORITY AREAS FOR ATTENTION:			Share and a New York of the State
Based on the information provided, audit accuracy can be	a improved by addres	sing the following compon	nents:
1: Volume from own sources	Contraction Service		
2: Billed metered	For more informat	ion, click here to see the Gradi	ing Matrix worksheet
3: Systematic data handling errors	TO THE WILL DO THE	A CONTRACT OF AND	

AWWA WLCC Free Water Audit Softwar Copyright@2009.American Water Works Association. All Reg			Back to Instructions
Click to access definition Water Audit Report for: Regional			Svill
Reporting Year: 2008	1/2008 - 12/2008		
Please enter data in the white cells below. Where available, metered values should be used; if input data by grading each component (1-10) using the drop-down list to the left of the input ce All volumes to be entered as: M	II. Hover the mouse over the	e cell to obtain a description of	the grades
	< Enter grading in	A Designed to the second second second	
Volume from own sourcea: 🚺 7	213,977.000	Megalitres/yr (or ML/Y	r)
Master meter error adjustment: 2 4 Water imported: 2 n/a	0.000	ML/Yr	ML/Yr
Water exported: 7	26,457.500	ML/Yr	
WATER SUPPLIED:	187,519.500	ML/Yr	
AUTHORIZED CONSUMPTION Billed metered: 7			Click here:
Billed unmetered:	163,665.000 433.900	ML/Yr ML/Yr	for help using option buttons below
Unbilled metered: 2 8	1,768.400	And the second se	Pont: Value:
Unbilled unmetered: 2 5	230.100	ML/Yr	230.100
AUTHORIZED CONSUMPTION:	166,097.400	ML/Yr	Use buttons to select
			percentage of water supplied <u>QR</u>
WATER LOSSES (Water Supplied - Authorised Consumption)	21,422.100	ML/Yr	value
Apparent Losses		F	Pont: Value:
Unauthorized consumption:	886.800	ML/Yr	0 0 886.800
Customer metering inaccuracies: 7	2,851.000	ML/Yr	0 2,851,000
Systematic data handling errors:	0.000	ML/Yr	0 9 2,851.000
Systematic data handling errors are likely, please enter			Choose this option to enter a percentage of
Apparent Losses:	3,737.800	ML/Yr	billed metered consumption. This is
Real Losses			NOT a default value
Real Losses = Water Losses - Apparent Losses:	17,684.300		
WATER LOSSES :	21,422.100	ML/Yr	CALIFORNIA STRATEGY S
NON-REVENUE NATER NON-REVENUE WATER:	22 420 600	100 100-	
= Total Water Loss + Unbilled Metered + Unbilled Unmetered	23,420.600	PLL/IT	A start and a start of the start of the start of the
SYSTEM DATA			
Length of mains: 7 8 Number of <u>active AND inactive</u> service connections: 7 9	4,161.0	kilometers	
Connection density:	287,905	conn./km main	
Average length of customer service line: 7	16.0	metres (pipe 1) meter or	angth between curbstop and customer r property boundary)
Average operating pressure: 📰 🚺	58.4	metres (head)	
COST DATA			
Total annual cost of operating water system: 2 3 Customer retail unit cost (applied to Apparent Losses): 2 10	\$100,000,000 \$0.64	\$/Year \$/1000 litres	and the second se
Variable production cost (applied to Real Losses): [1]		\$/Megalitre	
Retail costs are less than (or equal to) production	n costs; please re	view and correct if n	ecessary
PERFORMANCE INDICATORS			
Financial Indicators Non-revenue water as percent by volume or	f Water Supplied.	12.5%	
Non-revenue water as percent by cost of a	operating system:	15.0%	
	Apparent Losses: t of Real Losses:	\$2,399,668 \$11,353,321	
Operational Efficiency Indicators		011,000,001	
Apparent Losses per service con	nnection per day:	35.57 1	itres/connection/day
Real Losses per service com	nection per day*:	The second s	itres/connection/day
Real Losses per length of			
Real Losses per service connection per day per meter			itres/connection/day/m
Unavoidable Annual Rev		ALC: NOT A CONTRACT OF A	ubic meters/year
		0,900.91 C	woode, lagt
Infrastructure Leakage Index (ILI) [Re	eal Losses/UARL]:	1.97	
* only the most applicable of these two indicators will be calculated			
WATER AUDIT DATA VALIDITY SCORE:			
*** YOUR SCORE I	S: 64 out of	100 ***	
A weighted scale for the components of consumption and water los	s is included in the	calculation of the Wat	er Audit Data Validity Score
PRIORITY AREAS FOR ATTENTION:			The Contract of the Local
Based on the information provided, audit accuracy can be impro	ved by addressing	the following compone	ents:
1: Volume from own sources	The second second		
2: Master meter error adjustment	or more information, c	lick here to see the Gradin	g Matrix worksheet
3: Billed unmetered		NEW TANKS OF D	
	and the second		

AWWA WLCC Free Water Audit Software: <u>Acknowledgements</u> Copyright © 2009, American Water Works Association. All Rights Reserved. WAS v4.0	AWWA Water Audit Software Version 4.0 Developed by the Water Loss Control Committee of the American Water Works Association April 2009	This software is intended to serve as a basic tool to compile a preliminary, or "top- down", water audit. It is recommended that users also refer to the 3rd Edition AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.	DEVELOPED BY: ANDREW CHASTAIN-HOWLEY, Miya Water DAVID GOFF, P.E. Goff Water Audits & Engineering GEORGE KUNKEL, P.E. Philadelphia Water Department ALAIN LALONDE, Veritec Consulting DAVID SAYERS, Delaware River Basin Commission	 REFERENCES: - Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272 - Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65 - AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009 - Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

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AWWA Water Loss Control Committee

er Loss Control Committee (WLCC) Free Water Audit Software v4.0 Copyright© 2009. American Water Works Association. All Rights Reserved.	PURPOSE: This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water stribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.	USE: The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons on the left below. Descriptions of each sheet are also given below.		ing the following information, then proceed through each sheet in the workbook:	CITY OR UTILITY: Laguna Beach County Water District COUNTRY: USA	2007	ON: Rich Mathis E-MAIL: mathis@lbcwd.org TELEPHONE:	D REPORTING UNITS FOR WATER VOLUME: Acre-feet		The current sheet	Buter the required data on this worksheet to calculate the water balance	The values entered in the Reporting Worksheet are used to populate the water balance	Depending on the confidence of audit inputs, a grading is assigned to the audit score	Diagrams depicting possible customer service connection configurations	Use this sheet to understand terms used in the audit process	Use this sheet to interpret the results of the audit validity score and performance indicators			If you have questions or comments regarding the software please contact us at: <u>who@awwa.org</u>	
AWVA Water Loss	PURPOSE: This spreadsheet-based water distribution systems and identify areas format, and is not mear	USE: The spreadsheet c or by clicking the but	THE FOLLOWING KEY APPLIES THROUGHOUT:	Please begin by providing the following i	NAME OF CITY OR UTILI	REPORTING YEAR:	NAME OF CONTACT PERSON: Rich Mathis	PLEASE SELECT PREFERRED REPORTING UNITS FOR	Click to advance to sheet.	Instructions	Reporting Worksheet	Water Balance	Grading Matrix	Service Connections	Definitions	Loss Control Planning	Add comments here to	track additional supporting information, sources or names of participants		

Instructions 1

AWWA WLCC Free Water Audit Softw Copyright© 2009, American Water Works Association:		g Worksheet WASV4.0	Back to Instructions
Click to access definition Water Audit Report for: Legun Reporting Year: 200		District	
Please enter data in the white cells below. Where available, metered values should be us input data by grading each component (1-10) using the drop-down list to the left of the im All volume	sed; if metered values are unava put cell. Hover the mouse over th es to be entered as: ACRE-F	e cell to obtain a description of the grad	our confidence in the accuracy of the es
WATER SUPPLIED	<< Enter grading in		
Volume from own sources: 7 Master meter error adjustment (enter positive value): 7	0.000	acre-ft/yr	acre-ft/vr
Water imported: 7 Water exported: 7	4,569.480	acre-ft/yr acre-ft/yr	
WATER SUPPLIED:		acre-ft/yr	
AUTHORIZED CONSUMPTION			Click here:
Billed metered: 2 Billed unmetered: 2	4,457.450	acre-ft/yr acre-ft/yr	for help using option buttons below
Unbilled metered: 2 Unbilled unmetered: 2	8.770	acre-ft/yr Pcnt:	Value:
	8.770	acre-ft/yr	O ● [8.770
AUTEORIERD CONSUMPTION:	4,466.220	acre-ft/yr	Use buttons to select percentage of water supplied <u>OR</u>
WATER LOSSES (Water Supplied - Authorized Consumption)	103.260	acre-ft/yr Pcnt:	Value:
Unauthorized consumption:	and the second se	acre-ft/yr 0.25%	
Default option selected for unauthorized consumption - Customer metering inaccuracies: 2		acre-ft/yr	0
Systematic data handling errors:		acre-ft/yr	
Systematic data handling errors are likely, please en Apparent Losses:	11.424	otherwise grade = 5	Choose this option to enter a percentage of billed metered
Real Losses			consumption. This is NOT a default value
Real Losses = Water Losses - Apparent Losses:	91.836	acre-ft/yr	
MATER LOSSES :	103.260	acre-ft/yr	
NON-REVENUE WATER NON-REVENUE WATER:	112.030	acre-ft/yr	
= Total Water Loss + Unbilled Metered + Unbilled Unmetered SYSTEM DATA			
Length of mains:	135.0	miles	
Number of <u>active AND inactive</u> service connections:	8,513	conn./mile main	
Average length of customer service line:	30.0	ft (pipe length be meter or proper	stween curbetop and customer rty boundary)
Average operating pressure:	65.0	psi	
COST DATA			
Total annual cost of operating water system: Customer retail unit cost (applied to Apparent Losses):	\$6,900,000	\$/Year \$/100 cubic feet (ccf)	and the first in
Variable production cost (applied ta Real Losses):		\$/acre-ft/yr	The second
PERFORMANCE INDICATORS			
Financial Indicators			
Non-revenue water as percent by volum Non-revenue water as percent by cost	the state of the second s	2.5%	
	t of Apparent Losses: cost of Real Losses:	\$15,924 \$47,663	
Operational Efficiency Indicators			
Apparent Losses per service	e connection per day:	1.20 gallons,	/connection/day
Real Losses per service		and the second se	/connection/day
Real Losses per leng Real Losses per service connection per d	th of main per day*:	N/A	
and the second sec	L Real Losses (UARL):	56.23 million	connection/day/psi
Infrastructure Leakage Index (ILI) * only the most applicable of these two indicators will be calcula		0.53	
WATER AUDIT DATA VALIDITY SCORE!			
Add a grading value for 11 parameter	(s) to enable	an audit score to	be calculated
	(), 00 014010	addet BCOIG CO	at carcurated
PRIORITY AREAS FOR ATTENTION:			
Based on the information provided, audit accuracy can be in	mproved by addressing	the following components:	
1: Water Imported 2: Billed metered	For more information	lick here to see the Grading Matri	worksheet
3: Customer metering inaccuracies		new nere to see the endoing watch	A MOLASINEEL
	and the state of the second second		

AWWA WLCC F	'ree Water A	AWWA WLCC Free Water Audit Software:	re: <u>Water Balance</u>	Water Audit Report For:	Report Yr:
	Copyright © 2009, America	Copyright © 2009. American Water Works Association. All Rights Reserved.	. All Rights Reserved. WAS v4.0	District	2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 4,457.450	Revenue Water
Own Sources (Adjusted for		Authorized Consumption	4,457.450	Billed Unmetered Consumption 0.000	4,457.450
known errors)		4,466.220	Unbilled Authorized Consumption	Unbilled Metered Consumption 0.000	Non-Revenue Water (NRW)
0.000			8.770	Unbilled Unmetered Consumption 8.770	
	Water Supplied			Unauthorized Consumption	112.030
			Apparent Losses	11.424	
	4,569.480		11.424	Customer Metering Inaccuracies 0.000	
				Systematic Data Handling Errors	
	「「「「「「「」」」	Water Losses		0.000	ALL ALL ALL ALL ALL
Water Imported		103.260		Leakage on Transmission and/or Distribution Mains	
			Real Losses	Not broken down	A THE R. P. LEWIS CO.
4,569.480			91.836	Leakage and Overflows at Utility's Storage Tanks	
ALL PROPERTY			Contraction of the second second	Not broken down	A STATE STATE
	a subset			Leakage on Service Connections Not broken down	
A CONTRACTOR OF A CONTRACTOR O					

Water Balance 3

10	barnation 10: barnation 10: Contrau to refine pairy and procedures with intertion of procedures with intertion of uses of varia in unbied and uses of varia in unbied and care frequent be converted eventually.		Clear policies and to identify all communication and uncontradurase of water. Staff and procedures sust provide information for bioleas to and deter violations. Each occurrence is quantified via formula (time x typical flow) or similar methods.	Ra matimatian 10: Construes to retine policy and proposatines to retine policy and poppulaes that allow or tability poppulaes that allow or tability or the commentation and extronoment of them.	Good records of rumber, type and size of custome meters: corporate meter replacement occurs. Regular meter excurse) testing offers initiable mesare of others initiable mesare of the system. New metering for the ordery is embrandory technology is embrandory	la maintain 10. Increase the number of motions the function of explosion at justified by make accuracy test data. Continuary monitor a development of new technology in Assenced Meeting Interactionation to the grasp opportunities for greate continery in meticing and customer consumption data.
8	Maility for 10: condumes to ensure th memberod water are on mitting process mana mitting process mana of these uses have w billed and/or metered		Clear policies and good recordiseeping east for centain events (or competing water) water metans), often cocumencial water metans), often cocumencial water metano events (or contransion of bytween from formulate (time x typical from formulate (time x typical from and antiproce- estimates of unconfined estimates of unconfined	<u>Io qualify loc 10</u> Reline writen procedures and assign saft to seak out likely occurrences of unathrontand consumption. Ecyton exclang devices, monitors and other transforced consumption to detect and threat unauthrotized consumption.	Cregoring meter replacement and Courtery testing result in highly accurate sustant meter accurate sustant meter courtering testing is contained behaven on samples of meters at varying ittegaren to detamine optimum replacement time for various integracement time for various	In subtrive to the second seco
9	to quick for the stand of the stand of the stand for the second mean to the system stand for the stand for the stand. Create an end documentation of the system start use and documentation of the system start watter utility personnel.		Cohenent policies axist for some forms of unauthorized consumption but others the same consumption but others the consumption but others are dosen realization. Reasonable constitutions and for occurrences that it axist for occurrences that it and it of a same outher the activity of the available by inference from these records. Unsupervised uses are guestimeted.	In cutoffic for 8: Assess water uffly policies to ensure that at from couransess of manufactual comunitytion and documentation of various occurrences of unautherized consumption as they are uncovered.	A reliable electronic recordirespin program for meters acsa: Propulation includes a mix of new high performing meters and dated meters with suspect and dated meters with suspect accuracy results, builtimited. Band 8 meter accuracy testing and meter replacement court, insecuracy volume 8 quantified using a mix of reliable and tess certain data.	In <u>Date in the second second second second</u> second meter regeneration of your second
Grading 4 5	Lo qualify for C anality for C anality for L and the formation of the comparison of	APPARENT LOSSES	Procedures axist to document some unsufficient document such as observed unsufformized (ite hydram) opsening, Use (ite hydram) opsening, Use (ontuides to quantify his consumption (time running x typical flowrate x runnise of evalue di evalue di	In the second default values and the default of the default of the default values are applied and the default values are applied and the default values are applied and the default of the	Reliable record(seeping exists: meet information is improving as meets are replaced. Manual meets are replaced. Manual accuracy leating is conducted conditions accuracy resting table of meters. United number of older meters are and immediate the conducted acch year. Intercuracy volume is target intercuracy volume is target acting data.	io guality for 6: Sandardan procedures for meter contenence with the electronic information ferm. Accederate meter accuracy susting and the replacements guided by leading reach.
2	No quality for S. Uthere according default value of 1.25% of system function values as an expedient neares to gain a reasonable quarititeation of the use. Logality a reasonable quarititization of the use. Evaluate the dispartmettion of events that have been observed. Meat with user groupe (arc for fire hydrimits - the dispartments, contractures to accentian that' need for water from the hydraute).		Unauthorized consumption is a known occurrance, but its addent is a mysery. There en no requirantes to docurrent outserved events, but periodic field between 2 exports actions some of these and 4 consumption is approximated from this limited data.	ba accepted datauf of 0.25% of system input volume volume bactured of the system of the system is castification of the system uses are considered unautifordant, and consider are considered unautifordant, and consider the system operange) (or unsuthorized fire hydraet operange)	Poor record/seping and metar oversign is record/seping and metar unity management with bes allothed staff and funding resources to organize minor records gath and metar records gathered and organized to provide curary disposition of metar population.	In the second se
-	In shallin hor 5: Untrans mecophicit deflacts value of 1.20% of appentin input volume as an expondent memory operation of the memoralise qualification of the memoralise qualification of the appending what vector uses should be what vector uses anough of an excellent of the hydrard fueldings.		Edent of uneuthorized consumption is unknown due consumption is unknown due uneuthorized consumption is guesstimated.	Las accuatifications of system inpact values of system inpact values of the system inpact values frequent values are visit values are visit values are considered value values are considered values of one auching a much constrement operatings)	Customer meters axist, but with uncorrection meters records on meters. In meters recuracy testing or meter replacement program. Workfow is driven chaolically prostomer managoment. Loss volume due to sgraptes meter indecuracy is quessimated.	In Smallh for 2 Carlor evellable meter purchase revellable meter purchase revellable meter purchase revellable meter restriction on a mutil method to be inscortation. Favious satifing revellation and to be the budget for monsessity resources to bethe organics meter management.
. Na	Improvements to attain higher data gradio (or "unitiod Unitediend Consumption" component:		Unauthorizad consumption:	Improvements to attain higher data grading for Unsurbratiad Consumption* component:	Customer metering Customer metering inaccuracies: unmetered	International data and a statish higher and a guardia and a guardia and a guardia and an and and and and and and and and

