This presentation premiered at WaterSmart Innovations

watersmartinnovations.com
The Largest Water Loss Technical Assistance Program in the Nation

What’s Been Done, & What’s Next

*WaterSmart Innovations 2017*

Sue Mosburg
Program Manager - Sweetwater Authority

AWWA California-Nevada Section Water Loss Committee Chair
California Water Loss Control Collaborative Chair
AWWA Director
Main Points

- Program Drivers
  - Historical perspective and regulatory snapshot

- What’s Been Done
  - Program Development and the Water Loss TAP

- Next steps
  - Analysis, WAV, Target Setting and Beyond
Local Water Supply Projects 15%

State Water Project (Bay-Delta) 13%

Colorado River 72%

5 year average 2013-2017

Moving Water – From End to End
Past Conservation Actions – Statewide

- Statewide Water Delivery Systems
- California Urban Water Conservation Council
  - Voluntary
  - Best Management Practices
- Urban Water Management Plans
  - Supply and Demand Forecasts
  - Every 5 years
  - Supply Development Projects
  - Shortage Contingency Plans
State Focus on Water Efficiency

2009 (SB 7x7)
Mandatory 20% water use reduction by 2020; progress report in 2015

2014 (SB 1420)
Requires water audit, using M36 and AWWA software
Every 5 years, with Urban Water Management Plan (starting July 2016)

2015 (SB 555)
Audit required annually
Expert validation
Steps to increase validity
Performance standards (by 2020)
State Regulation – SB 555

- Rules & technical standards (January 1, 2017)
- State assistance to urban water providers
- Validated water loss audits (October 1 annually) accompanied steps taken to:
  - increase data validity
  - reduce loss volumes
- Audits to be posted to website
- Water loss performance standard by 2020
# The Water Balance

<table>
<thead>
<tr>
<th>SYSTEM INPUT VOLUME</th>
<th>AUTHORIZED CONSUMPTION</th>
<th>BILLED AUTHORIZED CONSUMPTION</th>
<th>BILLED METERED CONSUMPTION</th>
<th>REVENUE WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BILLED UNMETERED CONSUMPTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNBILLED AUTHORIZED CONSUMPTION</td>
<td>UNBILLED METERED CONSUMPTION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNBILLED UNMETERED CONSUMPTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER LOSSES</td>
<td></td>
<td>$$ $$ APPARENT LOSSES</td>
<td>CUSTOMER METER INACCURACIES</td>
<td>$$ $$ NONREVENUE WATER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$$ $$</td>
<td>UNAUTHORIZED CONSUMPTION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DATA HANDLING ERRORS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$$ $$ REAL LOSSES</td>
</tr>
</tbody>
</table>

$$ $$

\[ \sum \]
AWWA Free Water Audit Software

- **Industry Standard (M36)**
- **Free**
- **Defaults provided**
- ~20 potential inputs
- ~10 inputs for typical utility use

[Click to access definition]

AWWA Free Water Audit Software: Reporting Worksheet

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate the input data by grading each component (0-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to display the data grading. Enter grading in column E and F -

