

California Department of Water Resources

**Recommendations for Urban Wholesale
Distribution Systems Water-Loss
Audit Reporting**

Report to the Legislature

November 2019



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Acronyms and Abbreviations

AWWA	American Water Works Association
CUWCC	California Urban Water Conservation Council
CWC	California Water Code
DWR	California Department of Water Resources
MWDOC	Municipal Water District of Orange County
SB	Senate Bill
SCADA	Supervisory Control And Data Acquisition
Water Board	State Water Resources Control Board

1.0 Introduction

This report is respectfully submitted to the California State Legislature pursuant to California Water Code (CWC) Section 10608.35. This code directs the California Department of Water Resources (DWR) to conduct necessary studies and make recommendations to the Legislature by January 1, 2020 on the feasibility of developing and enacting water-loss reporting requirements for urban wholesale water suppliers. In developing this report, DWR coordinated with the State Water Resources Control Board (State Water Board) and solicited broad public participation through two stakeholder meetings/webinars, interviews with seven urban wholesale water suppliers regarding their distribution system water-loss practices, and discussions with multiple technical experts in the industry and academia.

2.0 Background

California water suppliers provide water under pressure through potable water distribution systems that consist of thousands of miles of pipelines, millions of connections to homes, businesses, and industries, and interconnections with other water suppliers across the state. Pressurized systems keep contaminants out of the pipes and water supplies; but this pressure can also force water out of the pipes, especially at connections, resulting in water loss from seepage, leaks, and pipe failures. Population growth, climate change, and the recent historic drought have forced California to evaluate all aspects of water use and management across the state, including determining the extent of water loss in the State's water suppliers' distribution systems.

Since 2014, three bills have been enacted related to water loss in water suppliers' distribution systems:

- Senate Bill (SB) 1420 (Wolk, 2014) required all urban retail and wholesale water suppliers to include water-loss audits reports as part of their urban water management plan submittal.
- SB 555 (Wolk, 2015) required urban retail water suppliers to submit annual validated water-loss audits to DWR starting October 1, 2017.
- SB 606 (Hertzberg, 2018) directed DWR to submit recommendations on the feasibility of extending the urban retail water supplier water-loss requirements to wholesale suppliers.

The type of distribution system water-loss audits required by this new legislation are not new to California. DWR developed one of the first water-loss audit protocols in the 1990s and held training workshops throughout the state for many years (California Department of Water Resources 1992). The American Water Works Association (AWWA), working with water-loss experts from across the country and internationally, expanded on the DWR water-loss guidebook to create its third edition of the *Manual of Water Supply Practices Water Audits and Loss Control Programs* (M36; American Water Works Association 2016). Now in its fourth edition, this publication serves as the current water industry standard and protocol for water-loss audits in the United States.

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The M36 manual also includes a free audit software program that allows suppliers to input information on distribution systems characteristics (e.g., miles of pipelines, number of connections, and operating pressures) and annual operational data (e.g., water production and delivery volumes, estimates of unmetered water use needed for fire flows, and economic values such as customer retail unit cost and variable water production costs) (American Water Works Association 2016, 2014). The software provides default values for missing data and requires suppliers to create data validity scores based on how the data inputs to the model were developed and quantified. The testing and accuracy of production and delivery meters is a significant component of the data validity scores.

Using the supplier data inputs, the AWWA software calculates real and apparent losses for the water system. (Apparent water loss is water that remains in the pipes, and thus is not actually lost from the system, but is not accounted for because of inaccurate meter reads in under-registering meters, theft, or underestimation of fire or flushing flows.) The software also calculates system performance metrics and water-loss-control cost effectiveness.

Water suppliers that were members of the California Urban Water Conservation Council (CUWCC) began using the AWWA software program in 2005 as part of the CUWCC's best management practices. Approximately 200 suppliers completed audits until the CUWCC reorganized in 2017 to become the California Water Efficiency Partnership. As part of the reorganization, the reporting on the implementation of best management practices, including submitted water audits, was discontinued as audits and other water use efficiency measures are now required by State law.