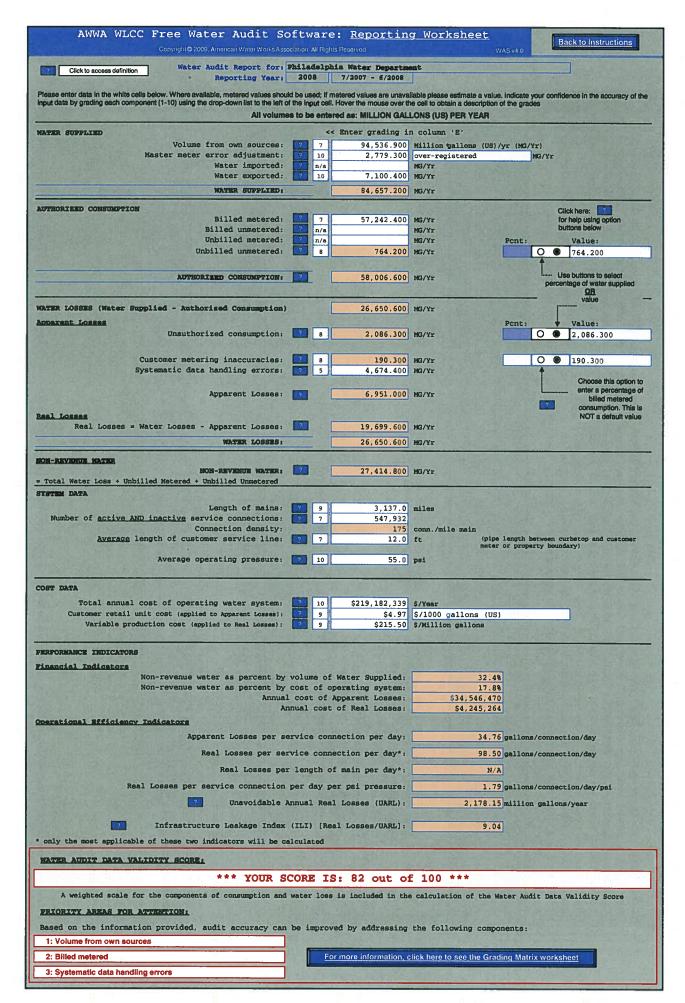
o Back to Instructions			Level V (91-100)	ces Annual water audit is a reliable gauge of year-to-year water efficiency standing	d Stay abreast of improvements in metering, metering, pilling, leakage management and infrastructure rehabilitation	 Continue incremental Improvements in short-term and Iong-term loss control interventions 	Ir Evaluate and refine loss control goals on a yearly basis	 Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service 	ved.
Loss Standing WASV4.0	de	I / Score	Level IV (71-90)	Refine data collection practices and establish as routine business process	Refine, enhance or expand ongoing programs based upon economic justification	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Performance Benchmarking - ILI is meaningful in comparing real loss standing	better data validity is achie
Determining Water Loss Standing Mation All Rights Reserved.	Water Loss Control Planning Guide	Water Audit Data Validity Level / Score	Level III (51-70)	Establish/revise policies and procedures for data collection	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Establish long-term apparent and real loss reduction goals (+10 year horizon)	Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	hould not be focus areas until
Software: erican Water Viorks Asso	Water Loss Con	Water /	Level II (26-50)	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.			50 or below, the shaded blocks should not be focus areas until better data validity is achieved
Water A			Level I (0-25)	Launch auditing and loss control team; address production metering deficiencies	Research information on leak detection programs. Begin flowcharting analysis of customer billing system				For validity scores of 50
AWWA WLCC Free			Functional Focus Area	Audit Data Collection	Short-term loss control	Long-term loss control	Target-setting	Benchmarking	

Loss Control Planning 16

Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage The lower the amount of leakage and Once data has been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control Index (ILI) that is appropriate for their water system and local conditions. real losses that exist in the system, then the lower the ILI value will be.

The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is <u>Note:</u> this table offers an approximate guideline for leakage reduction target-setting. useful if such an assessment is not possible.

	General Guidelines (without doing a full economic	nes for Setting a Target ILI mic analysis of leakage control options)	LI ntrol options)
Target ILI Range	Financial Considerations	Operational Considerations	Water Resources Considerations
0.E - 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 is 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 water resources are believed to be capability is sufficient to meet long-term needs long-term demand as long as but demand management intervention reasonable leakage management (leakage management, water controls are in place. long-term planning.	Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term planning.
>5.0 - 8.0	Cost to purchase or obtain/treat water is low, as are rates charged 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 leakage is not an effective utilis other than as an incremental goal	<pre>L considerations may allow a long-term ILI greation of water as a resource. Setting a target to a smaller long-term target - is discouraged</pre>	g-term ILI greater than 8.0, such a level of Setting a target level greater than 8.0 - is discouraged.
Less than 1.0	If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI 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.	<pre>Afrastructure Leakage Index (IUI) value for your system is 1.0 or less, two possibiliti maintaining your leakage at low levels in a class with the top worldwide performers in A portion of your data may be flawed, causing your losses to be greatly understated. Ou calculate a low ILL value but do not employ extensive leakage control practices in y cases it is beneficial to validate the data by performing field measurements to confi duction and customer meters, or to identify any other potential sources of error in the</pre>	is 1.0 or less, two possibilities the top worldwide performers in sses to be greatly understated. e leakage control practices in your ming field measurements to confirm otential sources of error in the



Camporting 2000 Annexet/Walk Subcoders All Hybrid Figures Page 1 Image: Control of the second and
Control continuition Reporting Year (2008) 1/2006 - 13/2008 Peace enter data in the while cells below. Where exalishing, methand values are unavailable please estimate a value. Indicate your confidence in the accumcy of the individual are unavailable please estimate a value. Indicate your confidence in the accumcy of the individual are unavailable please estimate as value. Indicate your confidence in the accumcy of the individual are unavailable please estimate as value. Indicate your confidence in the accumcy of the individual are unavailable please estimate as value. Indicate your confidence in the accumcy of the individual are unavailable please estimate as value. Indicate your confidence in the accumcy of the individual are expected. WATER SUPPLIED
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WATER LOSSES (Water Supplied - Authorised Consumption) 21,422.100 HL/Yr Pent: Value: Annarmat Losses Unauthorized consumption: 2 5 886.800 HL/Yr Pent: Value: Customsr metering inaccuracies: 2 7 2,851.000 HL/Yr 0 2,851.000 Systematic data handling errors: 2 7 2,851.000 HL/Yr 0 2,851.000 Systematic data handling errors are likely, please enter a non-zero value; otherwise grade = 5 0.000 HL/Yr Choose this option to enter a percentage of billed metered consumptions. This is NOT a default value Real Losses 3,737.800 HL/Yr 0 0 0.000 multivalue NOT a default value 17,684.300 HL/Yr 0 0.000multivalue 0.000multivalue Real Losses 17,684.300 HL/Yr 0 0.000multivalue 0.000multivalue NOT a default value 17,684.300 HL/Yr 0 0.000multivalue 0.000multivalue NOT a default value 17,684.300 HL/Yr 0 0.000multivalue 0.000multivalue NOT a default value 0 23,420.600 HL/Yr
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Real Losses Dilied metered Real Losses Water Losses - Apparent Losses: 17,684.300 ML/Yr WATER LOSSES; 21,422.100 ML/Yr NON-REVENUE WATER; 23,420.600 ML/Yr - Total Water Loss + Unbilled Metered + Unbilled Unmetered ML/Yr SYSTEM DATA Length of mains: 8 4,161.0 Kilometers Number of active AND inactive service connections: 9 287,905 Xilometers
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NON-REVENUE WATER: 23,420.600 ML/Yr = Total Water Loss + Unbilled Metered + Unbilled Unmetered ML/Yr SYSTEM DATA Length of mains: 2 Number of active AND inactive service connections: 2 9 287,905
Total Water Loss + Unbilled Metered + Unbilled Unmetered SYSTEM DATA Length of mains: 2 8 4,161.0 Number of <u>active AND inactive</u> service connections: 2 9 287,905
SYSTEM DATA Length of mains: 8 4,161.0 Number of <u>active AND inactive</u> service connections: 9 287,905
Length of mains: 8 4,161.0 Number of active AND inactive service connections: 9 287,905
Number of active AND inactive service connections:
Average length of customer service line: 2 5 16.0 metres (pipe length between curbstop and customer meter or property boundary)
Average operating pressure: 7 6 58.4 metres (head)
COST DATA
Total annual cost of operating water system: 🔽 3 \$100,000,000 \$/Year
Customer retail unit cost (applied to Apparent Losses): 7 10 \$0.64 \$/1000 litres
Variable production cost (applied to Real Losses): 10 \$642.00 \$/Megalitre Retail costs are less than (or equal to) production costs; please review and correct if necessary
PERFORMANCE INDICATORS
Financial Indicators Non-revenue water as percent by volume of Water Supplied:
Non-revenue water as percent by cost of operating system: 15.0%
Annual cost of Apparent Losses: \$2,399,668
Annual cost of Real Losses: \$11,353,321
Apparent Losses per service connection per day: 35.57 litres/connection/day
Real Losses per service connection per day*: 168.29 litres/connection/day
Real Losses per length of main per day*: N/A
Real Losses per service connection per day per meter (head) pressure: 2.88 litres/connection/day/m
2 Unavoidable Annual Real Losses (UARL): 8,960.91 cubic meters/year
or source and a source of the source and a source
Infrastructure Leakage Index (ILI) [Real Losses/UARL]: 1.97
* only the most applicable of these two indicators will be calculated
WATER AUDIT DATA VALIDITY SCORE:
*** YOUR SCORE IS: 64 out of 100 ***
A weighted scale for the components of consumption and water loss is included in the state of the state of the
A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score
PRIORITY AREAS FOR ATTENTION:
PRIORITY AREAS FOR ATTENTION: Based on the information provided, audit accuracy can be improved by addressing the following components:
PRIORITY AREAS FOR ATTENTION:
PRIORITY AREAS FOR ATTENTION: Based on the information provided, audit accuracy can be improved by addressing the following components:

				16-10-11
Free Water Audit Software: Acknowledgements Copyright © 2009. American Water Works Association. All Rights Reserved WAS v4.0	ftware Version 4.0 Developed by the Water Loss Control Committee of the American Water Works Association April 2009	This software is intended to serve as a basic tool to compile a preliminary, or "top- down", water audit. It is recommended that users also refer to the 3rd Edition AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.	ANDREW CHASTAIN-HOWLEY, Miya Water DAVID GOFF, P.E. Goff Water Audits & Engineering GEORGE KUNKEL, P.E. Philadelphia Water Department ALAIN LALONDE, Veritec Consulting DAVID SAYERS, Delaware River Basin Commission	- Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272
AWWA WLCC Free Water Copyright © 2009. Americ	AWWA Water Audit Software Ver the America	This software is intended to down", water audit. It is rec Publication, Water Audits and I comprehensive, or "bottom-u	DEVELOPED BY: ANDREW CHASTAIN-HOWLEY, Miya Water DAVID GOFF, P.E. Goff Water Audit GEORGE KUNKEL, P.E. Philadelphia ALAIN LALONDE, Veritec Consulting DAVID SAYERS, Delaware River Basin	- Alegre, H., Hirner, Supply Services. IWA
	AWWA Wat	This so down", we Publicati compre	DEVELOPED BY	REFERENCES:

- Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65

- AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009 - Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

Acknowledgements 20

Loss Control Committee (WLCC) Free Water Audit Software v4.0 Copyright® 2009. American Water Works Association. All Rights Reserved.	spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water ems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.	USE: The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons on the left below. Descriptions of each sheet are also given below.	THROUGHOUT: Value can be entered by user Value calculated based on input data mbcc calls contribution contribution and definit contribution		CITY OR UTILITY: Moulton Niguel Water District COUNTRY: USA	2007 START DATE (MM/YYYY): 07/2006 END DATE (MM/YYYY): 06/2007	Charles Roy B-MAIL: Croy@mnwd.com TELEPHONE: 949-425-3517	PLEASE SELECT PREFERRED REPORTING UNITS FOR WATER VOLUME: Acre-feet	Click here: 2 for help about units and conversions	The current sheet	Enter the required data on this worksheet to calculate the water balance	The values entered in the Reporting Worksheet are used to populate the water balance	Depending on the confidence of audit inputs, a grading is assigned to the audit score	Diagrams depicting possible customer service connection configurations	Use this sheet to understand terms used in the audit process	Use this sheet to interpret the results of the audit validity score and performance indicators		If you have questions or comments regarding the software please contact us at: wic@awwa.org
AWWA Water	PURPOSE: This spreadsheet-based water distribution systems and identify areas format, and is not mear	USE: The spreadsheet cont or by clicking the button	THE FOLLOWING KEY APPLIES THROUGHOUT:	Please begin by providing	NAME OF CITY OR UTILITY:	REPORTING YEAR:	NAME OF CONTACT PERSON: Charles Roy	PLEASE SELECT PREFERRED R	Click to advance to sheet.	Instructions	Reporting Worksheet	Water Balance	Grading Matrix	Service Connections	Definitions	Loss Control Planning	<u>Comments</u> here to Add comments here to track additional supporting information, sources or names of	

Instructions 1

AWWA WLCC Free Water Audit S Copyright© 2009, American Water Works Ase			g Worksheet WAS v4 0	Back to Instructions
Click to access definition Water Audit Report for: Reporting Year:	Moulton N			
Please enter data in the white cells below. Where available, metered values show input data by grading each component (1-10) using the drop-down list to the left	uid be used; I(of the input ce	metered values are unava ii. Hover the mouse over the	ne cell to obtain a description of the g	te your confidence in the accuracy of the rades
All	volumes to	be entered as: ACRE-F	EET PER YEAR	
WATER SUPPLIED		< Enter grading is		
Volume from own sources: Master meter error adjustment (enter positive value):	2	0.000	acre-ft/yr	acre-ft/yr
Water imported: Water exported:		36,410.000	acre-ft/yr acre-ft/yr	
MATER SUPPLIED:		36,410.000	A CARL CONTRACTOR OF THE ADDRESS OF	
AUTEORIZED CONSUMPTION	STRATES (Click here: 2
Billed metered:		33,175.000	acre-ft/yr	for help using option buttons below
Billed unmetered: Unbilled metered:			acre-ft/yr acre-ft/yr Pcnt	
Unbilled unmetered:		1,400.800	acre-ft/yr	0 0 1,400.800
AUTHORISED CONSUMPTION:		24 575 800		Luse buttons to select
AUTHORIZED COASURPTION		34,575.800	acre-ft/yr	percentage of water supplied
WATER LOSSES (Water Supplied - Authorised Consumption)		1 834 200	acre-ft/yr	value -
Apparent Losses	1254 16		Pent	: Value:
Unauthorized consumption:	and the second s		acre-ft/yr 0.25	
Default option selected for unauthorized consumpt:	and the second s		The state of the s	
Customer metering inaccuracies: Systematic data handling errors:		0.000	acre-ft/yr acre-ft/yr	
Systematic data handling errors are likely, plea	and the second sec	a non-zero value;		Choose this option to enter a percentage of
Apparent Losses:	?	91.025		billed metered
Real Losses				NOT a default value
Real Losses = Water Losses - Apparent Losses:		1,743.175	A	
WATER LOSSES:		1,834.200	acre-ft/yr	ALL SHELLINGS
NOM-REVENUE MATER EXXI-REVENUE MATER:	2	3,235.000	acre_ft/um	
= Total Water Loss + Unbilled Metered + Unbilled Unmetered		3,233.000	acre-tt/yr	
SYSTEM DATA				
Length of mains: Number of <u>active AND inactive</u> service connections:	2		miles	
Connection density:			conn./mile main	
<u>Average</u> length of customer service line:				n between curbstop and customer operty boundary)
Average operating pressure:	?		psi	
COST DATA Total annual cost of operating water system:				
Customer retail unit cost (applied to Apparent Losses):	2		\$/Year	
Variable production cost (applied to Real Losses):	2	and a second	\$/acre-ft/yr	Las Blog Barry Las Bridge
PERFORMANCE INDICATORS				
Financial Indicators				
Non-revenue water as percent by		the state of the s	8.98	
Non-revenue water as percent by Annua		Apparent Losses:		
A		t of Real Losses:		
Operational Efficiency Indicators				
Apparent Losses per s		the state of the state of the state	And the owner of the owner	ons/connection/day
Real Losses per se		State State State State	The second s	ons/connection/day
Real Losses pe	r length o	of main per day*:	gallo	ons/mile/day
Real Losses per service connection	per day p	per psi pressure:	gallo	ons/connection/day/psi
Unavoidable . *** UARL cannot be calculated as either average pressu		al Losses (UARL) :		
Infrastructure Leakage Index				SEE UARL DEFINITION ***
* only the most applicable of these two indicators will be c	alculated		WARD PROPERTY AND	
WATER AUDIT DATA VALIDITY SCORE :	1937-201		A HEAL MARKED	
Add a grading value for 11 parame	stor(a)	to enable	an audit geore to	a he coloulated
Aut a grating value for it parame	SCOL (S)	to enable	an audit score to	5 be calculated
PRIORITY AREAS FOR ATTENTION:	he former		A. 6.33. 1.	
Based on the information provided, audit accuracy can 1: Water imported	De impro	ved by addressing	the following components	States Bares States
2: Billed metered	F	or more information of	lick here to see the Grading Ma	trix worksheet
3: Customer metering inaccuracies			source to see the drabing ma	ITTA WOLKSINGEL
		Contraction of the		