<table>
<thead>
<tr>
<th>WATER SUPPLIED</th>
<th>Volume from own sources: 5,000,000 MG/Yr</th>
<th>Water imported: 100,000 MG/Yr</th>
<th>Water exported: 1,000,000 MG/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER SUPPLIED:</td>
<td>825,000 MG/Yr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUTHORIZED CONSUMPTION</th>
<th>Billed metered: 700,000 MG/Yr</th>
<th>Billed unmetered: 50,000 MG/Yr</th>
<th>Unbilled metered: 10,313 MG/Yr</th>
<th>Unbilled unmetered: 10,313 MG/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTHORIZED CONSUMPTION:</td>
<td>760,313 MG/Yr</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WATER LOSSES (Water Supplied - Authorized Consumption)</th>
<th>64,688 MG/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent Losses</td>
<td>3,000 MG/Yr</td>
</tr>
<tr>
<td>Unauthorized consumption:</td>
<td>3,000 MG/Yr</td>
</tr>
<tr>
<td>Customer metering inaccuracies: 7,071 MG/Yr</td>
<td></td>
</tr>
<tr>
<td>Systematic data handling errors: 5,071 MG/Yr</td>
<td></td>
</tr>
<tr>
<td>Apparent Losses:</td>
<td>15,071 MG/Yr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Real Losses (Current Annual Real Losses or CARL)</th>
<th>49,617 MG/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Losses = Water Losses - Apparent Losses:</td>
<td>49,617 MG/Yr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WATER LOSSES</th>
<th>64,688 MG/Yr</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NON-REVENUE WATER</th>
<th>75,000 MG/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>= (Water Losses + Unbilled Metered + Unbilled Unmetered)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SYSTEM DATA</th>
<th>Length of mains: 100 miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of active AND inactive service connections: 1,000</td>
<td></td>
</tr>
<tr>
<td>Service connection density: 100 service/mile main</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Are customer meters typically located at the curbstop or property line?</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average length of customer service line: 50 ft</td>
<td></td>
</tr>
<tr>
<td>Average length of customer service line has been set to zero and a data grading score of 5 is applied but not displayed</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COST DATA</th>
<th>Total annual cost of operating water system: $1,000,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer retail unit cost (applied to Apparent Losses): $3.00</td>
<td></td>
</tr>
<tr>
<td>Variable production cost (applied to Real Losses): $3,000,000</td>
<td></td>
</tr>
</tbody>
</table>

awwa.org/waterlosscontrol
Which Value Goes Where?
WRF 4372 - 2010 Water Data Analysis and Validation:

- Simple steps of data validation were applied

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Percent of Full Data Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>California – CUWCC BMP1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Utilities Reporting Water Audit Result</td>
<td>125</td>
<td>100%</td>
</tr>
<tr>
<td>Number of Utilities Reporting Negative Water Losses</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>Number of Utilities Reporting ILI&lt;1</td>
<td>36</td>
<td>29%</td>
</tr>
<tr>
<td>Number of Utilities Reporting ILI&gt;20</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>Number of Utilities Reporting Erroneous Infrastructure Data</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Final Data Set After Removal of Erroneous Water Audit Reports</td>
<td>80</td>
<td>64%</td>
</tr>
</tbody>
</table>

- Results highlight the problems utilities are facing when completing an audit for the first time!

Source: Reinhard Sturm 2013
# 2016 UWMP Submitted Data - Unfiltered

<table>
<thead>
<tr>
<th>STATISTIC</th>
<th>2016 n = 292</th>
<th>2016 n = 292</th>
<th>2016 n = 292</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>median</td>
<td>max</td>
<td></td>
</tr>
<tr>
<td>Customer Retail Unit Cost</td>
<td>$0.00</td>
<td>$3.93</td>
<td>$180,097.61</td>
<td>$ / 1,000 gal</td>
</tr>
<tr>
<td>Variable Production Cost</td>
<td>$0.00</td>
<td>$1,315.45</td>
<td>$25,007,000.00</td>
<td>$ / million gal</td>
</tr>
<tr>
<td>NRW as % of Operating Cost</td>
<td>0.00%</td>
<td>3.54%</td>
<td>242305%</td>
<td>% of operating cost</td>
</tr>
<tr>
<td>Apparent Losses</td>
<td>-4.34</td>
<td>6.36</td>
<td>122.3</td>
<td>gal/ serv conn / day</td>
</tr>
<tr>
<td>Real Losses (serv conns)</td>
<td>-35</td>
<td>19.46</td>
<td>334.54</td>
<td>gal/ serv conn / day</td>
</tr>
<tr>
<td>Real Losses (pressure)</td>
<td>-0.66</td>
<td>0.371</td>
<td>5.31</td>
<td>gal/ serv conn / day / psi</td>
</tr>
<tr>
<td>ILI</td>
<td>-3.03</td>
<td>1.18</td>
<td>17.84</td>
<td>CARL / UARL</td>
</tr>
<tr>
<td>Data Validity Score</td>
<td>2.35</td>
<td>75.33</td>
<td>98.27</td>
<td>points out of 100</td>
</tr>
</tbody>
</table>
# Data Grading Matrix

When grading for each input, determine the highest grade where or exceeds all criteria for that grade and all grades below it.