Currently, urban wholesale water suppliers are required to include five years of water-loss audits as part of their urban water management plan submittals, which occurs in five-year intervals. In addition to the water-loss audit reporting, in DWR's interviews with wholesale water suppliers, many described implementing extensive asset management programs. These programs include daily visual checks of pipeline systems, meter calibrations and inspections, pressure zone monitoring, and system modeling.

Since 2017, California urban retail water suppliers have been required to submit annual water-loss audits to DWR. (Urban retail water suppliers are

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defined as having 3,000 or more connections or annual retail sales of more than 3,000 acre-feet of potable water for municipal purposes.) As part of the requirement, the water-loss audits must be validated by certified professionals. The validation focuses on how well the audit reflects the agency's operations, including the data validity grading for each entry and the accuracy of the data inputs. It is not expected that retailers initially have high data validity scores, but that they show improvement in their water-loss audit data collection methods through increased data validity scores over time. The State Water Board is using the data to develop a performance standard that retailer water suppliers will have to comply with by 2027.

Wholesale water systems differ significantly from retail systems. Retail water systems typically have many miles of a small-diameter pipe that serve many connections. Wholesale distribution systems typically have fewer miles of larger-diameter pipes with very few connections. The M36 audit program was developed for retail water systems (American Water Works Association 2016). As a result, the default values for missing data, the data validity scores, and the performance metrics are not applicable to urban wholesale water suppliers. Urban wholesale water suppliers have used the M36 software to create water-loss audit reports but leave many of the sections blank as they are not applicable to wholesalers (American Water Works Association 2014).

In the accounting of water losses, calibrating and testing meters for measurement of water volumes is foundational to the accuracy of water system audits. The meter readings form the basis for calculating how much water is supplied into the system, how much water is sold to customers, and how much water is used for operations and other authorized consumption. The meters used by wholesale water suppliers are large (typically classified as more than 6 inches), with many wholesaler systems having meters larger than 24 inches and some scaling up to 108 inches. This poses a problem for meter testing because removal is difficult due to their size and because they are critically important for system operations. If removed, the meters often need to be transported (sometimes by rail) to a specialized test facility. Testing in place may be feasible but, if not initially designed for in-place testing, the upstream and downstream pipeline flow conditions could adversely affect meter test results. Ultimately, testing requirements for large water meters needs to be further evaluated before DWR can make

recommendations in this area.

DWR has identified 49 urban wholesale water suppliers in California. (Urban wholesale water suppliers are defined in CWC Section 10608.12(w) as agencies providing more than 3,000 acre-feet per year of potable water annually at wholesale for municipal purposes.) These urban wholesale water suppliers vary greatly in terms of the size, water supplies, and delivery mechanisms used in their systems. Some wholesale water suppliers have their own water supplies and reservoirs, and others receive supplies from larger systems such as the State Water Project or the Central Valley Project. Some water suppliers are strictly wholesale, and others offer both wholesale and retail deliveries. Seven urban wholesale water suppliers only contract for and sell water to retailers but have no water infrastructure or delivery mechanism. One example is the Municipal Water District of Orange County (MWDOC). Other suppliers do have infrastructure, such as the Metropolitan Water District of Southern California, the supplier that provides water directly to MWDOC's customers. Thirteen wholesale water suppliers provide raw water to their retail customers, and 29 wholesale water suppliers provide potable water to their retailers.