AWWA WLCC F	AWWA WLCC Free Water Audit Software:	udit Softwar	re: <u>Water Balance</u>	Water Audit Report For:	Report Yr:
	Copyright © 2009, American Water Works Association. All Rights Reserved.	n Water Works Association	1. All Rights Reserved. WAS v4.0	Moulton Niguel Water District	2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 33,175.000	Revenue Water
Own Sources (Adjusted for		Authorized Consumption	33,175.000	Billed Unmetered Consumption 0.000	33,175.000
known errors)		34,575.800	Unbilled Authorized Consumption	Unbilled Metered Consumption 0.000	Non-Revenue Water (NRW)
0.000			1,400.800	Unbilled Unmetered Consumption 1,400.800	
	Water Supplied			Unauthorized Consumption	3,235.000
	36, 410.000		Apparent Losses 91.025	91.025 Customer Metering Inaccuracies 0.000	
		Water Losses		Systematic Data Handling Errors 0.000	
Water Imported		1,834.200	Real Losses	Leakage on Transmission and/or Distribution Mains Not broken down	
36, 410.000			1,743.175	Leakage and Overflows at Utility's Storage Tanks Not broken down	
				Leakage on Service Connections Not broken down	

Water Balance 3

		e ti_		- 16 58	and the second se	20 7 0	2 H
	10	In maturethin 10: Continue to mittine policy and procedures with instantion of modeling the number of althreaded uses of water in unbilled and uses of water in unbilled and team fewatidy become blied area eventualy.		Clear policies exist to identify all hown unsufficient activity all writer. Staff and proceedures axis to provide anticorrement of policies and detect Vidations. Each accurrence is quantified via formutes (time x typical flow) or similar methods.	the second secon	Good records of number, type and size of customer meters: ongoing meter replacement occurs. Regular meter accuracy velue gives reliable measure of composte instanze velume for composte instant. New metering technology is embraged to keep technology is embraged to keep overall accuracy improving.	Burninghi IC Increase the number of meters meter accuracy test data. The formal sector development of new technology in Advanced free sectoredy in Advanced prespondenties for greater accuracy in metering and customer comunitation data.
	8 8	that all a oversear anaged by a point, to a status ared status		Conditions between 8 and 10	n staff to uthorized devices. sumption	Conditions between 8 and 10	opulation setto and ypes and ustomer improving
Contraction of the second	8	Io Javilly for 10: Perfine write Decession to ensure that all uses of undilided, vermeinered water are overseen by a structured performer. Teaseness perforey to determine if acres of these uses these values in being converted to billed and/or matered status.		Clear policies and good recorditerphing exist for extrain meters), of their occurrences fixer minited oreganity. Total consumption is a combination of volumes from formulate (time is typical flow) and subjective estimates of uncontinend consumption.	Io quality to 10 Refine writen procedures and assign saft to seas out likely occurrances of analythorized consumption. Explore new locking devices, monitors and other technologies designed to detect and threat unauthorized consumption.	Orgoing meter replacement and accuracy restrin replacement and accuracy escing result in high accuracy escing accurate annelse of meters at verying titespans to determine optimum replacement time for verticus types of meters.	In <u>Datific 10</u> : Contrarue of ID <u>Datific 10</u> : Contrarue of IDD Datification metales provided on with metales and replacement. Evaluate new metal types and traditioner excounts each year in croter to plat improving excounts each year in croter to plat improved metalenge excounts each year in croter to plat improved metalenge excounts each year in croter to plat improved metalenge excounts each year in croter to plat improved metalenge excounts each year in croter to plat improved metalenge excounts each year in croter to plat improved metalenge excounts each year in croter to plat improved metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the top of the second metalenge excounts each year in the second metalenge excounts each ye
	7	edures to issued for r. Creation rearned.		Conditions between 6 and 6	no that eli rized I that 1. Create Antado ontard ered.	Conditions between 6 and 8	eting to mither of mather disticually g meters
	9	<u>Bacarity lat 8</u> : Assess water utility patity and procedures to ensure that the hydrant parameter stated for use by pensors outside of the utility. Create writter procedures for use and documentation of the hydrarith by writter utility personnel.		Coherent policies asts for some forms of unauthorized construption to drains await closer evaluation. Rassonable closer evaluation. Rassonable asts for occurrences that fail under the policy. Volumes quartie of yinternea from these records. Unsupervised uses are guessimated.	to guality the 3 Assess water utility policien to ensure that all known courrentees of unauthorized consumption are outdread, and that expropted an and documentation d'enfous occumences of unauthorized consumption is they are uncovered.	A reliable elsectronic recordreaping system for malens of new high performing means of new high performing means and dated means with support means recurrancy resing and mean means recurrancy variang and mean recurrancy volume is quantified using a mix of reliable and less certain data.	<u>to cuality for 8:</u> E-point annual metric accuracy setting to evaluate a statistically algorithment tumber of metric matecenhoodise. Expand meter replacement program to replace statistically significant number of poor performing measure such year.
	2	Lo quality for Loc greaters Frankins Proventia on field checks Proceedin top-clowm top		Default value of 0.25% of system input volume employed	As quality for 6 or consulta- foreitae do field do field checks. Proceed it top-clown	Conditions between 4 and 6	noter Mometion testing and ing results.
Grading	4	to crastify for £: bo crastify for £: Utilities eccoped default vatue of 1.25% of argains input vature as according framerits og sin a reasonable quantification of al arcount use. The particularity appropriate for vatur utilities who an in the early stages of the water auditing process.	APPARENT LOSSES	Procedures exist to document proceedures exist to document such as observed unauthorized for hydrant openings. Use formulae to quantify this consumption (time running x typical forwats x number of events).	In <u>Data Physics</u> In <u>Data Brown</u> Ultime accorded data thread University of the state of the secondary of whome as approxime for a acch use. This is particularly appropriate for the same utility process.	Reliable recordresping avidst, meler information is improving as merans are supplexed. Meler accuracy testing is conducted accuracy testing is conducted meters. Limited number of meters unitation or anait number of meters automation or anait number meters aplead deach year.	Bo sufficiency in the second mark in the second second mark in the second second mark in the second second mark is second second mark in the second
	6			conditions between 2 and 4	ystem input watter uses consider cocursion	Conditions between 2 and 4	system for by using by using usitomer r socuracy than.
	2	<u>In the second default for 5:</u> Utilize accepted default waise of 1.55% of system input volume as an opposited means to gain a reasonable quantification of the use. Decention and the second the second been determed. Mean thin user groupe (or for for hydrams) - the departments, contraction to excertain their mood for wetter from the accertain their mood for wetter from the hydrams).		Unauthorizad consumption is a known occurrance, but is aviating a mystery. There are no requiraments to occurrant observed events, but periodic field observed events, but periodic field appris auptime some of thees occurrances. Total unauthorizad from this limited data.	In 2014/11/12/5 Use accepted default of 0.25% of system input volume Dought/DE-4 Review utility policy water water uses are considered unamborized, and consider are considered unamborized, and consider the considered free hydram openings) (are unamborized free hydram openings)	Poor recorditeeping and meter oversignt is recognized by water utility management wooh has allohed saff and funding recordiseping and start meter records gathering, Existing paper records gathering, Existing paper records gathering paperised to privide oursory disposition of meter population.	In Dutient a multiply (for 4: Inplanment a multiply (for 4: customer motion by the second system for customer motiones typically linked for or part of, the Outsidness for the second of the second the Customer System. Expanded means and the attributes of larger group of meters.
	1	Io guality for 5: Utilities accepted defautti wales of 1.25% of against input Wounse as an acpodiant means to guality for a nearonable quality for a nearonable quality for 2 Establish to 2 polisity regarding what water uses should be what water uses should be what water uses should be what water uses about to a small semple of one such use (act for hydratt fusthing).		Extent of unauthorized consumption is unknown due to unciest poticies and poor to consumption is unauthorized consumption is guesstimated.	to suality for £. Lee accepted default of 2.25% of system input values. Bio suality policy regarding what water uses and considered unumbritation, and considered unumbritation, and of one auch considered unumbritation, the hydrant openings)	Custome melens adst, but with unoparated oper- records on melens; no melen records of testing or meter opticent program. Workflow is driven factorial by custome rempating with no proscher management. Loss volume due la aggregate meler inaccurscy is guesstimated.	In cuality for 2: Cather eventuation motor cather eventuation motor purthane monorks. Conduct being on a remail muchane present another of the most interaction of motor and interaction motor of the motor interaction motor of the motor interaction
	∵. n∕a :					select r/a only if the customer population is unmelered	entrance of the manufacture of t
		triprovements to attach higher data primiti or "Undalled Unnetsned Construction" component:		Unauthorized consumption:	Intervention to attain higher data grading for "Unsutrindrad Constantifion" component:	Customer melering Inscorracies:	Improvements is attain higher data gardo for Vocamer mitter insocurany volume* component:

Back to Instructions		The second s	Level V (91-100)	Annual water audit is a reliable gauge of year-to-year water efficiency standing	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation	Continue incremental improvements in short-term and long-term loss control interventions	Evaluate and refine loss control goals on a yearly basis	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service	
Loss Standing VAS v4:0	de	I / Score	Level IV (71-90)	Refine data collection practices and establish as routine business process	Refine, enhance or expand ongoing programs based upon economic justification	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Performance Benchmarking - ILI is meaningful in comparing real loss standing	For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved
DETERMINING WATER LOSS STANDING solation. All Rights Reserved.	Water Loss Control Planning Guide	Water Audit Data Validity Level / Score	Level III (51-70)	Establish/revise policies and procedures for data collection	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Establish long-term apparent and real loss reduction goals (+10 year horizon)	Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (IL) for performance comparisons for real losses (see below table)	hould not be focus areas until
SOL LWALE : erican Water Works Asso	Water Loss Con	Water A	Level II (26-50)	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.			or below, the shaded blocks si
AWWA WLCC FIEE WATEF AUGIT Copyrght © 2009, Am		AND ADDRESS AND THE	Level I (0-25)	Launch auditing and loss control team; address production metering deficiencies	Research information on leak detection programs. Begin flowcharting analysis of customer billing system				For validity scores of 50 (
AWMA WLCU			Functional Focus Area	Audit Data Collection	Short-term loss control	Long-term loss control	Target-setting	Benchmarking	

Loss Control Planning 16

Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage The lower the amount of leakage and Once data has been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control Index (ILI) that is appropriate for their water system and local conditions. real losses that exist in the system, then the lower the ILI value will be.

The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is Note: this table offers an approximate guideline for leakage reduction target-setting. useful if such an assessment is not possible.

Copyright © 2009, American Water Works Ass	-		AND ADDRESS OF A DECEMBER	WAS v4.0	
Click to access definition Water Audit Report for: Reporting Year:	Phila 200		14 Water Departme 7/2007 - 6/2008	mt	
Please enter data in the white cells below. Where available, metered values shound nput data by grading each component (1-10) using the drop-down list to the left of All volume	of the inp	out celi.	Hover the mouse over th	lable please estimate a value. Indicate e cell to obtain a description of the gra LONS (US) PER YEAR	your confidence in the accuracy of t des
ATTER SUPPLIED	a bere	~~	Enter grading in	1 column 'E'	
Volume from own sources:	2	7	94,536.900	Million gallons (US) /yr (MG/	Yr)
Master meter error adjustment:	2	10	2,779.300	over-registered	MG/Yr
Water imported: Water exported:	2	n/a 10	7,100.400	MG/Yr MG/Yr	
WATER SUPPLIED:	17.20		84,657.200	MG/Yr	
AUTHORISED CONSUMPTION	-	0			Click here:
Billed metarad:	2	7	57,242.400	MG/Yr	for help using option
Billed unmetered: Unbilled metered:	7	n/a n/a		MG/Yr MG/Yr Pent:	buttons below Value:
Unbilled unmetered:	2	8	764.200	MG/Yr Pent: MG/Yr	0 0 764.200
			Shill a greas a		
AUTHORIZED CONSUMPTION:	2		58,006.600	MG/Yr	use buttons to select percentage of water supplied
					- OR value
ATER LOSSES (Water Supplied - Authorised Consumption)		L	26,650.600	MG/Yr	
postent Losses				Pcnt:	Value:
Unauthorized consumption:		8	2,086.300	MG/Yr	O O 2,086.300
Customer metering inaccuracies:	2	8	190.300	MG/Yr	O (190,300
Systematic data handling errors:	2	5	4,674.400	MG/Yr	1
	-				Choose this option to enter a percentage of
Apparent Losses:	2		6,951.000	MG/Yr	billed metered
Losses	1	110			NOT a default value
Real Lossss = Water Losses - Apparent Losses:	?		19,699.600	MG/Yr	
WATER LOSSES:			26,650.600	MG/Yr	
IN-REVENUE MATER	-	2 374			THE GAME CANTER THE
NON-REVENUE WATER: Total Water Loss + Unbilled Metered + Unbilled Unmetered	12	L	27,414.800	MG/Yr	
TOTAL DATA		0.0-2	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		The second second
Length of mains:	7	9	3,137.0	miles	
Number of active AND inactive service connections:	2	7	547,932		
Connection density: <u>Average</u> length of customer service line:	2	7	175	conn./mile main ft (pipe length	between curbstop and customer
A KARANA TANA TANA MANANA M					erty boundary)
Average operating pressure:	2	10	55.0	psi	
OST DATA	T.S.S.	11:33	LEV MANY TO THE PA		I C S S MANDA DES E
Total annual cost of operating water system:		10	\$219,182,339	\$/Year	
Customar retail unit cost (applied to Apparent Losses):	?	9		\$/1000 gallons (US)	
Variable production cost (applied to Real Losses):	2	9		\$/Million gallons	
ERFORMANCE INDICATORS					
Insucial Indicators Non-revenue water as percent by	volum	ne of	Water Supplied:	32.48	
Non-revenue water as percent by			and a state of the second s	17.8%	
			of Real Losses:	\$34,546,470 \$4,245,264	
perational Efficiency Indicators					
Apparent Losses per s	ervice	e conr	nection per day:	34.76 gallon	s/connection/day
Real Losses per se					s/connection/day
			main per day*:		
Real Losses per service connection					s/connection/day/psi
Unavoidable .	Annua]	Real	Losses (UARL):	2,178.15 millio	n gallons/year
Infrastructurs Leakage Index	(ILI)	(Rea	al Losses/UARL]:	9.04	
only the most applicable of these two indicators will be c	alcula	ted	ALL ALL ALL	and the second second	四 上生 一 一 一
MATER AUDIT DATA VALIDITY SCORE:			Participant and		RAL NO. VAL BUD
	CORF	е т.9	: 82 out of	100 ***	
				the Britshing Street	Alle Dates Wallates -
A weighted scale for the components of consumption and	water	1088	is included in the	calculation of the water Au	art Data validity Score
PRIORITY AREAS FOR ATTENTION:	The last				
Based on the information provided, audit accuracy can	be in	mprov	ed by addressing	the following components:	
1: Volume from own sources		1			a contraction of the second
2: Billed metered	1	-	a manage to day and the	lick here to see the Grading Mat	

AWWA WLCC Free Water Audit Sc Copyright © 2009, American Water Works Asso			Cover the second se	Back to Instructions
			WAS \$4.0	
Click to access definition Water Audit Report for: 1 Reporting Year:	2008	1/2008 - 12/2008		
Please enter data in the white cells below. Where available, metered values shoul			J	
input data by grading each component (1-10) using the drop-down list to the left of	the input cell.	. Hover the mouse over th	ND CUBIC METRES) PER YEAR	our confidence in the accuracy of the es
WATER SUPPLIED		Enter grading in		and the state of the state of the
Volume from own sources:	7 7	213,977.000		
Master meter error adjustment:	2 4	0.000		ML/Yr
Water imported: Water exported:	2 n/a 2 7	0.000 26,457.500		
WATER SUPPLIED:		187,519.500		
AUTHORIZED CONSUMPTION				
Billed metered:	2 7	163,665.000	ML/Yr	Click here: 2 for help using option
Billed unmetered:	2	433.900	ML/Yr	buttons below
Unbilled metered: Unbilled unmetered:	2 8 2 5	1,768.400 230.100	and the second se	Value:
ormanico manocor da		250.100		O 230.100
AUTHORIZED CONSUMPTION:	2	166,097.400	ML/Yr	Use buttons to select
	Hall-Torra			percentage of water supplied OB
WATER LOSSES (Water Supplied - Authorised Consumption)		21,422.100	ML/Vr	value —
Apparent Losses			Pcnt:	Value:
Unauthorized consumption:	2 5	886.800	the state of the s	0 0 886.800
	alter and			
Customer metering inaccuracies:	7	2,851.000	ML/Yr	0 0 2,851.000
Systematic data handling errors: Systematic data handling errors are likely, pleas	se enter a	0.000	ML/Yr	Choose this option to
Apparent Losses:		3,737.800	ML/Yr	enter a percentage of
	12-12	AND SUPPLY		billed metered consumption. This is
Real Losses = Water Losses - Apparent Losses:		17 (04 200)		NOT a default value
		17,684.300		
WATER LOSSES:		21,422.100	ML/Yr	
NON-REVENUE MATER NON-REVENUE MATER:		22 420 600		
- Total Water Loss + Unbilled Metered + Unbilled Unmetered		23,420.600	ML/Yr	
SYSTEM DATA	GYP			
Length of mains:	8	4,161.0	kilometers	
Number of <u>active AND inactive</u> service connections: Connection density:	2 9	287,905	ann Br asta	
<u>Average</u> length of customer service line:	2 5	16.0		stween curbstop and customer
Average operating pressure:		CO. 4	meter or proper	rty boundary)
werage operating pressure:	6	58.4	metres (head)	
COST DATA	1			HORE THE REAL PROPERTY OF
Total annual cost of operating water system:	2 3	\$100,000,000	\$/Year	
Customer retail unit cost (applied to Apparent Losses):	10		\$/1000 litres	
Variable production cost (applied to Real Losses):	10		\$/Megalitre	
Retail costs are less than (or equal to) p	roduction	costs; please re	view and correct if necessa	ry
PERFORMANCE INDICATORS				
Financial Indicators Non-revenue water as percent by	volume of	Water Supplied	12.5%	
Non-revenue water as percent by		the state of the s	12.5%	
		Apparent Losses: of Real Losses:	\$2,399,668	
Operational Efficiency Indicators	COSC	OF NOOI DUBBEB!	\$11,353,321	
Apparent Losses per se	rvice cor	action nor dev	35 53 14	
			35.57 litres/	
Real Losses per ser		THE READED TO THE READED	168.29 litres/c	connection/day
		f main per day*:	N/A	
Real Losses per service connection per day p	er meter :	(head) pressure:	2.88 litres/c	connection/day/m
Unavoidable A	nnual Real	Losses (UARL):	8,960.91 cubic me	aters/year
Infrastructure Leakage Index	(****)	1.1.00000	Astronomic and the second	
		LOSSES/UARLJ:	1.97	
* only the most applicable of these two indicators will be ca	iculated			water and the section was due
WATER AUDIT DATA VALIDITY SCORE:				
*** YOUR SC	ORE IS	: 64 out of	100 ***	
A weighted scale for the components of consumption and	-			t Data Validity Secre
PRIORITY AREAS FOR ATTENTION:	2008		ensentation of the water Aug	to baca, variancy SCORE
and the second	he in		Ab. 6.11.	
Based on the information provided, audit accuracy can	De improv	ed by addressing	the following components:	
1: Volume from own sources	1	-	A REAL PROPERTY AND A REAL	A DECKER STREET
2: Master meter error adjustment	Fo	r more information, c	lick here to see the Grading Matrix	worksheet
3: Billed unmetered	1 242 71			The state of the state

AWWA WLCC Free Water Audit Software: Acknowledgements

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Version 4.0 Developed by the Water Loss Control Committee of April 2009 the American Water Works Association AWWA Water Audit Software

Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a down", water audit. It is recommended that users also refer to the 3rd Edition AWWA M36 This software is intended to serve as a basic tool to compile a preliminary, or "topcomprehensive, or "bottom-up", water audit using the same water audit methodology.

Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272 - Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water GEORGE KUNKEL, P.E. Philadelphia Water Department DAVID GOFF, P.E. Goff Water Audits & Engineering DAVID SAYERS, Delaware River Basin Commission ANDREW CHASTAIN-HOWLEY, Miya Water ALAIN LALONDE, Veritec Consulting DEVELOPED BY: REFERENCES:

- Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65

- AWWA Water Audits and Loss Control Programs, M36 Publication, 3^{rd} Edition, 2009

Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

Loss Control Committee (WLCC) Free Water Audit Software v4.0 Copyright® 2009. American Water Works Association. All Rights Reserved.	spreadsheet-based water audit tool is designed to help guantify and track water losses associated with water ems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.	USE: The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons on the left below. Descriptions of each sheet are also given below.	Value	These cells contain recommended default values following information, then proceed through each sheet in the workbook:	of Tustin Water Services Division COUNTRY: USA	2007 START DATE (MM/YYYY): 01/2007 END DATE (MM/YYYY): 12/2007	B-MAIL: [adjarian@tustinca.org TELEPH	ING UNITS FOR WATER VOLUME: Acre-feet	Click here: 2 for help about units and conversions	The current sheet	Enter the required data on this worksheet to calculate the water balance	The values entered in the Reporting Worksheet are used to populate the water balance	Depending on the confidence of audit inputs, a grading is assigned to the audit score	Diagrams depicting possible customer service connection configurations	this sheet to understand terms used in the audit process	this sheet to interpret the results of the audit validity score and performance indicators		If you have questions or comments regarding the software please contact us at: <u>wic@awwa.org</u>
AWWA Water Lo	PURPOSE: This spreadsheet-based water distribution systems and identify areas format, and is not mear	USE: The spreadsheet contains several or by clicking the buttons on the left	THE FOLLOWING KEY APPLIES THROUGHOUT:	Please begin by providing the following information.	NAME OF CITY OR UTILITY: City of	REPORTING YEAR:	NAME OF CONTACT PERSON: Fred Adjarian	PLEASE SELECT PREFERRED REPORTING UNITS FOR WATER VOLUME:	Click to advance to sheet	Instructions	Reporting Worksheet	Water Balance	Grading Matrix Der	Service Connections Dia	Definitions	Loss Control Planning Use	Comments here to Add comments here to track additional supporting information, sources or names of participants	H

Instructions 1

AWWA WLCC Free Water Audit S	oftware	e: <u>Reportin</u>	g Worksheet	Back to Instructions
Copyright © 2009, American Water Works Ase	sociation. All Righ	its Reserved	WAS v4 0	Back to Instructions
Click to access definition Water Audit Report for:			ces Division	
Reporting Year:		1/2007 - 12/2007		
Please enter data in the white cells below. Where available, metered values sho input data by grading each component (1-10) using the drop-down list to the left	of the input cell.	. Hover the mouse over the	hable please estimate a value. Indicate the cell to obtain a description of the grad	your confidence in the accuracy of the les
All	volumes to b	e entered as: ACRE-F	EET PER YEAR	
WATER SUPPLIED		Enter grading i		
Volume from own sources: Master meter error adjustment (enter positive value):	7 10 7 4	11,292.800 28.000	acre-ft/yr under-registered	acre-ft/yr
Water imported:	2 10	3,014.900	acre-ft/yr	
Water exported: WATER SUPPLIED:	10	0.000	Carlo Carlo Carlo Marco de Carlo	
AUTHORIERD CONSUMPTION		14,555.700	acte-ic/yi	
Billed metered:	10	13,360.000	acre-ft/yr	Click here: 2
Billed unmetered: Unbilled metered:	2 10	408.000	acre-ft/yr acre-ft/yr Pcnt:	Value:
Unbilled unmetered:	2 9	35.000	The second se	O O 35.000
A CARLEND AND A CARLENDER OF THE REAL PROPERTY OF		filmes a feasible of		1
AUTHORIZED CONSUMPTION:		13,803.000	acre-ft/yr	Percentage of water supplied
	1			- <u>QR</u> value —
WATER LOSSES (Water Supplied - Authorized Consumption) Apparent Losses		532.700	acre-ft/yr	
Unauthorized consumption:	2 2	5.000	acre-ft/yr	Value:
Customer metering inaccuracies: Systematic data handling errors:	2 9 2 7	425.814	acre-ft/yr 3.00% acre-ft/yr	0
Systematic data handling errors are likely, plea	and the second s	non-zero value;		Choose this option to
Apparent Losses:	2	430.814		billed metered
Real Logger				Consumption. This is NOT a default value
Real Losses = Water Losses - Apparent Losses:	2	101.886	acre-ft/yr	
WATER LOSSES:		532.700	acre-ft/yr	The second states of
HON-REVENUE WATER				
NON-REVENUE WATER: = Total Water Loss + Unbilled Metered + Unbilled Unmetered		975.700	acre-ft/yr	
System Data	a minute			Hat the state of the second
Length of mains:	2 6	172.0	miles	
Number of <u>active AND inactive</u> service connections: Connection density:	2 10	14,124	conn./mile main	
Average length of customer service line:	2 9	20.0	ft (pipe length b meter or prope	etween curbstop and customer erty boundary)
Average operating pressure:	2 9	50.0	psi	
	1010 10		Re services that it are	The state of the state of the
COST DATA				
Total annual cost of operating water system: Customer retail unit cost (applied to Apparent Losses):	10	\$11,649,391 \$1,99	\$/Year \$/100 cubic feet (ccf)	
Variable production cost (applied to Real Losses):	2 9		\$/acre-ft/yr	
	A CONTRACTOR	a constant in the		Antonia (marking)
PERFORMANCE INDICATORS				
Financial Indicators Non-revenue water as percent by	volume of	Water Supplied:	6.8%	
Non-revenue water as percent by	And the second s	perating system: Apparent Losses:	5.0%	
		of Real Losses:	\$373,449 \$38,680	
Operational Efficiency Indicators				
Apparent Losses per s	ervice com	nection per day:	27.23 gallons	/connection/day
Real Losses per se	rvice conne	ection per day*:	6.44 gallons	/connection/day
Real Losses pe	r length o	f main per day*:	N/A	
Real Losses per service connection	per day p	er psi pressure:	0.13 gallons	/connection/day/psi
Unavoidable .	Annual Rea	Losses (UARL) :	62.97 million	gallons/year
Infrastructure Leakage Index	(ILI) [Real	al Losses/UARL1 .	0.53	
* only the most applicable of these two indicators will be c				
MATER AUDIT DATA VALIDITY SCORE:		102 EVA 12 77 EV		
	COP# 74	5: 83 out of	E 100 +++	CONCERNENT ALL AND
A weighted scale for the components of consumption and	water loss	is included in the	a calculation of the Water Aud	it Data Validity Score
PRIORITY AREAS FOR ATTENTION:				
Based on the information provided, audit accuracy can 1: Master meter error adjustment	be improv	ed by addressing	the following components:	
2: Unauthorized consumption		r more information	lick hare to see the Creding Hete	iv workshoot
3: Customer retail unit cost (applied to Apparent Losses)	<u></u>	, more mormation, c	lick here to see the Grading Matri	A WORKSHEEL
or oversomer retent unit coer (applied to Apparent Losses)		March Hannahana	X - Could - Set With	Sector and the sector and the sector

AWWA WLCC F	AWWA WLCC Free Water Audit Softw	udit Softwar	are: <u>Water Balance</u>	Water Audit Report For:	Report Yr:
	Copyright © 2009, America	Copyright © 2009, American Water Works Association. All Rights Reserved	. All Rights Reserved. WAS v4.0	Division	2007
	Water Exported 0.000			Billed Water Exported	
			Billed Authorized Consumption	Billed Metered Consumption (inc. water exported) 13,360.000	Revenue Water
Own Sources (Adjusted for		Authorized Consumption	13,360.000	Billed Unmetered Consumption 0.000	13,360.000
known errors)		13,803.000	Unbilled Authorized Consumption	Unbilled Metered Consumption 408.000	Non-Revenue Water (NRW)
11, 320.800			443.000	Unbilled Unmetered Consumption 35.000	
	Water Supplied		Apparent Losses	Unauthorized Consumption 5.000	975.700
	14, 335.700		430.814	Customer Metering Inaccuracies 425.814	
		Water Losses		Systematic Data Handling Errors 0.000	
Water Imported		532.700	Real Losses	Leakage on Transmission and/or Distribution Mains Not broken down	
3,014.900			101.886	Leakage and Overflows at Utility's Storage Tanks Not broken down Leakage on Service Connections	
				Not broken down	

Water Balance 3

Back to Instructions	audit component and n in red		10		100% of water production sources are methered, mether accuracy are production calabration conducted semi-annuality, with less than 10%, found outside of +/- 3% accuracy.	<u>Burnelintain 10</u> : Standardae meter accuracy test fingquanty to ann-annual, or more trequent, for all meters. Regular or metacements outsido of 4-3% accuracy. Continually metering technology metering technology	Computerized system (SCAUA) or stimular) automatistically balances flowe from all sources and storages, results tweivered daily. Mass balance technique compares production meet data to ave (untrastruction meet data to ave (untrastruction) water and to anomalies. Regular calibrations between SCAUA and sources between SCAUA and sources means ensures minimal data transfer enror.	In matching 1.0. Marchine matter impossible to development of more accurate to development of more accurate Continue to replace or repair means as they perform outside of desired accuracy innea.	100% of imported water sources are meaned, when accuracy testing and/or electronic calibration conducted sami- amulaly, with less than 10% found outside of +/-3% accuracy.	Io maintain 10: Standardiar mater accuracy test trequency to semi-annual, or mon trequent, for all meters Repair or replace meters outside of -+-3% accuracy. Continuativ metering technology.
MASA 4.0	The grading assigned to each rioritizing those items show		8		00% of wetler supply sources are melared, meter sources are and electronic calibration between conducted amutaly less than 10% of meters are found outside of 44 6% accuracy	<u>In aduality Mo. 10.</u> Marinan, annual metan accuracy lasting for ad metans. Pagnal or replaces matures outatios of 44. 6% accuracy, investigation new meta behnology, pixel one or more replacements with innovative metans in attempt to improve metar accuracy.	Continuous production melar data (orgoad automicatiny & newwood daily. Data aquisated to correct gross arror from equipment matkincipen a results or interior between reacruers featible. Tankitökotage facitity develor charges are automaticality used in "Volume from own sources" tabulationa.	In characteristic for 10: Link all production and landwittmage healiny elevation characteristic and characteristic of characteristic a Data Acquistation (SCUAD) System, or elimitar a Data Acquistation (SCUAD) System, and entrophysication monitoring/outcomes system, and and regulatry calibratis between SCADA and active metion.	100% of imported water sources as melanor, meter sources testing and/or electronic calibration conducted annually, less than 10% of meters are lound outside of 4. 6% accuracy	In a second second second second of a second
<mark>Matrix</mark> Reserved	ting Worksheet, grades were assigned to each component of the audit to describe the confidence and accuracy of the input date. The grading assigned to each audit component the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red		6 7	-	At least 75% of water production sources are mellend, gr at least sources are mellend, gr at least from matered sources. Meller from matered sources. Meller contractive fasting and/or electronic calibration conducted amellen. Least Man 25% of inseted mellen are found outside of +/ 6%	In charter for the second sec	Hourly production meter data logged automatically & tweiweed on at least a weekly basis. Teating adjusted to correct gross error. Teom equipment matilunction and error contract areas and of a secure and a secure basineshy used in exclusing a automatically used in exclusing a automatically used in exclusing a balanced "Volume from own sources" component.	Is carefully for 8: Complete installation of elevation Instrumentation on all mathematic and elevation Instrumentation on all mathematic and the Continue to use daily instrumention on a caustainty abstroad "Vanish from one caustainty" component. Adjust production mean data for gross error and insourcery continued by tealing.	At least 75% of imported water sources are metioned, meater accuracy testing and/or electronic confliction controlled at multi- lass than 25% of treated metions. B and B are found outside of 4-7 6% b	Complete policy in the Statistic for Statistic for Statistic for the state of the s
Water Audit Software: <u>Grading Matrix</u> Copyright@ 2009, American Water Works Association All Rights Preserved	to describe the confidence a ited in yellow. Audit accuracy	Grading	4 0		50% - 75% of water production sources are netered. Other sources estimated. Occasional meter accuracy testing	In 2014 for the former of all observation representation re	Production meter data is logged automaticarly in electronic format and reviewed at least on a monthy yeast. "Volume trans eources" tabudators includes estimate of daty changes in tarteststorage includes. Meter data is adjusted when gross data entres docur, or occusional meter lesting deters this necessary.	Review hourly <u>to Quality Ioc</u> 6. Review hourly production mater data tor prosa entro on a tel least, a weekly basis. Begin to trestal treatmentation to mand-screege trestal treatmont development. Use daty reli storage change to balance flowe in calculating Water Suppleof volume.	50%75% of imported water 50%75% of imported water sources are melenod, other sources estimated. Occasional meter socuracy testing 4 and 8	Is <u>ousify for 9</u> . Formulae annual metine accuracy teating for all motion of metine metion. Commune stated metines on unmetiened exponent of interconnections and replacement of cooperativeliacitive maters.
Free	o each component of the audit ments and actions are highligh		2 3		25% - 50% of water production sources are neflared, other sources estimated. No regular meler accuracy testing. 2 and 4	<u>bacterity for 4</u> . Locate all verter production normans on maps and in field, lamon mere socurrary testing for undering means, wegin to heall means on unmerend water production sources and replace any obsolete/defective meters	No automatic datalogging of production voltimes, data readings are actihed on paper records. Tank/storage elevation charges are not employed. In between calculating Volume from own calculating Volume from own actives component. Data is actives on when groesty evident data emor occurs.	th callify for 5: Interait automatic classingling equipment on production means. Monthly hamaterizingo facilities and inviside estimated data y value facilities and inviside estimated data y value supplied" values based upon changes in storage.	25% - 50% of imported water 25% - 50% of imported water sources are melened; other sources estimated. No regular meler accuracy lesting. 2 and 4	To outfir fire 4: Locets all imported water sources on maps and a in flok, teamp restored water sources to maps and the flok, teamp restored water branches on unmatered imported water intercommendance and replace obsolekuldetecher meterne
AWVA WLCC	grades were assigned to ng recommended improveme		-		ng Less than 25% of water production sources are metered, remaining sources as are estimated. No regular meter accuracy testing.	to qualify for 2. Organize efforts to begin to collect data for determining volume from own sources	If inventory information on all inventory information on the larger records of measured volumes in crude for condition, data enror cannot be for condition, data enror cannot be ter	to autility for 2. Develop partial to restructure recordination graphine to capture to the data, and procedure to review data data to detact input errors	by Less than 25% of imported water sources are metared, femathing sources are astimated. No regular meter accuracy testing	Review total water protocol severe vote water purchase agreements with partner experiments for use and maintenance of accurate requirement meters with goal to meter al imported with accura
	In the Reporting Worksheet, the correspondi		n/a		Select this grading only if the water uilty water uilty water uilty water uilty water the water the water uilty wa	traprovennents to attain higher data grading for "Volume from own Sources" component:	Select r/a only if Select r/a only if the weter unity fails to have meators of the sources of the sources and/or imported (purchaso) water sources	tumpoverments to attabin higher data grading for "Masser meter entre adjustment" component:	Select n/a if the water utility's supply from water utility's supply from the arcuiash from the sectores of the bud the purchased imported water)	Improvements to attain higher data greening for Water Imported Volume component:

-	the supervised to the		were the	to the second se		all and a second s
9	100% of export are methered, thesting and calibration annually, with	Io maintain 10 Standardan mere accuracy test Traquency to semi-armual, or more frequent, for all meters. Repair or replace meters outside of +- 5% accuracy. Continually investigate/pilor improving metering technology.		A least 96% of customers with volume-based balling from mater reads. A least 65% customers reads. A least 65% customers mater reading success rate, or mater reading success rate, with Automatic weater and 25% with Automatic weater and 25% with Automatic underwest 25% and 25% and 25% of the and 25% and 25% and 25% and 25% of the and 25% and 25% and 25% and 25% of the and 25% and 2	Io maintain 10. Peoplara internant and brind party auditing, and metar accuracy taking ensures that accuracy taking ensures that accuracy taking ensures at the basis of the ensure of an internation (AMI) and information management. Per partied upgrades in motionity, motion reading and billing data mention management.	Water utility policy requires metering and volume based billing for all customer accounts. Loss the all customer accounts. Loss turmeared and oxist because unneared and accounts are unneared accounts of the oxient but is economical the avent but is economical the avent but is economical the avent to assess to mutumer a customer of a these accounts wa estimates of consumption are estimates of customer and customer are estimates of customer are estimates of customer and customer are estimates of customer and customer are estimates of customer are estimates of customer and customer are estimates of customer and customer are estimates of customer and customer and customer and customer and estimates of customer and customer and customer and customer and estimates of customer and customer and customer and estimates of customer and customer and estimates of customer and customer and estimates of customer and customer and customer and estimates of customer and customer and es
	Conditions between 8 and 10	ting for all taide of +/- moter cements o improve		Conditions between 6 and 10	matered matered resulting achieved achieved achieved partition planning party bitrd party	Conditions between 8 and 10
8	water sources ater accuracy electronic cied amualty, of meters are - 6% accuracy	In outside the second s		Al least 97% of customers with number and any set of customers with reacts. At least 90% customer meler read success rate with planting and budging for minum 80% and budging for thats of Automet Mahang Rateding (AMR) in one or more pliot areas. Good customer meler plate area plateer meler reactors. Regulate and elabling melers ach year, reuting auditing of computerized billing reacting of computerized billing statistics: with a party.	bo subtly for 10: Purchase and invalimments on unmented ecounts. Laurach Automatic Mean Paseding (AMR) system trais if mean air moter Paseding (AMR) system trais if mean air moter reading (AMR) system program. Contrast mean whith a fibro-year program. Contrast mean which a fibro-year program. Contrast mean and budgeting for these contrast and budgeting for these areas mitter reading and regulate armait their porty. Total armain of a mean system. Contrast and budgeting and regulate armait their porty routine auding and regulate armait their porty.	Water utility policy requires mering and outine based billing call customer based billing for all customer based Merinfing to prevaient in the adding base and and billed accounts unmeared and calcumstances. The goal is to minitize in hindrate of circumstances. The goal is to unmalered accounts of unmeared accounts obtained for unmeared accounts via site specific estimation nethods.
2	Conditions between 6 and 8	replace I wother il mother ar methan if +i- 6%		between 8 and 6		Conditions between 6 and 8
9	oported water tered, meter nd/or electronic cred annualty. testad meters de of +/- 6%.	<u>to quality for 8:</u> Complete project to instal new, or replace districtive, meliner on all apported water melinocomencions. Maintain annual melin mecomencions. Maintain annual melin mecomencions. Maintain annual melin mecomencions. Maintain annual melino di constanta appair or replace meline outoble of 4-6 %.		At laast 90% of customers with volume-based billing from meler estimated. Manual customer estimated. Manual customer estimated. Manual customer customer meler median product estomer meler records, imheler mediar are estimated. Table, falled reads are estimated rate, falled reads are estimated product estomer of oldest meters. Computarized billing records with routine auditing of global statistics.	ID Statistic for S Doubles of healt method method Purchase and healt method method with the Purchase and healt method with system for Automatic theter Passadag (AMR) system for Automatic theter Passadag (AMR) system for Purchase and the system for the purchase program. Set metro replacement grants are coursely result program. Set metro replacement grants are coursely result prog	Water utility policy does require matering and volume based billing but examines and rotume based billing but examines and as municipal butlichips. As many as 15% utilichips. As and the second as a sametter with volt the impediate in the mutal unmatered accounts. Individual unmatered accounts.
ß	Conditions between 4 and 6	setting for all stallation of 1 watter sent of 8.	LON	Conditions between 4 and 6	metared ing and chre based mitrue to mitrue to mitranation accurate, discoment discoment	Conditions between 4 and 6
Grading 4	50% - 75% of exported water sources are melered, other sources estimated. Occasional meter accuracy testing	hadality for C. Formation annual medier accountry totating for all exported water meters. Contrave instationt of anteres on unmetered expression with interconnections and replacement of obsolotio/defective meters.	AUTHORIZED CONSUMPTION	At iteast 75% of customers with hume-based rate billing from meter reads: flat or fixed rate billed for reads: flat or fixed rate billed for used at least 5 w meter reading used at least 5 w meter reading accretes rate, failed reads are accretes rate, rated rate read accretes rate. Computer read reating is conducted. Customer reaters replaced only upon meters replaced only upon billing records, but only periodic billing records, but only periodic hinternal auditing conducted.	So guilt/Jord: Purchase and leadal meters on unmetered accounts. Eliminate fait too lang and accounts. Eliminate fait too lang and upon messared consumption. Confinue to active verticable accounts in momoring manual mater reading barriers. Expand mater accuracy testing. Launch ingular mater represented program. Conduct mathes audit of global addition.	Water utility policy does require the second second second billing but lacks withen procedures and employe casual oversight, reacting in up a 20% of billed accounts believed to be accounts believed to be the annual vaster audt, with no inspection of individual unmetered accounts.
	Conditions between 2 and 4	n maps and sting for elens on ections and eters		Conditions between 2 and 4	ummetened improve meter information information amputerized	Conditions between 2 and 4
2	25% - 50% of exported water sources are metered; other sources estimated. No regular meter accuracy testing.	To supply for the second secon		At least 50% of customers with volume-based billing from meter reads, far or flawd rate billed for used, less than 50% read success rate, latiled reads are estimated. Linited customer meter records, no regular meter testing of replacement Pilling data maintaind on paper records, with no auditing.	Purchaee and install related : Purchaee and install meters on unneteesd Purchaee and install meters on unneteesd macing access. Catalog meter information during meter and vatis to identify ageiment of meters for accuracy. Install computationd meters for accuracy. Install computationd the acting relation.	Water utility policy does not require customer metering; flat or filted fee billed. Some metering filted fee billed. Some metering externit policid areas or folstrict system (pick areas or folstrict externed Areas) with consumption mecored on portable dataloggens. Data from these sample meters are used for trustantor methods are used for unusatal buildingswater uses.
F	Less than 25% of exported water sources aro melered, remaining sources are estimated. No regular meler estimated, No regular meler	to cualify for 2, Review built water solos agreenents with partner augmennents vith partner maintens for vas a uploop of accurate meterney, identify needs to install new, or replace defective metere as neoded.		Less than 50% of customers with volume-based billings from meler readings: flat or fibed rate billed for the majority of the customer population	Is 2441h for 2 conduct Investigations or vista of customs makes to avior appropriate makes to avior appropriate makes to avior budget translations. Investigatio volume based water ratio solutions.	Water utility policy does not require customer matering: fra- require customer matering: fra- oblection on customer consumption. Only estimates extraines an even of non data estimation methods using average future count multiplied by number of connections, or by number of connections, or
n/a	Select n/a if the water utility selis no bulk water to neighboring water utilites (no exported water sales)			Select his only if Select his customer population is not melared, and is melared, and is served on water fixed rate basis	If the is selected because the customer meter unmetered, consider consider consider consider potation and consider the meter the potation and employ water relea- potation and employ water relea- potation and employ water relea- ted upon metered volumes.	Select Ma if it is the publicy of the water utility to mater all outstomer connections and it has been confirmed by detailed utuling by detailed utuling by detailed utuling by detailed auction by detailed a
	Water Exported:	Improvements to attain higher data grading for "Water Exported Valume" component:		Billed motored:	Improvements to attain higher data grading for "Billed Meisend Consumption" component:	Billed unmetered:

-	AL CONTRACTOR OF A			
ę	Continue to the estimation 10. Continue to three estimation methods for unmelling consumption and explore means to establish method, accounts as its bland unmelling locasitible.	Clearly written policy identifies the types of accounts given a billing exemption, with emphasis on keeping out, which emphasis minimum. Customer meler management and meter meler management and meter meler for these accounts is given proper for these accounts is given proper Regular auditing continue this Regular auditing continue this roadings from accurate melers.	Io maintain 10: Passess publication 10: env water uses to po "united": It is possible to meter and bill an ecounts, were in the fee charged for water consumption is an end billing all accounts ensures and water vessels from phombing and water vessels from phombing and water vessels from phombing	Clear policies adds to identify permittatues of wates in unailled, unmetered fashion, with the intertion of minimizing the type consamption. Good records document each occurrence and document each occurrence and formulae (from is quantified via tormulae (from is q
a	a tellation h a good to Sustatin the Sustatin the fith access of hill worker a water	Conditions between 8 and 10	t (meter ment) and ed the same ish ongoing ish ongoing that water and provided	Conditions between 8 and 10
CC CC CC CC	ID contained to a contribution of the contained of the contained contained and the contained of the containe	Written policy identifies the types of accounts granted a billing of accounts granted a billing management and meter reading priorities. but meter reading is conducted at least amurally to conducted at least amurally to be amural water audit. High level auditing of billing mocords ensures that a reliabiling mocords ensures that a reliabiling nectors ensures	In <u>chanith for 10</u> . Ensure that meter management (meter accurary testing, meter replacement) and meter reading activities an accorded the same priority as billed accounts. Establish priority as billed accounts. Establish amutal auditing process to ensure that water consumption is reliably collected and provided to the arrutual water audit process.	Clear policles and good record/septing aist for some uses record/septing aist for some dons registering consumption, but registering consumption, but uses of the hydrams have immed wereight. Total consumption is a mix of veil quantified use such as from formulae (time x hydreal flow) of remporary meters, and retherly subjective estimates of test less regulated use.
-	coste brasis. edures to a municipal meters. n reliable ed accounts n.	Conditions between 6 and 8	n policy mplement molement accounts a accounts a scheduled s.	Conditions between 6 and 8
	Lo catality for 3: thestat customer melanes on a full scale basis. Rathen metering policy and proceedures to resure that a accounts, including manifolds properties, and segmented for meters properties. To robatin relation contamption estimate for unmatende accounts evaluing mater instatlation.	Written policies regarding billing exemptions exist but addremence in paratice is questionable. Melaeining and melar reading for municipal buildings is eliabled but sporadio for other unbialed but sporadio accounts. Pentodic auditing of accounts. Pentodic auditing of accounts are machings where accounts but the majority where consumption is estimated	Bu Quelifit for 8: Communicate fulling exerption policy troughout the organization and implement propositions that organization and inframed programment. Conduct implementang a caroount memogenesit. Conduct implementang and another prot accurate meterne acids and ano verify that accurate meterne acids and ano verify for routise meter readings.	Coherent policies addit for some times of united, unmened consumption but others await does revaluation. Reasonable accordenging for the managed uses addis and allows for annual volumes to be quantified by uniteence. Au unsupervised uses are guesstimated.
3	ew billing operation. Unding motions to unmetared	Conditions between 4 and 6		Default value of t.25% of system input votume is employed
6urne 19	Rudget for staffty for 6: Budget for staff meanures to review billing records to identify unmeaned properties. Sporty meaning under and under requirements to install sufficient means to significant reduce the number of unmotered accounts	Dated written proceedures permit billing assumption for specific accounts, such as municipal accounts, and a numicipal properties, but are unclear regarding catella organization ow phoring where available. The total number of unclinged, urmetered abong with consumption urmetered abong with consumption workings.	budantih in C. budantih in C. Drah a new witten policy regarding billing asomgene based upon consensus ritteria atowing the occurrence. Assign resources to utilit mater records and billing records to obtain centrals of urbitled method accounts.	Edent of unbilled, ummetered consumption is antially forom, and procedures exists to foroment miscellanoverhis such as miscellanoverhis such as Formulae is used to quantify the consumption form such events fulline unming, trypted flowrata x number of events).
8	y requiring t metaering neter types, popmic s options at to devise at volumes.	dicy requiring plot metering and metering and an interaction and an and an and also rotations dic Conditions dic Conditions a and 4		Conditions between 2 and 4
2	to califity for 4: inglement a new water utility policy requiring customer meaning. Extend polic methong attuch is include several different meter types, which will provide data for economic sessement of his varies methoding options. Assess after with access officulties to devise means to obtain water consumption volumes.	Billing practices exampt certain accounts, such as municipal buildings, but only sarathend, buildings, but only sarathend, practice Arrender and when accounts is unvariable. Spondic meter discounts is admuned basis. The total annual water motion of an unvalied based upon approximating the assigning consumption from accounts billed accounts and assigning consumption from actively billed accounts of same	Device habito differ for 4: Pervice habito within humbles and policy documents allowing centerin accounts to to biling-esency. Draft an aufine of a written policy for the guarding centrephon, thereigh other that grants an exerption, the apoil of humples this number of accounts to a minimum level of a number of accounts to a minimum	Clear axiant of unbilled, Unaterory, but a number of events unknown, but a number of events are randomy documanter acid year, contimute a statence of such year, contimute an accurate satistices consumption, but without the annual volume consumed.
	In contrast to the second seco	Billing practices exempt certain accounts such as municipal buildings, but written policioa do not exist; and a reliable count of exist; and a reliable count of exist; and a reliable count of exist matera do not exist and accounts is rare and not updrepart meter consumption for all such accounts is purely for all such accounts is purely puestimated	B_B_B_B_L_C	Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordreaphing. Tatal consumption is quantified based upon a purely subjective estimate.
n/a		select två if all billing-exampt consumption is ummelered,		
-	Improvements to attain higher data grading (or "Billiad Utematered Consumption" component:	:beratar	Improvements to attain higher data grand for "Unstand material Consumption" component:	Untstilled unmetered:

	10	lo maintain 10: Condure to mitime policy and poroedures with interition of procedures with interition of unteritient in unclined and unteritient in unclined and unteritient factors. Any uses that can freaticly become blact and metared should be converted ventually.		Clear policies exist to identify all whom, unsumbrad uses of whom, variantonad uses of and procedures exist to provide antionement of policies and detect volations. Each accurrence is quantified via formulae (time x typical flow) or similar methods.	In maintain 10: Continue to refine polidy and Continue to refine polidy and poppolees that allow or anathencized consumption. Continue to be sygiliant in documentation and enforcement efforts.	Good records of number, type and aze of customer melers: ongoing meter replacement occurs. Paylur merer accursor vesting gives reliable measure of oromoposte harccursory volume for the systam. New metering technology is embraced to keep overall accuracy improving.	to maintain 10: Increase the number of matern tested and majorison as justified by mater socuracy set data. Continuest more and increased metric opportunities for greater accuracy in metricog and customer consumption data.
	8	Refine writin <u>for tuality for to</u> : Beline writin procedures or ensure that all unatered water are overseen by a structured permitting process managed by water utility presonnel, these uses have value in being converted to billed and/or melaned status		Clear policies and good recordisesping asist for certain events (ormporing with water meteraci, ofter cocurrences the water imited oversight. The Conditions immed oversight. The Conditions of the construction of and 10 byteal flow and ablictive standals of unconfined estinates of unconfined	In guality for 10: Refine writin procedures and gasgy saff to eask out lawy occurrences of unauthoridad constantion. Explore new hocking devices, monther and divest unauthorizad consumption.	Cropoling meter replacement and councy traping result in highly accurate sustamer meter accurate sustamer meter constamples of meters to writen litespans to determine optimum replacement time for venous	Continue of <u>15 duality (or 10</u> : Continue of <u>15 duality (or 10</u> : with reliable mocordencing, meter relating and replacement. E-relutate new meter types and install or on rome types in 5-10 customer accounts each year in order to piet improving accounts each year in order to piet improving
	2 Z	In addity for 3: Assess water with patiery and procedures to recard that the hydrom paties are issued for use by persons outdoor of the utfay. Create written procedures for use and documentation of the hydrams by water utfar personnal.		Coherent policies axist for some forms of unauthorized consumption but offers super consumption but offers are consumption but offers constrained and and 8 under the policy. Yourmes axis for cocurrences that full the area of unaverse and 8 under the policy. Yourmes executed the policy. Yourmes executed the area of the area are puerified by the area for the ecods. Unsupervised uses are guestimated.	D. Quality Iot.8: Assess water utility policies to ensure that all hown counteness of unauthorized consumption are outsewid. Creats appropriate provides and that witten proceedures for unauthorized oriesumption as they are uncovered.	A reliable electronic recordresping system for meters adds. Propation miculose and of new high performing means and and taken tenters with suspect meter accuracy testing and meter accuracy testing and meter pelacement is quantified using a mix of reliable and less oritin data.	Bu custify for S. Expand anal metric recents y setting to evolutus a statistically significant metric meter materimodes. Expand meter replesement program to proforming meters significant mether of poor performing meters and your.
Grading	4	In calmith factors in the second seco	APPARENT LOSSES	Procedures exist to document some unsufficient concument such as observed unsufficing and the hydram consumpton the consumption thme running x typical flowrate x running x woltime is eventa).	Lo currently for first and currently for currently for currently for the current current of the current current of the current current current of the current	Reliable recordiseping avists. meler information is improving as meler are replaced. Mark Conditions accuracy leasing is conducted annually for a small number of melers. Limited number of olders annually for emine largely an mean replaced acth year. Inned festing data.	Route and the second se
		In a second default for S. Uthan excepted default value of 1.25% of system that volume are an expedient means to gain a reasonable quantification of this use. Double of countention of or white user groupe (ac for the hydrates - the departments, contractants to execution that need for water from the hydrates).		Uhauthodraed consumption is a known occurrance, kut is a mystery. There are no requirements to document no counterents to document to document to the second friend events, but periodis field between 2 reports duptions endine of these and 4 countermedia.	Use accepted detaulify for 5 Use accepted detaul of 0.23% of system input volume Revew utility policy modaring what water uses an considened unautiforizad, and consider an considened unautiforizad, and consider for unautiforizad fire hydrart opentings) (ex. unautiforizad fire hydrart opentings)	Poor recorditeping and meter oversight is recognized by water utility management winch has allothed staff and funding conclusted staff and trantoved resources or ogranize moroved tecordiseping and staff meter accuracy testing. Existing paper accuracy staffag. Existing paper accuracy atteration of the provide curacy discontinn of meter population.	In contrast a the contrast function of the con
	1	Luttise accorpted default verse utilities accorpted default verse utilities accorpted default verse up gains a reasonable partification of the sea <u>Bustier for a consider tenden</u> what verse areas accurd to what verse uses should be unreleved as untilities and unreleved as untilities and unreleved as untilities and a small sumple of one such as not such the such as not sumple of one such as not such as not such as not as not such as not as not as not such as not as not as not as not as not as not as not as not as not as not as not		Extent of unauthorized consumption is unknown due to undear policies and poor to access policies and poor unauthorized consumption is guesstimated.	In Quality for S. In a secorphic detauth for C. of system in port volume. In Quality policy regarding with what was an considered unauthorizod, and considered unauthorizod, and considered of one auch considered of one auch contenting of one auch the hydrawit operinge)	Customer mealers adist, but with unorganized gaper records on meters: no meter records on meters: no meter accuracy testing or meter registeremit program. Worldhow is driven tradicella ty usukomer management. Loss vulum due la aggement. Loss vulum due la aggement.	to public to 2. Cather evaluation motor Cather evaluation motor purchans around. Jonator purchans and the purchard motor balance to be an most inscrutes to befare organiza motor management.
	n/a					select rie only if the customer population is unmetered	If You is more pro- position that is more pro- position that is not provide the proposition that and the proposition that and the proposition that and and the proposition that and and the proposition that and the proposition the proposition the
		Inprovements to attain highe data granding far Unwilked Ummetaned Consumption*		Unauthorized consumption:	Inprovements to attain hyber data grading for "Unsucherdend Consumption" component:	Customer malaring Inacouracies:	Improvements to attain higher data grading for "Customer meter insourcey victomer component:

			-	and the second second	and the second se	- Mu	
Q.	Sound policy e Sound policy e Robust com system gives and reportu Assessment c handling and party amu party amu consumption (b is minimized a	binterinter and a second secon		Sound policy exists for managing water maine ordensions and replacements. Geographic formations System (sigs) data and asset management database agree and random field validation proves truth of databases.	lo <u>Inhinitetii 10:</u> Conthue with industraturation and rendom Madu validation tu Improve knowkedge of system.	Sound permitting policy and well managed and audited procedures ensure reliable management of anche compaction politabilo Compatibility and internation Compatibility and and Geographic information System (GIS) informat	to the second se
¢	Conditions between 8 and 10	s that allow Miled, or data that internel ed annually.		Conditions between 8 and 10	m (GIS) and induct field	Conditions between 8 and 10	that allow d. Link nent system nent system (ormation nentation of ormections ocks and
œ	Permitting and billing policy reviewed at least blaimually. Computerized billing system contim billing data and system tunctionality. Amutal internal checks ordicated with periodic thind party audit. Accountability choick and participations to constamption lost to billing lapeas is well quantified and reducing year-by-year.	A cualify from 100 cualify from 100 cualifies that allow Cases policy/procedure teapholes that allow the cuation reaconnic loss to involució or data franting error to cual: Erauro Bat viernal and third party audits are conducted annually.		Sound policy and procedures exist to permitting and commissioning row water mains. Electronic socialesping and assert management bystem are used to store and manage data.	In Geographic Information System (GIS) and asset management databasets, contract field verification of data.	Permitting policy and procedures reviewed at least biarrurality. Wells managed computerized managed computerized routins, periodic field revisian and routins, periodic field revisian and internal system audits allows counts of connections that is no more than 2% in error.	Is creative for the second properties of the second properties of the second se
2	Conditions between 8 and 8	itting and g capability formalize cope of data		Conditions between 6 and 8		Conditions between 6 and 8	ing policy aid checks kep reports adminand am.
9	Policy for permitting and billing is adoptulta and raviewad adoptulta and raviewad adoptulta and raviewad anglustments and raviewad anglustments on measurad consumption volumes is well billing data anto: conducted billing data anto: conducted annuality. Reasonaby accurate quantification of consumption volume lost to billing date as is obtained.	Io quality loc 8. Formalica regular review of pomitting and billing practocas. Enhance reporting quapatity of computarizad billing greaters. Formalize- regular auditing process to reveal acope of data handling ende.		Sound policy and proceedures exist for permitting and commissionand hew water matrix. Highly accurate paper records with applier fueld wateration: or electronic records and wateration: or management page in the pool condition. Includes system in good	lo <u>suelity for 8</u> Launch random field cheat of immed number of locations. Convert to electrant with backup as justified.	Permitting policy and procedures are adequate and weivered are adequate and weivered are adequate and weivered information management system & abandonma mual instalisations & abandonma mual instalisations & abandonma trutuker. Very limited field verifications and mitted field verifications and service connections is believed to be no more that 3%.	Rounding to a sumplify for 8. Formatize regular review of permitting policy and proceedings. Laured model modes of limited number of locations. Develop report and auditing mechanisms for computational information management system.
ø	Conditions between 4 and 6	edures and by policy portunity for the value pt the value ritce internal		Conditions between 4 and 6	policy and soning new y of records orrect any	Conditions between 4 and 6	
Grading 4	Policy and procedures for permitting and billing oxist but media refinament. Computerized billing system adds, but is diado tacks needed functionality. or duck and don form with approving accuracy the construption volumes lost to billing lapses.	A constraint of the second of	SYSTEM DATA	Sound policy and proceedures for permitting and cocumenting new water main installations, but gaps in management result in a uncontrain degree of area in tabulation of mains length.	humath for the first of the second se	Permitting policy and procedures adds. but white some gars in performance and oversight. Computations and oversight. management system is being brought online to replete dated brought online	Is autified for 6: Refine proceedures to ensure consistency with permitting placity to extensive an exercise connections or decormisation assiming connections. Improve process to include all totals for at least fine years prior to audit year.
6	Conditions between 2 and 4	and billing. Ther billing Ing records		Conditions between 2 and 4	la of water nts for a landow landow and distion and	Conditions between 2 and 4	Contraction of the local division of the loc
2	Policy for perr exists but ne exists but ne exists but ne records or insu records or insu records or insu periodic unst work conducte data handling e of unblied wo	lo cuality for 4: Phalase writen polery for participant balling. Implement a comparitional customer balling egain. Conduct writelia augit of balling encodes as part of this process.		Paper records in poor condition (no annual tracking of installations & abandomments). Poor procedures to resure that new water mains installed by developers ere accurately developers ere accurately	In Dutility for 4: Compares Internation of participant and and maniferent of years prior to audit years. Reviewe publicy and provedures for non-missioning and documenting now water main installation and abandomments.	General permitting policy addss but paper records, procedural gates and weak or eversight read in quastionable total for number of connections, which may vary 5- 10% of actual count.	Ratine policy and procedures for permitting and Builing. Research comparison fexoreheaping system (Customer Information System or Customer Billing System) to improve documentation format for service connections.
-	Vague polic: (creating n data mainté data mainté records which billing data ha Unknown num escape routie lack of bil lack of bil	In control of the second secon		Poorly assembled and maintained paper as-built records of extsing water main frequencies of extsing water main frequencies and/or of system pipe length impossible. Length of mains is guestimated.	Is autility for 2 Analysis personnel to inventory current activation content billymery gettern records and ingreen operating and countertain documents regarding documents regarding of the utility getter in proceedure that result in poor documentation.	Vague permitting (of new sarvice connections) policy and poor paper record(seping of customer connections/billinga result in supped rommation of the number of service connections, which may be 10-15% in error from actual count.	Its anality for 2 Draft now policy and proceedures for pormitting and tabling, freesensh and collect paper resords of heratilations & abardromments for avoid your.
n/a	select n/a only if the customer population is billed population is billed atta or fused rate charge that is not based upon masured volumes of water consumption (unmetered population)						
	Systematic Data Handling Error	Improvements to attain higher data grading for "Systematic Data Handling Error volume" component:		Length of mains.	Improvements to statish higher data greating for "Langsh of Water Mating" component:	Number of active AND inactive service connections:	Improvements to statist higher data grading for "Number of Active and Inactive customer service connections" component:

AWWA Water Loss Control Committee

Grading Matrix 8

ę	2	Either of two conditions can be availed additing addition of 10: 3) The customer water maker is a probed outside of the customer building addreem to the customer of boundary separating of boundary separating of boundary separating of boundary separating of boundary separating of boundary separating of the service active of the properties are unmetered. In other case the distance is not the properties are unmetered. In other case the distance is not of the properties are unmetered. In other case the distance is not customer to dist of car- net of the properties are ordinal to frame from 6 deorgraphic information System (GIS) and confirmed by routine field checks.	to metricitatin. 10: Contrinsi with standardization and nannotom field validation to improvee knowledge of system.	Weil-managed pressure districtationes. SCADA System and hydraulic model exist to gree the verser dathurtion system. Average system pressure is reliably, and cross-checked data, reliable, and cross-checked data.	It maintein 10. Continue to refine the hydraulic model of the distribution system and consider limiting it with SCUAD System for real-threador, and newarging.
	sponsible for the entire service connection service connection piping, and the typical first statue.	Clearly worded policy advantage the location of curdsops and melans, which are inspected upon installation. Accurate and well maintained detronk: records asks with detronk: records asks with electronk: records asks with policie fields to confitions policie field cashed to confit priss An accurate mumber of customer proparties from the customer billing system allows for tellable averaging of this length.	to suality for 10: Link customer information management system and Geographic Information System (GIS), standardize process for field werthration of data.	Weil-managed, discrete pressure zones addr with peneally predictable pressure fluctuations. A current trib-casel SCA. A strent trib-casel SCA. distruction system and could distruction system and could cast function at representative ates cross the system. The verage system pressure is determined from reliable SCADA System	Detain average pressure data trom hydraufic model of the distribution system that has been calibrated var field measurements in the water distribution system and confirmed in comparisons with SCADA System data.
8 1 7 1	a, or h baratin e the v	Clear policy exists to define Clear policy exists to define utility/customer responsibility for a web commercial policy Accurate, web-maintained paper or basic alectronic recordisepting between the pase alectronic recordisepting the the customer properties.	In purpose the second s	Reliable pressure controls separate distinct pressure controls apparate distinct pressure zones, that breach pressure zones, that breach pressure zones. Well- boundary verse are encountered that breach pressure zones. Well- photometral size of pressure data between distance by gauges/dataloggers at fire by gauges/dataloggers at fire between by gauges/dataloggers at fire between data between on a second between on a second	In sum of the second of the se
Grading 4 5 5	at and are located inside the customer building premise e average distance between the curbstop or boundary set entimest be quarified. Gradings of 1:9 are used to grad (See the "Service Connection Diagram" worksheet)	Good policy requires that the curtospo serves as the deliheation port between water utility port between water utility conversible and utility conversible and utility conversible an evention of the serventive threatied are aneled and the califor varies widely from the califor varies widely from the califor varies widely from the califor varies widely from the eventiability of paper records.	In a second seco	Effective pressure controls apparate of the pressure controls apparate of the pressure variation moderate pressure variation open boundary variation open boundary variation open boundary variation discovered that thereich pressure discovered that thereich pressure discovered that thereich pressure discovered that thereich pressure advances at the hydramic data pathened by gauges or gathened by gauges or gathened by gauges or distultings when fow pressure adatalogies and the hydramic datalogies and hydramin fuel hydramic advances and an advance thow this mix of data.	In cuality increases Expand to use of pressure grauphyticklagging of quipmont to pather combined pressure data at a representative Ultime pressure and have data to a faits, buesed upon pressure and have data. Correct any bank pressure actives, particity, correct any bank pressure actives, particity open boundary varives, althola evalues, particity open boundary varives, b ensure propersure dataset from these activities to gomentan system. white average pressure.
2 3	incoperties are unmetered. If customer meters as the customer building. In any of these cases the point of use (ex faucet) or the customer me	Policy requires that the curdedop serves as the definitation curdedop serves as the definitation curdedop and customer where utility connersing and customer connection pipting. The service connection pipting. The pipting from the pologing from the curdedop to the customer ware utility waster mailed to the curdedop to the customer the curdedop to the customer ware down and the pologing from the customer. The from a well occurrent of the distance is an estimated. The frostle, and group of locations an assured in the field.	Rockallh / for 3: Formatize and communicate policy defineating utility/curatize and communicate policy defineating commonton pairor. Assess accouncy of space commonton pairor. Assess accouncy of space resorts by field inspection of a wmail sample of aervice oron-tectors using public burton as needed. Research the potential migration to accounterized information management system to atome earvice connection data.	Limited telementy monitoring of static pressure data, which is static pressure data, which is recorded in handwritten oppoorts. Recorded in handwritten oppoorts. Awarge pressure is determined by everaging retained y significant variation in ground elevations. System nead dos and gage in pressure controls at points in the distribution system.	In standing for the second sec
F	Gradings t-9 appy it customer properties are unmet piping from the water main to the customer build point of use (Vague policy exists to define the delineation of water utility ownership and customer ownership and customer ownership and customer ownership of the service are porced of the service pean weather deal of the another bean weather wheat the build of concerned. Their focation and estimating the distance is and estimating the distance is	In cualify if C 2 and a construction of the co	Available records are poorly assembled of mainlained paper records of supply pump characteristics and water characteristics and water characteristics and water conditions. Average pressure conditions. Average pressure tis information and ground elevations from crude elevations from crude elevations from crude elevations from crude elevations from crude pressure actuality pressure actualition.	b statistic find a statistic find a statistic find a statistic datalogging exclore datalogging exclore datalogging exclore datalogging exclore datalogging exclore datalogging exclore a statistic find a statisti
n/a		If customer water outside of the outside of the outside of the customer building adjacent to the boundary separating utility/customer the sarvice connection piping (byo charge) in the fasporting the anter a value, then enter a value, then enter a value, then enter a value, then enter a value, the anter a value, the			
		Average langth of customer service line.	Insprovements to attain higher data garang for Yvenega Length of Custome Service Line" component:	Average operating pressure:	Inprovements to attain higher data grand for "Avenge Operating Pressue" component:

	10		Reliable electronic, industry- standard cost accuming system attera, with a portinent valar system operating, costs tracked Data audited arrushy by utility personnel and by finit-party CPA.	to maintain 10. Maintain program, sitay abroast of opportess subject to entratic cost changes and budgebhack costs proactively	Third party reviewed weighted average composite consumption tate (includes readente), commercial, industral, etc.)	builden 10. Neepo water rate structure current revenuer moedica Update the revenuer moedic. Update the restantion of the customer unit rate as new rate components, components are modified.	Either of two conditions can be and to obtain a grading of 10: 1) Third party CFA audit of 10 primary and eccondary cost components on an amrual basis. 2) Water supty is entirely 2) W	to maintain 10: Maintain program say abroast of expenses autilitiest to entrati- changes and budget/mack costs proactively
	6		Conditions between 8 and t0	uct a third-	Conditions between 8 and 10	dit of water assilications ate structure.	Conditions between 8 and 10	uct a third- an annual
	8		Reliable electronic, industry- standard cost eccounting system in place, with all pertinent water system operating costs tracked. Data audiod at least amunaity by utility personnel, and periodically by third-party CPA.	to <u>the 100 the 100 th</u>	Effective water rate structure is in billing operations. Competing billing operations. Competing customer rate is determined using a weighted average composite consumption rate, including and any other customer classes within the water rate structure.	It <u>outfill for 10.</u> Conduct a periodic hind-perint audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure.	Reliable electronic, industry- standard cost socurbing system in place, with all pertiment variable production costs tracked. Data audited at least annually by utility personnel, and periodically by	ito quality tor 10. Standardze the process to conduct a third- party financial audit by a CPA on an amual basis.
	7		Conditions between 8 and 8	ect routine basis.	Conditions between 8 and 8		Conditions between 6 and 8	to include setment) as trability. ct periodic
	9		Reliable electronic, industry- andrad cost acounting system in place, with all performent water system operating costs tracked personnel, not a Centified Public personnel, not a Centified Public	In guilt for S. Standardae the process to conduct routine financial audit on an annust basis.	Clearly written, up-to-date water rate structure is in force and is applied relativity in hitting operations. Composite eustoner operations. Composite eustoner are is determined using a weighted average residential rate using violares of water in each using violare block.	Evaluate volume of variet used in each usage block by all classifications of users. Multiply volumes by full rate structure.	Reliable electronic, industry- reader costs actouring system in place, with all pertinent water system operating costs tracked. Power and treatment costs beyond power and treatment act. I are production cost. Data audited at included in the unit vatable production cost. Data audited at least annually by utility personnel.	Possibility by Guellith by G. Formatize the accounting process to include primary cost components (power, treatment) as well as accordary control your finability, residuats management, etc.) Conduct periodic third-perity audits.
	0		Conditions between 4 and 6	mel audit of tity cost data acking these	Customer population unmetened. Fixed fee chargle composite numbosite from mutiple customer classes.	Metter. customens and change rates bened upon water volumes	Conditions between 4 and 8	the second day of the
Grading	4	COST DATA	Electronic, industry-standard cost accurring system in place. Gaps in data known to exist, periodic indan aveves conducted but not internal structured audit.	to <u>statific for</u> and the formal of the formal of the state of the sta	Straight-ionward water rate structure in use, but not updated in several years. Bling operators rateby employ he rate structure. The composite billing, tate is derived from a single billing, tate is derived from a single billing, tate is derived from a rates from effect of different rates from variving outstomer classes.	Ro anality for 6: Eventuates volumes of water used in each usage plock by readmining users. Munitipy volumes, by full rates, and structure.	Electronic, industry-standard cost accounting system in place. Electic pover and instament costs are reliably tracked and allow accurate calculation of unit vardable protoction costs based and the protoction costs based on these two inputs onty. All costs are audided internally on a periodic basis.	In <u>Destrict for G</u> . Formulars process for regular internal audits of production costs. Assess whether additional costs (limitible), residuals amogenemic, etc.) anound be included to cubustis a more accurate variable production cost.
	3		Conditions between 2 and 4	counting cocounting se	Conditions between 2 and 4	n and ease billing at billing shed water	Conditions between 2 and 4	counting coounting
	2		Reasonably maintained, but incomplete, part or electronic accounting provides data to estimate the major portion of water system operating costs	to outside for 4: Implement in electronic cost accounting system, structurad accounting to accounting standards for water utilities	Dated, cumbersome water rate structure, not alwarge employed consistently in actual billing consistently in actual billing pilling rate actual composite billing rate is known to differ from the published water rate structure, and a rassonably accurate and a rassonably accurate estimate of the degree of error is determined, allowing a composite billing rate to be quantified	to sumify for 4: Review the water for structure and updathformulize as needed. Assess billing operations to ensure that actual billing operations incorporate the established water rate structure.	Reasonably maintained, but Incomplete, pager or electronic accounting provides data to ucythy estimate the base operations costs (pumping power costs and treatment costs) and calcutate a unit variable production cost.	to sumity for 4: implement an electronic cost accounting system, structured according to accounting standards for water utilities
	1		Incomplete paper records and lack of documentation on many operating functions making calculation of water system operating costs a pure guessimate	to studic for 2: Gether remainshe records, Institute new procedures to regularly collect and audit basic cost data of most important operations functions.	Antifiquated, cumbersome water rate structure is use, with periodic historic antendments periodic historic antendments and inverse pony documented classes of usedimental billed inconsistent charges. The actual composite billing billed inconsistent anter billed inconsistent billed	to quality for 2. Formulae the process to Implement vestimation including a secure documentiation procedure. Create a current, lornell vestim references and gain approval from all satisfaction	Incomplete paper records and lack of documentation on primary operating functions (electic power and treatment costs most importantly), makes calculation of variable production costs a pure production costs a pure	to country to country to country to country to country to country to the country to coun
	n/a		1				If the water utility its entire water its entire water suppy, then anter cost of the bulk water suppy in the Reporting Worksheet with a grading of 10	
			Total annual cost of operating water system:	Improvements to attain higher data grading for "Tosa Amual Cost of Operating the Water System" component:	Customer retail unit cost (appled to Apparent Loases):	Improvements to attain higher data grading for "Customer Pastal Lett Cost component:	Variable production cost (applied to Raai Lossaa):	Improvements to attain higher data grading for "Vartable Production Coaf" component.