## Master Meter Error Adjustments

<table>
<thead>
<tr>
<th>Water Supplied:</th>
<th>Pmt:</th>
<th>Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WATER SUPPLIED:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Billed metered:</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Billed unmetered:</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Unbilled metered:</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Unbilled unmetered:</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

### Percentage of 1.25% (of billed metered consumption)

---

<table>
<thead>
<tr>
<th>Billed Consumption</th>
<th>Pmt:</th>
<th>Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorized consumption:</td>
<td>+</td>
<td>0.000</td>
</tr>
</tbody>
</table>

---

### Dummy Matrix

1. Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.
2. 25% - 50% of treated water production sources are metered, other sources estimated. No regular meter accuracy testing or electronic calibration conducted.
3. Conditions between 2 and 4
4. 50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted.
5. Conditions between 4 and 6
6. At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.
7. Conditions between 6 and 8
8. 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy.
9. Conditions between 8 and 10
10. 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Statewide Water Loss Management Program

Phase 1
Establish Annual M36 Water Auditing
- Implement established requirement for annual M36 Water Audits
- Educate Regulatory Community on M36 Method and appropriate use of performance indicators
- Establish Statewide Water Loss Control Committee
- Develop State Manual and Training Framework
- Provide extended, progressive training to utilities

Phase 2
Achieve Minimum Standard of Audit Reliability
- Augment DWR Data Management & Review Process
- Establish posting system and communication protocols
- Establish minimum standards of validation for quality assurance
- Determine by Agency or 3rd Party
- Establish validation program until certification program is in place
- Design and implement a Water Audit Validator Certificate program for sustained quality control
- CA-NV Section Administers Water Auditor Validator Certification Program

Phase 3
Manage Water Loss Performance for Long-Term Reduction
- Suite of Performance and Process Measures
- System specific improvement over time in a cost-effective manner
- No universal targets
- Excessive thresholds established
- Annual audit submission threshold exceedances
- System specific progress review during Urban Water Management Plan submissions

Year 1
Year 2
Year 3
Year 4
Year 5
Year 6
Year 7
Phase One - Water Loss Technical Assistance Program

**Water Loss TAP**

**Goal is to provide:**

- Training on AWWA Water Audit Methodology
- Level 1 Validation of Water Audits
- 452 Urban Water Agencies

**Wave Timeline:**

- **Wave 1:** In-person work session
- **Wave 2:** Teleconference work session
- **Wave 3:** In-person work session
- **Wave 4:** Final validation Teleconference work session

**Submission of level 1 validated audits**
The Water Loss Technical Assistance Program (Water Loss TAP) aids urban water suppliers in complying with California Senate Bill 555, requiring utilities to submit a completed and Level 1 validated water loss audit annually to the California Department of Water Resources (DWR).

The Water Loss TAP is brought to you by the California-Nevada Section AWWA. This project has been funded by the Environmental Protection Agency and the State Water Resources Control Board. The contents of this website do not necessarily reflect the views and policies of the EPA or the SWRCB, nor does the EPA or the SWRCB endorse trade names or recommend the use of commercial products if mentioned in this website.

**Timeline**

- **July 2016**
  - In Person Work Session

- **October 2017**
  - Remote Work Session
  - In Person Work Session
  - Remote Validation Session
New Learner
(NL)

Water Auditing 101: designed to build a strong foundation for water auditing and data validation.

- Limited prior involvement with AWWA M36 Water Auditing.
- Results in Level 1 Validated Water Audit for October 2017 submittal to DWR.

Check your track here

Early Adopter
(EA)

Water Auditing 201: designed to focus on data validation and advanced water loss analysis.

- Previous engagement with AWWA M36 Water Auditing.
- Results in Level 1 Validated Water Audit for October 2017 submittal to DWR.

Update: Final Validation Documents for calls conducted on or before 9/15 are expected to be emailed to your utility by around 9/27. For calls after 9/15, documents will be emailed within 5-10 business days.

Instructions for DWR Upload

Final Upload to DWR (after validation)

News

North American Water Loss - Register now!
Summer 2017 Update
SWRCB Letter Urging Wave 4 Sign-up
Winter 2017 Update
Water Loss TAP Update-Oct/Nov16
Water Loss TAP Update-September16
Water Loss TAP Update-August16
DWR Letter

Water Loss TAP Progress

Sign Up for Your Wave 4 Call

Upload Wave 4 Supporting Documents

Registered Individuals: 1500
Registered Systems: 435
Wave 4 Signups: 400
Utilities not yet signed up for Wave 4: 35
Don't let that be you!
Wave 1 is a day-long in-person work session (classroom) that covers the basics of water auditing and introduces water audit data validation.