3.0 Primary Issues Raised by Stakeholders

DWR held two meetings with stakeholders, in July and August of 2019. During these meetings, DWR staff discussed the issues and gathered input. In addition, several wholesale water suppliers were interviewed by DWR to help determine the current status of best practices for wholesaler water real losses by urban wholesaler suppliers. The process was very helpful in providing input on the needs and issues surrounding urban wholesaler water-loss control programs. Key issues raised included the following:

- Urban wholesale water suppliers face challenges with using the required M36 methodology and water system audit software (American Water Works Association 2016, 2014). Many of the audit software inputs and results are not applicable to wholesaler systems. Wholesalers are currently scheduled to submit the next set of water-loss audits by July 30, 2021, with their 2020 urban water management plans.
- Urban wholesalers water suppliers should be required to conduct accuracy flow testing on large wholesale delivery meters where feasible. The purpose of this would be to increase confidence in the water input values, especially for retail water-system audits. Urban retail water suppliers are particularly concerned about the accuracy of the large meters that determine water input values, given the planned regulation of a water system loss volume-based performance standard by the Water Board.
- There are concerns with the feasibility and cost effectiveness of large-meter accuracy testing, given the size of some of the meters and the limited option for testing meters of this size.
- In addition to potable water systems, urban wholesale water suppliers should be required to conduct water-loss audits of their raw water canal or pipeline systems and their recycled water system, if applicable.

4.0 Recommendations

Based on background information gathered, interviews with wholesale suppliers, and stakeholder input, DWR makes the following recommendations on the feasibility of developing and enacting water loss reporting requirements for urban wholesale water suppliers:

1. **Annual Reporting**: As part of the urban water management plan submittal requirement, change the wholesaler water audit reporting requirement from the current five-year interval schedule to an annual schedule to match the same schedule as the urban retail water suppliers.

Wholesalers should report water loss using an audit form developed by DWR specific for urban wholesale water suppliers, as the current AWWA Manual M36 *Water Audits and Loss Control Programs* (American Water Works Association 2016) methodology is not fully applicable to reporting by wholesaler water suppliers. Because meter accuracy is a critical part of the water audit methodology and because there is a lack of technical consensus on how best to test and calibrate large meters, urban wholesale water suppliers should not be required to validate their water-loss audits until large-meter testing and other best management practices, along with any appropriate data validity scores, are developed.

DWR to Develop Wholesaler-Specific Methodology: To implement these recommendations, CWC Sections 10631(3)(A) and (B) should be changed to require only the quantification of annual water-loss volumes for the reporting year in the plan and estimates of future water loss in five-year intervals for the 20-year urban water management planning horizon. In addition, CWC Section 10608.34 should be amended to require wholesale reporting to DWR on the same schedule (annually) as retail suppliers, but without the validation requirement and instead using a wholesaler-specific form developed by DWR.

2. **Large Meter Testing Protocols**: Direct DWR to complete a study on large-meter testing protocols that would lead to establishing industry best practice protocols for large-meter accuracy. This study is necessary for developing technical and industry consensus regarding the testing of large meters and to develop the criteria for data validity scores. In conducting the study, DWR would collaborate with the AWWA

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on the Manual M36 methodology updates (American Water Works Association 2016), other meter accuracy pilot studies, and academic institutions.

3. **Provide Training**: Direct DWR to conduct training workshops for urban wholesale water suppliers on industry best management practices for water-loss management programs. This training would include instruction on the newly developed wholesale water supplier water-loss audit methodology developed by DWR. These workshops should provide a forum to discuss practices, programs, and cost-effective measures to enhance wholesale water-loss control programs.

5.0 Stakeholder Input Not Addressed

The following stakeholder suggestions were not addressed in the recommendations.

Stakeholder comment: Make large meter testing mandatory.

- **Rational for not including in DWR's recommendations:** Based on discussions with industry experts and urban wholesale water suppliers, urban retailers can request an investigation into meter accuracy or pursue a change in their contract with a particular urban wholesale water supplier that allows for such testing. The intent of this requested testing is to have more accurate meter testing performed where known or suspected issues exist with wholesaler meters (e.g., retailer consumption meters are accounting for more water than the wholesaler system input volume). Methods to test meters in situ exist and are documented in AWWA technical peer-reviewed publications (e.g., AWWA Manuals of Water Supply Practice: *Manual M6 – Water Meters – Selection, Installation, Testing and Maintenance*, *Manual M36 – Water Audits and Loss Control Programs*; *Manual M33 – Flowmeters in Water Supply*; and [American Water Works Association 2012, 2016, 2018]). It is recognized that in some situations, e.g., the location of a particular meter, it is neither physically possible nor economically cost-effective to perform meter testing given infrastructure constraints. DWR is proposing to study this issue more thoroughly to develop further recommendations as necessary to address meter testing accuracy needs in support of SB 555 compliance.