AWWA Water Loss Control Committee

Grading Matrix 10

Back to Instructions	1 2		Level V (91-100)	Annual water audit is a reliable gauge of year-to-year water efficiency standing	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation	Continue incremental improvements in short-term and long-term loss control interventions	Evaluate and refine loss control goals on a yearly basis	Identify Best Practices/ Best in class - the IL is very reliable as a real loss performance indicator for best in class service	T
Loss Standing WASV4.0	de	I / Score	Level IV (71-90)	Refine data collection practices and establish as routine business process	Refine, enhance or expand ongoing programs based upon economic justification	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Performance Benchmarking - ILI is meaningful in comparing real loss standing	better data validity is achieve
Determining Water Loss Standing Marion All Rights Reserved.	Water Loss Control Planning Guide	Water Audit Data Validity Level / Score	Level III (51-70)	Establish/revise policies and procedures for data collection	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Establish long-term apparent and real loss reduction goals (+10 year horizon)	Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	ould not be focus areas until
Software: erican Water Works Asso	Water Loss Con	Water A	Level II (26-50)	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.			50 or below, the shaded blocks should not be focus areas until better data validity is achieved
Water A Copyright ©			Level I (0-25)	Launch auditing and loss control team; address production metering deficiencies	Research information on leak detection programs. Begin flowcharting analysis of customer billing system				For validity scores of 50 c
AWWA WLCC Free			Functional Focus Area	Audit Data Collection	Short-term loss control	Long-term loss control	Target-setting	Benchmarking	

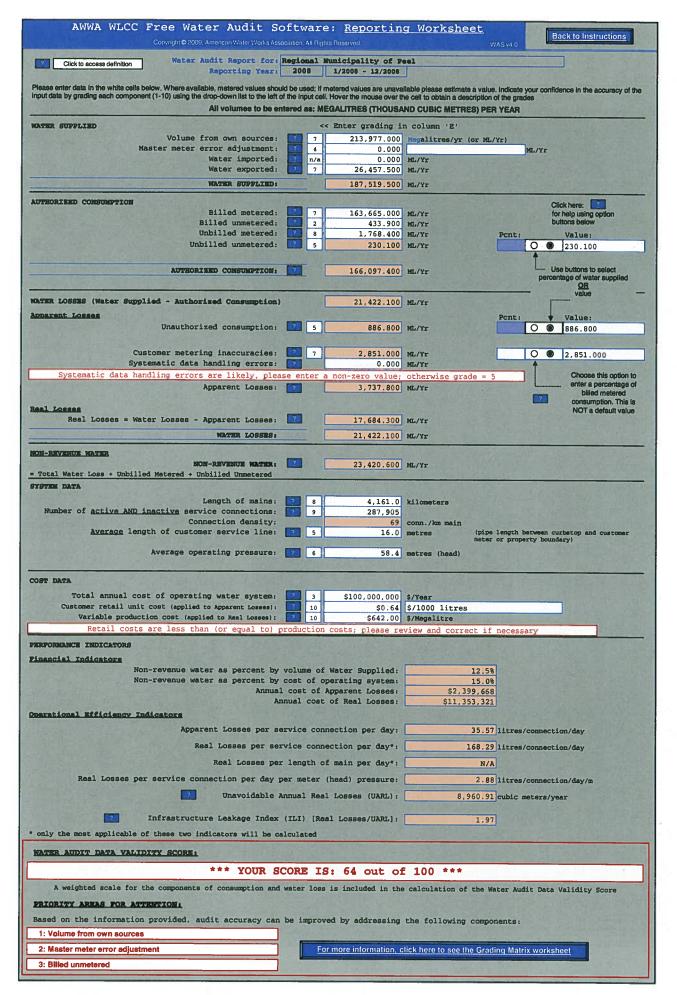
AWWA Water Loss Control Committee

Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and Once data has been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control real losses that exist in the system, then the lower the ILI value will be.

The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is <u>Note:</u> this table offers an approximate guideline for leakage reduction target-setting. useful if such an assessment is not possible.

witho	General Guidelines (without doing a full economic	for Setting a Target analysis of leakage	: ILI control options)
E	Financial Considerations	Operational Considerations	Water Resources Considerations
Water resource develop or pur increase reven greatly limite regulation or affordability.	s are costly to chase; ability to ues via water rates is d because of low ratepayer	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.
ater res urchasec eriodic easibly Y the cu	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 Water resources are believed to be capability is sufficient to meet sufficient to meet long-term needs long-term demand as long as but demand management intervention. (leakage management conservation) are included in the controls are in place. long-term planning.	Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term planning.
Cost to purc) water is low to customers	nase or obtain/treat , as are rates charged	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.
lthough eakage i ther tha	Although operational and financial considerations may allow a lor leakage is not an effective utilization of water as a resource. other than as an incremental goal to a smaller long-term target -	Although operational and financial considerations may allow a long-term ILI greater than 8.0, such a level leakage is not an effective utilization 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.	ng-term ILI greater than 8.0, such a level of Setting a target level greater than 8.0 - is discouraged.
If the ca exist. leakage c This is l operation the accur data.	If the calculated Infrastructure Leak exist. a) you are maintaining your leakage control. b) A portion of you This is likely if you calculate a low operations. In such cases it is bene the accuracy of production and custom data.	If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI 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.	n is 1.0 or less, two possibilities 1 the top worldwide performers in 5ses to be greatly understated. 7e leakage control practices in your aming field measurements to confirm 5otential sources of error in the

AWWA WLCC Free Water Audit So Copyright© 2009, American Water Works Ass			g Worksheet	Back to Instructions
Click to access definition Water Audit Report for: Reporting Year:	Philadelph 2008	ia Water Departme 7/2007 - 6/2008	nt.	
Please enter data in the white cells below. Where available, metered values shot input data by grading each component (1-10) using the drop-down list to the left.	uid be used; if m	etered values are unavai	llable please estimate a value. In cell to obtain a description of it	dicate your confidence in the accuracy of the
and the second			LONS (US) PER YEAR	ine Bildnes
WATER SUPPLIED Volume from own sources:	<	Enter grading in 94,536.900		(MG/Yr)
Master meter error adjustment: Water imported:	2 10 2 n/a	2,779.300	over-registered MG/Yr	MG/Yr
Water exported: WATER SUPPLIED:	2 10	7,100.400	MG/Yr MG/Yr	
AUTHORIZED CONSUMPTION				Click here:
Billed metered: Billed unmetered:	2 7 2 n/a	57,242.400	MG/Yr MG/Yr	for help using option buttons below
Unbilled metered: Unbilled unmetered:	2 n/a 7 8	764.200	MG/Yr P MG/Yr	cnt: Value:
AUTHORIEED CONSUMPTION:		58,006.600	Mg/Yr	Use buttons to select percentage of water supplied
WATER LOSSES (Water Supplied - Anthorized Consumption)		26,650.600	MG/Yr	value —
Apparent Losses Unauthorized consumption:	28	2,086.300		cnt: Value:
Customer metering inaccuracies: Systematic data handling errors:	7 8 7 5	190.300 4,674.400	MG/Yr MG/Yr	0 190.300
Apparent Losses:		6,951.000		Choose this option to enter a percentage of billed metered
Real Losses = Water Losses - Apparent Losses:		19,699.600	MG/Yr	consumption. This is NOT a default value
WATER LOSSES:		26,650.600	MG/Yr	
NON-REVENUE MATTER NON-REVENUE MATTER:	2	27,414.800	MG/Yr	
- Total Water Loss + Unbilled Metered + Unbilled Unmetered SYSTEM DATA				
Length of mains: Number of <u>active AND inactive</u> service connections:	9 9 7	3,137.0 547,932	miles	
Connection density: <u>Average</u> length of customer service line:	7	175 12.0		mgth between curbstop and customer
Average operating pressure:	10	55.0		property boundary)
COST DATA	世紀日本			
Total annual cost of operating water system: Customer retail unit cost (applied to Apparent Losses): Variable production cost (applied to Real Losses):	? 10 ? 9 ? 9 ? 9		\$/Year \$/1000 gallons (US) \$/Million gallons	
PERFORMANCE INDICATORS	ft. Land	A STATISTICS		
Pipencial Indicators Non-revenue water as percent by	volume of	Water Supplied:	32.4%	
	1 cost of A	Apparent Losses:	17.8% \$34,546,470	
A Operational Efficiency Indicators	nnual cost	of Real Losses:	\$4,245,264	
Apparent Losses per s		Street Charles Street Interest		allons/connection/day
Real Losses per se Real Losses pe		<pre>ection per day*: f main per day*:</pre>	and the second sec	allons/connection/day
Real Losses per service connection				allons/connection/day/psi
Unavoidable	Annual Real	Losses (UARL):	2,178.15 m	illion gallons/year
 Infrastructure Leakage Index only the most applicable of these two indicators will be of 		al Losses/UARL]:	9.04	
MATER AUDIT DATA VALIDITY SCORE:	asculated			
*** YOUR S	CORE IS	: 82 out of	E 100 ***	
A weighted scale for the components of consumption and	i water loss	is included in the	calculation of the Wate	er Audit Data Validity Score
PRIORITY AREAS FOR ATTENTION: Based on the information provided, audit accuracy can	be improv	ed by addressing	the following compone	nts:
1: Volume from own sources				
2: Billed metered 3: Systematic data handling errors	Fo	r more information, c	lick here to see the Grading	g Matrix worksheet
	A REAL PROPERTY.	Press and the second		



AWWA WLCC Free Water Audit Software: <u>Acknowledgements</u> Copyright © 2009. American Water Works Association. All Rights Reserved. WAS v4:0 WAS v4:0	AWWA Water Audit Software Version 4.0 Developed by the Water Loss Control Committee of the American Water Works Association April 2009	This software is intended to serve as a basic tool to compile a preliminary, or "top- down", water audit. It is recommended that users also refer to the 3rd Edition AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.	DEVELOPED BY: ANDREW CHASTAIN-HOWLEY, Miya Water DAVID GOFF, P.E. Goff Water Audits & Engineering GEORGE KUNKEL, P.E. Philadelphia Water Department ALAIN LALONDE, Veritec Consulting

Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272 - Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water REFERENCES:

- Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65

- AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009

- Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.

Appendix F

ME Simpson Leak Survey Reports



Mr. Steve Davis Vice President Malcolm Pirnie, Inc. 8001 Irvine Center Drive, Suite 1100 Irvine, California 92618

Dear Mr. Davis,

M.E. Simpson Co., Inc. is a technical service company that offers Leak Survey Programs, Large Meter Testing and Repair Programs, Water Main Location, and Valve Exercising, Location and Computer Mapping Programs. These "Technical Services" offered by M.E. Simpson Co., Inc. are designed to aid a utility in reducing unaccounted for water and lost revenue.

M. E. Simpson Co., Inc. is pleased to submit this report of our leak detection survey for Malcolm Pirni, Inc. in the City of Huntington Beach as part of the Leak Survey Program for the Metropolitan Water District of Orange County. This survey addressed the Huntington Beach water distribution system, consisting of approximately 12 miles of water main. The report contains the results of our investigation that includes the following:

- 1. A DESCRIPTION OF THE AREA SURVEYED.
- 2. METHODOLOGY OF THE SURVEY.
- 3. A LIST OF LEAKS AND TYPE OF LEAK LOCATED.
- 4. GENERAL RECOMMENDATIONS BASED ON OUR INVESTIGATION.

DESCRIPTION OF THE AREA SURVEYED

Approximately 63,360 lineal feet were surveyed as part of the system investigation. This included all fire hydrants, all accessible mainline valves and selected services.

METHODOLOGY

Your survey was conducted using the latest state of the art leak computers, the FLUID CONSERVATION SYSTEMS' Tri-Corr 2001 the 90/90 or C2000 with the MP90 preamplifier-transducer system. All of these correlators are manufactured by Fluid Conservation Systems of Milford, Ohio. These electronic instruments are microprocessor units that measure the time it takes the sound of the leak to travel from the leak to the point where the leak correlator is connected to the water line. By connecting the leak correlator to the water line at two locations, it will compute the distance from the leak to each connection point thus enabling us to determine the exact leak location. Our experienced technicians used these devices, along with the S-30 electronically enhanced listening device, as listening equipment to survey your pipeline network. Each hydrant and accessible valve was used as listening points to identify leaks. Services, boxes, and hydrants were used on an as needed basis to keep the listening distances under five hundred feet (500'). All PVC style watermains were investigated via correlation. Correlation distances for PVC did not exceeding five hundred feet (500') unless listening points were unavailable. "Pinpointing" of the leak, as well as locating leaks that other methods fail to reveal was also done with this equipment.

Survey Results

M.E. Simpson Co., Inc. was unable to locate any discernable leaks on the Huntington Beach water distribution system. It is our opinion, at this time, that the water system is leak free.

RECOMMENDATIONS

This survey confirms that the City of Huntington Beach's water distribution system has benefited from the on-going leak survey program by a reduction in underground leakage. There is always a concern over the cost effectiveness of leak detection because of the uncertainty of the number of leaks located. While there were no leaks found on the system this year, a leak can occur at anytime and the sooner it is found the less it ends up costing the utility. It is important to remember that new leaks may occure at any time with changing weather and soil conditions. Additionally, the lack of leaks located does attest to the the high level of integrity of the pipe in the area surveyed. We would recommend that you continue to conduct a Leak Survey Program every other year on the water system. This recommendation becomes more critical as your cost of water increases.

We appreciate your cooperation and that of the utility staff who were available to answer our questions during this project. If you have any questions with the information in this report, please do not hesitate to call.

Sincerely Yours,

Michael D. Simpson CEO MDS/jph



Mr. Steve Davis Vice President Malcolm Pirnie, Inc. 8001 Irvine Center Drive, Suite 1100 Irvine, California 92618

Dear Mr. Davis,

M.E. Simpson Co., Inc. is a technical service company providing Leak Survey Programs, Large Meter Testing and Repair Programs, Water Main Location, Valve Assessment, and Computer Mapping Programs. These "Technical Services" offered by M.E. Simpson Co., Inc. are designed to aid a utility in reducing unaccounted for water and lost revenue.

M.E. Simpson Co., Inc. is pleased to submit this report of our leak detection survey for Malcolm Pirnie, Inc. in the City of Brea as part of the Leak Survey Program for the Metropolitan Water District of Orange County. This survey addressed the Brea water distribution system, consisting of approximately 16.8 miles of water main. The report contains the results of our investigation including the following:

- 1. A DESCRIPTION OF THE AREA SURVEYED.
- 2. METHODOLOGY OF THE SURVEY
- 3. A LIST OF LEAKS AND TYPE OF LEAKS LOCATED
- 4. GENERAL RECOMMENDATIONS BASED ON OUR INVESTIGATION

DESCRIPTION OF THE AREA SURVEYED

Approximately 88,704 lineal feet were surveyed as part of the system investigation. This included all fire hydrants, accessible mainline valves and selected services.

METHODOLOGY

Your survey was conducted using the latest state of the art leak computers, the FLUID CONSERVATION SYSTEMS' DigiCALL Correlating System, Accu Corr Leak Correlator, or FCS Tri-Corr 2001 Leak Correlator. The FCS S-30 is a tool used as an electronically enhanced listening device. All of these correlators are manufactured by Fluid Conservation Systems of Milford, Ohio. These electronic instruments are microprocessor units that measure the time it takes the sound of the leak to travel from the leak to the point where the leak Correlator is connected to the water line. By connecting the leak correlator to the water line at two locations, it will compute the distance from the leak to each connection point thus enabling us to determine the exact leak location. Our experienced technicians used these devices, along with the S30 electronically enhanced listening device or the L-Mic electronic listening device, as listening equipment to survey your pipeline network. Each hydrant and accessible valve was used as listening points to identify leaks. Selected services, b-boxes, were used on an as needed basis to keep the listening distances under five hundred feet (500'). "Pinpointing" of the leak, as well as locating leaks that other methods fail to reveal was also done with this equipment.