Objectives
- Introduce Water Loss TAP
- Begin technical assistance
- Create utility water audit teams

Technical Assistance Themes
New Learners: Water Audit Fundamentals
Early Adopters: Introducing Data Validity

Action Steps
- Register your utility and water audit team for the Water Loss TAP (Register here)
- RSVP to attend an in-person work session
  Not sure which track you are? Not sure if you've already RSVP'd? Check here
- Attend the work session (8AM - 3:30PM)

Materials to bring:
1. Laptop Computer with the AWWA Free Water Audit Software v5.0 (optional: your most recent Water Audit, as submitted with your Urban Water Management Plan completed using this software - we will not work with your audit's specific data during the Wave 1 session, but this can serve as a good reminder of your audit volumes and practices to date).
2. Work Session Slides (Downloadable here)
3. Lunch on your own (breakfast and snacks provided)
4. Questions on Water Audit Methodology and Validation

July 2016 - September 2016
WAVE 2

Wave 2 is a teleconference work session in which water auditing experts and each utility’s water audit team examine the utility’s FY14-15 or CY15 water audit in a two-hour interview.

Objectives
- Review the FY14-15 or CY15 water audit
- Discuss water audit data and data validity scores
- Amendments as needed

1 2 3 4

October 2016 - February 2017

Action Steps

Compile your FY14-15 or CY15 water audit and supporting documents

Schedule a teleconference session

Send your water audit and supporting documents to the Program Management Team (PMT) one month before your work session

Attend your work session

Implement any amendments or actions from your teleconference work session
Wave 3 is a day-long in-person work session (classroom) that reinforces the water audit methodology before more deeply exploring water audit data validation and the connection between water auditing and water loss control.

**Objectives**
- Continue technical assistance
- Connect water audits to water loss control
- Prepare for Wave 4

**Action Steps**
- **RSVP** to attend an in person work session. Not sure which track you are? [Check here](#)
- Attend the work session. (8AM - 3:30PM)

**Materials to bring:**
1. Your Wave 2 call follow-up document and Wave 2 reflections
2. Lunch on your own (breakfast and snacks provided)
3. A laptop per utility team is recommended.
4. Something to take notes on to prepare for Wave 4 validation.
Wave 4 is a teleconference session in which water auditing experts and each utility’s water audit team perform a Level 1 validation of the FY or CY water audit that will be submitted to DWR.

**NOTE:** The DWR rules for SB555 compliance are not yet final and may be subject to change. It is anticipated that the rules will be made final following the DWR public hearing on June 21st, 2017. As such, a final determination is pending on which FY period is acceptable.

Objectives
- Level 1 validate FY or CY water audit
- Prepare for submitting Level 1 validated water audits to DWR

**Action Steps**
- Compile your most recent water audit and supporting documents, informed by the Wave 2 work session
- **Schedule** a teleconference validation session
- **Send** your water audit and supporting documents to the PMT at least two weeks before your validation session
- Participate in your validation session
- Receive post-session document & audit from PMT
- **Submit** your Level 1 validated water audit package to DWR (when the State Portal is up)
Program Reach
Total of ~460 Water Audits

Water Loss TAP - Program Participation

- Registered to date: 435 (95%)
- WAVE 1: 341 (78%)
- WAVE 2: 356 (82%)
- WAVE 3: 335 (77%)
- WAVE 4: 400 (92%)

System Sign Ups vs. % of Target
Program Impact

1. How would you describe your experience participating in the TAP to date?

DAUNTING AT FIRST MUCH MORE COMFORTABLE NOW & CONFIDENT WE CAN PERFORM AN ACCURATE AUDIT

2. What improvements or suggestions do you have for the program?

The experience has been great. All of the technical assistance engagements have been worthwhile and truly valuable as water utilities embark on SB 555 Compliance.

participating in the TAP to date?

Awesome experience. I gained clarity as a member of The training was very helpful. I would encourage other members to attend.