Stakeholder comment: Require water-loss audits of non-potable water systems and recycled-water systems in addition to audits of potable water systems.

- **Rational for not including in DWR's recommendations:** DWR did not include this suggestion as a recommendation as it is outside the scope of the legislation which directs DWR to consider the requirements for urban wholesale water suppliers specific to potable pressurized systems. In addition, CWC Section 10608.12 (w) for urban wholesale water suppliers refers to providing water for potable municipal purposes, which excludes recycled water. Wastewater

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agencies would also need to be included because they produce and distribute the majority of the recycled water in California.

6.0 References

California Department of Water Resources. Revised 1992. *The Resources Agency and California – Nevada Section of the American Water Works Association, Water Audit and Leak Detection Guidebook*. Sacramento (CA). California Department of Water Resources. 164 pp. [Guidebook.]

American Water Works Association. 2012. *Manual of Water Supply Practice – M6, Water Meters – Selection, Installation, Testing, and Maintenance*. Denver (CO). American Water Works Association. 130 pp. [Manual.]

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Appendix A

Summary of Stakeholder Comments

The following is a summary of comments provided and issues raised by the urban wholesale water suppliers during stakeholder interviews and meetings conducted by DWR staff. These issues and comments are diverse and reflect the unique positions of suppliers with wholesaler system infrastructure and interested stakeholders.

- The severity of risk and tremendous liability of large infrastructure failure drives a very rigorousness level of system monitoring, inspection, maintenance, and repair of any real water losses.
- Reporting and costly meter testing is not necessary given the additional financial drivers to avoid water losses caused by lost revenue from retailers.
- Losses are often documented to be less than 1 percent of contracted water deliveries. It is best practice that the agreements with urban retailers, in the terms and conditions, cite the ability for the retailer to request meter inspections and testing by wholesale suppliers.
- Challenges exist with the water system audit reporting given the lack of applicability of the M36 manual reporting on wholesaler systems.
- Significant concerns exist regarding the necessity, feasibility, and cost of flow-meter testing beyond electronic calibration.
- Real time supervisory control and data acquisition (SCADA) system monitoring and regular visual inspections on order of daily, weekly, and certainly monthly on both raw- and treated-water delivery infrastructure is constantly occurring along with annual condition assessments of portions of canals and pipelines (i.e., often targeted at older higher-risk or higher-pressure sections).
- Aerial and satellite data also has been leveraged in visual assessments for leakage because it shows up as unintended green habitats developed from higher seepage areas, indicating a potential leak.
- Urban wholesale water suppliers perform regular analysis by operators, including pipeline hydrostatic tests. Multiple wholesalers commented that their systems are tight without real losses. Reported

anomalies reconciled by operators (most often attributable to an interest in financial recovery) that appear to be real losses are only apparent losses. This is because of the large scale of the meter size, constraints on testing meter accuracy, and the effects of piping configurations, rather than from real water losses.

- There is a need for improved water-loss knowledge sharing through education. It is recognized that DWR may be able to provide a positive role by seeking funding support to provide more peer-to-peer support. This support could include education and field training to enhance and accelerate the advancement of best management practices for addressing urban wholesaler real water-loss reductions. Part of this educational effort should include steps to improve the understanding of the current reporting process using the AWWA water-loss audit software (i.e., consistency across suppliers in reported data validation grades) (American Water Works Association 2014).
- There is also a potential for the development of a better tool to audit wholesale water systems, thus providing an enhanced reporting tool to benefit wholesaler and retailer water systems audits. The tool development would be designed directly by DWR or in conjunction with AWWA.