LEAKAGE LOCATED

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All water mains within the Project area were surveyed and 1 leaks were located. These leaks have been grouped as follows: Main Line Leak - 1, Service Line Leak - 0, Fire Service Leak -0, Valve Leak - 0, Hydrant Leak - 0, Other Type Leak - 0. All of these leaks have been verbally reported to your office with these locations, so many have probably been repaired already. Following are the leak locations with an estimated GPD (Gallons Per Day) leakage potential.

Туре	Location	SIZE
Main Line	Beechwood Drive & Parkcrest Way - Brea, California	
	see enclosed diagram	79,200 GPD
1 Leaks Located	ESTIMATED LEAKAGE TOTAL	79,200 GPD

LEAK QUANTITIES

Quantifying leaks is difficult because there is not any accurate means of doing so. Pipe material, size of the leak, system pressure, soil material and water table will affect the noise that a leak makes. Small leaks under high system pressure will make more noise than a large leak under low system pressure. However, the above leaks are of sufficient noise levels that the above estimates should be very conservative. If a production price of \$2.17 per thousand gallons is used, these leaks were costing your utility in excess of \$171.86 per day or \$62,730.36 annually. It's obvious this Leak Survey Program has proven to be cost effective. Naturally the main line leaks have the greatest potential for loss followed by service line, valves, and finally hydrants. Once leaks have been repaired, we would recommend that the Utility compare pumping rates before and after. This information will be more meaningful and accurate.

RECOMMENDATIONS

This survey confirms the City of Brea's water distribution system will benefit from this project by a reduction in underground leakage. There is always a concern over the cost effectiveness of leak detection because of the uncertainty of the number of leaks located. However, with your present cost of water and the discovery of this one leak, the cost of this 2009 leak survey will pay for itself within 1 month. It only takes a recovery of about 4,924 gallons per day on an annual basis (4,924 per day is only 3.4 gallons per minute throughout your entire water distribution system) to recover your investment. We would recommend that you conduct a Leak Survey Program every year. This recommendation becomes more critical as your cost of water increases.

We appreciate your cooperation and that of the Utility staff we were available to answer our questions during this project. If you have any questions with the information in this report, please do not hesitate to contact us.

Sincerely Yours,

Michael D. Simpson CEO MDS/jph

M.E. SIMPS<u>ON COMPANY, INC.</u> LEAK LOCATION REPORT

Client: Brea, California

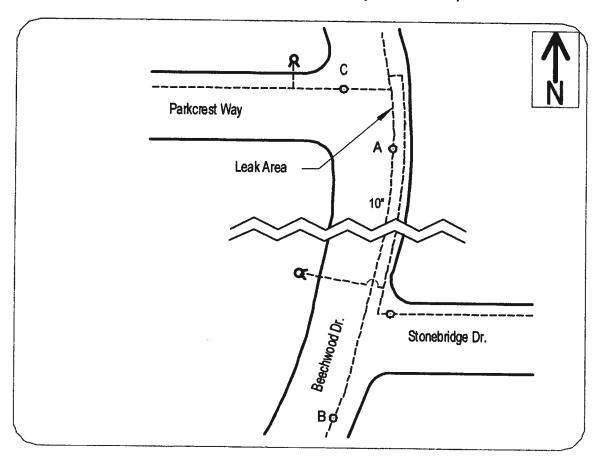
Time: 09:15 Leak# 01'09

Date: Saturday, December 19, 2009

Tech: Sandison P. & Craig V.

Address: Beechwood Drive & Parkcrest Way - Brea, California

Below is a diagram of the area surveyed for a suspect leak.



Distance: 256' from A to B / 75' from A to C

Connection point:A= Main Line ValveConnection point:B= Main Line ValveConnection point:C= Main Line Valve

Connection point: Leak Location: 23' from A

Comments: This is a leak on a 10" main.

We thank you for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.



Mr. Steve Davis Vice President Malcolm Pirnie, Inc. 8001 Irvine Center Drive, Suite 1100 Irvine, California 92618

Dear Mr. Davis,

M.E. Simpson Co., Inc. is a technical service company that offers Leak Survey Programs, Large Meter Testing and Repair Programs, Water Main Location, and Valve Exercising, Location and Computer Mapping Programs. These "Technical Services" offered by M.E. Simpson Co., Inc. are designed to aid a utility in reducing unaccounted for water and lost revenue.

M. E. Simpson Co., Inc. is pleased to submit this report of our leak detection survey for the City of Tustin Water Department as part of the Leak Survey Program for the Metropolitan Water District of Orange County. This survey addressed the Tustin water distribution system, consisting of approximately 5.3 miles of water main. The report contains the results of our investigation that includes the following:

- 1. A DESCRIPTION OF THE AREA SURVEYED.
- 2. METHODOLOGY OF THE SURVEY.
- 3. A LIST OF LEAKS AND TYPE OF LEAK LOCATED.
- 4. GENERAL RECOMMENDATIONS BASED ON OUR INVESTIGATION.

DESCRIPTION OF THE AREA SURVEYED

Approximately 27,984 lineal feet were surveyed as part of the system investigation. This included all fire hydrants, all accessible mainline valves and selected services.

METHODOLOGY

Your survey was conducted using the latest state of the art leak computers, the FLUID CONSERVATION SYSTEMS' Tri-Corr 2001 the 90/90 or C2000 with the MP90 preamplifier-transducer system. All of these correlators are manufactured by Fluid Conservation Systems of Milford, Ohio. These electronic instruments are microprocessor units that measure the time it takes the sound of the leak to travel from the leak to the point where the leak correlator is connected to the water line. By connecting the leak correlator to the water line at two locations, it will compute the distance from the leak to each connection point thus enabling us to determine the exact leak location. Our experienced technicians used these devices, along with the S-30 electronically enhanced listening device, as listening equipment to survey your pipeline network. Each hydrant and accessible valve was used as listening points to identify leaks. Services, b-boxes, and hydrants were used on an as needed basis to keep the listening distances under five hundred feet (500'). "Pinpointing" of the leak, as well as locating leaks that other methods fail to reveal was also done with this equipment.

Survey Results

M.E. Simpson Co., Inc. was unable to locate any discernable leaks on the Tustin water distribution system. It is our opinion, at this time, that the water system is leak free in the area surveyed. There may be more leakage throughout the system if a larger scale survey is conducted in the future.

RECOMMENDATIONS

This survey confirms that the City of Tustin Water Department's water distribution system has benefited from the on-going leak survey program by a reduction in underground leakage. There is always a concern over the cost effectiveness of leak detection because of the uncertainty of the number of leaks located. While there were no leaks found on the system this year, a leak can occur at anytime and the sooner it is found the less it ends up costing the utility. It is important to remember that new leaks may occure at any time with changing weather and soil conditions. Additionally, the lack of leaks located does attest to the the high level of integrity of the pipe in the area surveyed. We would recommend that you continue to conduct a Leak Survey Program every other year on the water system. This recommendation becomes more critical as your cost of water increases.

We appreciate your cooperation and that of the utility staff who were available to answer our questions during this project. If you have any questions with the information in this report, please do not hesitate to call.

Sincerely Yours,

Michael D. Simpson CEO MDS/jph



Mr. Steve Davis Vice President Malcolm Pirnie, Inc. 8001 Irvine Center Drive, Suite 1100 Irvine, California 92618

Dear Mr. Davis,

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M. E. Simpson Co., Inc. is pleased to submit this report of our leak detection survey for Malcolm Pirnie, Inc. in the Moulton Niguel Water District as part of the Leak Survey Program for the Metropolitan Water District of Orange County. This survey addressed the Moulton Niguel Water District's water distribution system, consisting of approximately 16.5 miles of water main. The report contains the results of our investigation that includes the following:

- 1. A DESCRIPTION OF THE AREA SURVEYED.
- 2. METHODOLOGY OF THE SURVEY.
- 3. A LIST OF LEAKS AND TYPE OF LEAK LOCATED.
- 4. GENERAL RECOMMENDATIONS BASED ON OUR INVESTIGATION.

DESCRIPTION OF THE AREA SURVEYED

Approximately 87,120 lineal feet were surveyed as part of the system investigation. This included all fire hydrants, all accessible mainline valves and selected services.

METHODOLOGY

Your survey was conducted using the latest state of the art leak computers, the FLUID CONSERVATION SYSTEMS' Tri-Corr 2001 the 90/90 or C2000 with the MP90 preamplifier-transducer system. All of these correlators are manufactured by Fluid Conservation Systems of Milford, Ohio. These electronic instruments are microprocessor units that measure the time it takes the sound of the leak to travel from the leak to the point where the leak correlator is connected to the water line. By connecting the leak correlator to the water line at two locations, it will compute the distance from the leak to each connection point thus enabling us to determine the exact leak location. Our experienced technicians used these devices, along with the S-30 electronically enhanced listening device, as listening equipment to survey your pipeline network. Each hydrant and accessible valve was used as listening points to identify leaks. Services, b-boxes, and hydrants were used on an as needed basis to keep the listening distances under five hundred feet (500'). All PVC style watermains were investigated via correlation. Correlation distances for PVC did not exceeding five hundred feet (500') unless listening points were unavailable. "Pinpointing" of the leak, as well as locating leaks that other methods fail to reveal was also done with this equipment.

Survey Results

M.E. Simpson Co., Inc. was unable to locate any discernable leaks on the Moulton Niguel Water District's water distribution system. It is our opinion, at this time, that the water system is leak free.

RECOMMENDATIONS

This survey confirms that the Moulton Niguel's water distribution system has benefited from the on-going leak survey program by a reduction in underground leakage. There is always a concern over the cost effectiveness of leak detection because of the uncertainty of the number of leaks located. While there were no leaks found on the system this year, a leak can occur at anytime and the sooner it is found the less it ends up costing the utility. It is important to remember that new leaks may occure at any time with changing weather and soil conditions. Additionally, the lack of leaks located does attest to the the high level of integrity of the pipe in the area surveyed. We would recommend that you continue to conduct a Leak Survey Program every other year on the water system. This recommendation becomes more critical as your cost of water increases.

We appreciate your cooperation and that of the utility staff who were available to answer our questions during this project. If you have any questions with the information in this report, please do not hesitate to call.

Sincerely Yours,

Michael D. Simpson CEO MDS/jph



Mr. Steve Davis Vice President Malcolm Pirnie, Inc. 8001 Irvine Center Drive, Suite 1100 Irvine, California 92618

Dear Mr. Davis,

M.E. Simpson Co., Inc. is a technical service company providing Leak Survey Programs, Large Meter Testing and Repair Programs, Water Main Location, Valve Assessment, and Computer Mapping Programs. These "Technical Services" offered by M.E. Simpson Co., Inc. are designed to aid a utility in reducing unaccounted for water and lost revenue.

M.E. Simpson Co., Inc. is pleased to submit this report of our leak detection survey for Malcolm Pirnie, Inc. in the Laguna Beach County Water District as part of the Leak Survey Program for the Metropolitan Water District of Orange County. This survey addressed the Laguna Beach County water distribution system, consisting of approximately 6.5 miles of water main. The report contains the results of our investigation including the following:

- 1. A DESCRIPTION OF THE AREA SURVEYED.
- 2. METHODOLOGY OF THE SURVEY
- 3. A LIST OF LEAKS AND TYPE OF LEAKS LOCATED
- 4. GENERAL RECOMMENDATIONS BASED ON OUR INVESTIGATION

DESCRIPTION OF THE AREA SURVEYED

Approximately 34,320 lineal feet were surveyed as part of the system investigation. This included all fire hydrants, accessible mainline valves and selected services.

METHODOLOGY

Your survey was conducted using the latest state of the art leak computers, the FLUID CONSERVATION SYSTEMS' DigiCALL Correlating System, Accu Corr Leak Correlator, or FCS Tri-Corr 2001 Leak Correlator. The FCS S-30 is a tool used as an electronically enhanced listening device. All of these correlators are manufactured by Fluid Conservation Systems of Milford, Ohio. These electronic instruments are microprocessor units that measure the time it takes the sound of the leak to travel from the leak to the point where the leak Correlator is connected to the water line. By connecting the leak correlator to the water line at two locations, it will compute the distance from the leak to each connection point thus enabling us to determine the exact leak location. Our experienced technicians used these devices, along with the S30 electronically enhanced listening device or the L-Mic electronic listening device, as listening equipment to survey your pipeline network. Each hydrant and accessible valve was used as listening points to identify leaks. Selected services, b-boxes, were used on an as needed basis to keep the listening distances under five hundred feet (500'). "Pinpointing" of the leak, as well as locating leaks that other methods fail to reveal was also done with this equipment.

LEAKAGE LOCATED

All water mains within the Project area were surveyed and 1 leaks were located. These leaks have been grouped as follows: Main Line Leak - 0, Service Line Leak - 0, Fire Service Leak -0, Valve Leak - 0, Hydrant Leak - 1, Other Type Leak - 0. All of these leaks have been verbally reported to your office with these locations, so many have probably been repaired already. Following are the leak locations with an estimated GPD (Gallons Per Day) leakage potential.

Туре	Location	SIZE
Hydrant (visible)	49 La Costa Court - Laguna Beach, California	
	see enclosed diagram	1,440 GPD
1 Leaks Located	ESTIMATED LEAKAGE TOTAL	1,440 GPD

LEAK QUANTITIES

Quantifying leaks is difficult because there is not any accurate means of doing so. Pipe material, size of the leak, system pressure, soil material and water table will affect the noise that a leak makes. Small leaks under high system pressure will make more noise than a large leak under low system pressure. However, the above leaks are of sufficient noise levels that the above estimates should be very conservative. If a production price of \$4.40 per thousand gallons is used, these leaks were costing your utility in excess of \$3.34 per day or \$2,312.64 annually. It's obvious this Leak Survey Program has proven to be cost effective. Naturally the main line leaks have the greatest potential for loss followed by service line, valves, and finally hydrants. Once leaks have been repaired, we would recommend that the Utility compare pumping rates before and after. This information will be more meaningful and accurate.

RECOMMENDATIONS

This survey confirms the Laguna Beach County Water District's water distribution system will benefit from this project by a reduction in underground leakage. There is always a concern over the cost effectiveness of leak detection because of the uncertainty of the number of leaks located. However, with your present cost of water and the discovery of this 1 leak, the cost of this 2009 leak survey will pay for itself within 20 months. It only takes a recovery of about 2,428 gallons per day on an annual basis (2,428 per day is only 1.7 gallons per minute throughout your entire water distribution system) to recover your investment. We would recommend that you conduct a Leak Survey Program every year. This recommendation becomes more critical as your cost of water increases.

We appreciate your cooperation and that of the Utility staff we were available to answer our questions during this project. If you have any questions with the information in this report, please do not hesitate to contact us.

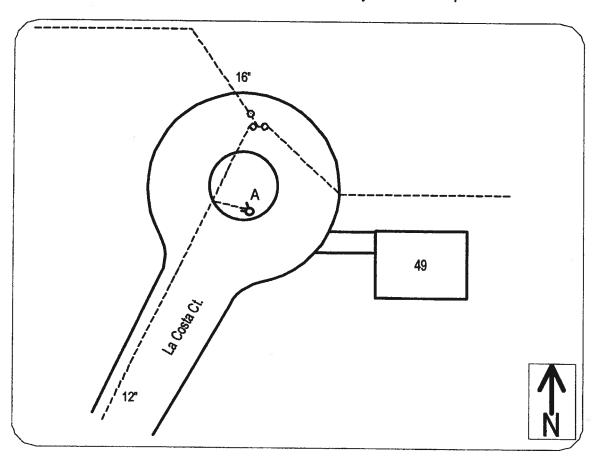
Sincerely Yours,

Michael D. Simpson CEO MDS/jph

M.E. SIMPS<u>ON COMPANY, INC.</u> LEAK LOCATION REPORT

Client: Laguna Beach, CaliforniaTime: 10:00Leak# 02'09Date: Wednesday, December 09, 2009Tech: Sandison P. & Craig V.Address: 49 La Costa Court - Laguna Beach, California

Below is a diagram of the area surveyed for a suspect leak.



Distance: 0' from A Connection point: A= Hydrant #6 60/8 Connection point: Connection point: Connection point:

Leak Location: 0' from A Comments: This is a visible hydrant leak.

We thank you for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.

M.E. SIMPSON COMPANY, INC. LEAK LOCATION REPORT

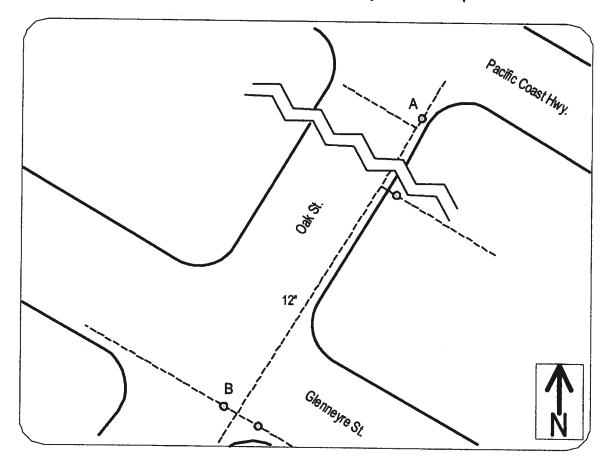
Client: Laguna Beach, California	Time: 08:00	Leak# 01'09
Date: Wednesday Describes 00,0000		

Date: Wednesday, December 09, 2009 T

Tech: Sandison P. & Craig V.

Address: Oak Street - Between Glenneyre Street & Pacific Coast Highway -Laguna Beach, California

Below is a diagram of the area surveyed for a suspect leak.



Distance: 258' from A to B

Connection point: A= Main Line Valve

Connection point: B= Main Line Valve

Connection point:

Connection point:

Leak Location: There were no leaks pinpointed in this area.

Comments: After correlation we listened to area connection points but did not detect any leak noise.

We thank you for the opportunity to work for your Utility and look forward to serving you again. If you have any questions please don't hesitate to call.