1. How would you describe your experience participating in the TAP to date?

Excellent learning process, when I am learning to take a fresh look at our workflows.

After Wave 2, the confidence in our data was higher. Wave 2 experience exceeded our expectations. The only surprise was the amount of knowledge gained.

Did your Wave 2 experience meet your expectations? Any surprises?

Exceeded expectations - Drove home the importance of efforts & program

1. How would you describe your experience participating in the TAP to date?

It's been very insightful. It's like a complete shift in philosophy - retraining use on how to consider the audit process, what's important and a big wake up call on
Data Quality and Validation

• **Data quality** – the validity, or trustworthiness, of the data

• **Data validation** – a quality control process conducted to verify, and improve as needed, the data inputs and gradings of the water audits submitted by water utilities.

• **Water Loss Audit validation** – does not make data inputs or gradings “right” or “wrong”, but merely aligns them with the actual conditions that occurred in the operation of the utility for the audit year
  - Level 1 -- Top down Data Review
  - Level 2 -- Top down Data Mining Review
  - Level 3 -- Bottom up Field Investigation
What’s Next?

Water Audit Validator Program Development

WAV Certificate Program

- Committee formed & program development underway
- Informed by the Georgia QWLA certification program, customized to California
- Water Loss Auditing ≠ Water Audit Validation different training and demonstrated knowledge
- Development goal: Spring 2018
Water Conservation a California Way of Life

2016 (EO B-37-16)
State agencies directed to establish framework
13 required elements

2017 (Implementation Report)
4 inter-related objectives
Implementation actions

Use Water More Wisely
1. 2. 3.

Eliminate Water Waste
4. 5. 6.

Strengthen Local Drought Resilience
7. 8. 9.

Improve Agricultural WUE & Drought Planning
10. 11. 12. 13.

# EO item number
Water Balance
- AWWA Annual Water Audit
- Real Losses v. Apparent Losses
- 3Vs

Validate & Disaggregate
- Validation
  - Level 1
  - Level 2
  - Level 3
- Real Loss
  - Background
  - Reported
  - Hidden
- Apparent Loss
  - Theft
  - Meter Inaccuracy
  - Data Handling

Cost-Benefit & Targets
- Value Lost Water/Revenue
- Evaluate Cost of Intervention

Implement Interventions
- Real Losses:
  - Active Leak Detection
  - Pressure Optimization
  - Repair Time Reduction
- Apparent Losses:
  - Theft Reduction
  - Meter Replacement & Repair
  - Revenue Protection
Agency Actions

• Improved understanding of who owns what data
• Validating legacy software/calculations (assumptions, metering lag time adjustments, SCADA setpoints)
• Training staff in the Water Audit methodology
• Meter testing programs
• AMI/AMR projects
• Increased metering of own water uses
• Pressure management projects
• Leak detection technology pilot projects
Urban Retail Water System
Wholesale Systems
Small Systems
Recycled Water Systems
Source of Supply
Water Loss Control Collaboration

- Coordination between industry associations, regulators, utilities
- Water Loss TAP (Stakeholder/steering Committee)
- Water Audit (SB 555) Rulemaking Group (*New: Title 23, Division 2, Chapter 7, § 700.0*)
- Water Loss Control Committee CA-NV AWWA Section
- Water Auditor Certificate (WAV) development subcommittee
- Leak detection, pressure management, meter testing training
- Executive Order/ Urban Advisory Group (retail, wholesale and small system)
- California Energy Commission devices study
- Public Utilities Commission rate case inclusion
- WRF projects to further refine the process, real loss component analysis, data validity criteria, water loss control program design
SAVE THE DATE

December 3 - 5, 2017
Paradise Point Resort · San Diego, CA

Presented by: American Water Works Association
California-Nevada Section

In cooperation with the American Water Works Association, the Alliance for Water Efficiency and the NAWL 2017 Conference Planning Committee.

Sponsorships will be available.

www.northamericanwaterloss.org
CALIFORNIA WATER LOSS CONTROL COLLABORATIVE

Water Loss TAP
WAV Certificate Program

Sue Mosburg – Chair, California Water Loss Control Collaborative
Sweetwater Authority
smosburg@sweetwater.org