This presentation premiered at WaterSmart Innovations

watersmartinnovations.com
M-36 or Bust

A Story of Conducting Nearly 50 System Wide Water Audits on Small Water Providers

Presented by:
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Overview

- Regional Water Conservation Planning by Southeastern Colorado Water Conservancy District
  - Required as Part of Project Permitting
  - Funded By Reclamation and State of Colorado
  - Project ParticipantsRequested Efficiency Support with Infrastructure and Water Rates (versus Customer Demand Management)
WELL, THERE'S YOUR PROBLEM
Audits

- AWWA M-36 Used As Framework/Guide
  “It’s a Process”
- No Mandate – This is Not Georgia
- https://www.secwcd.org/BMPToolbox
Audits

- Not Intended to Create Report Card on Water Loss
- Data Collection and Assessment
  - Collective Snapshot of “Conditions”
    - What Kinds of Data and How Managed
  - Educational
  - Policy Support
    - Regional Reporting Related to Project
    - Informing Regional and Statewide Planning
AWWA M-36 Water Accounts

Water Produced

Water Sold
AWWA M-36 Water Accounts

Non-Revenue Water – Water that has a cost to produce (e.g., energy, treatment, distribution) which does not generate revenue.
AWWA M-36 Water Accounts

- Water Produced
- Water Sold

Non-Revenue

- Unmetered/Unbilled
- Metered/Unbilled
- Apparent Losses
- Real Losses
AWWA M-36 Water Accounts

Water Produced

Water Sold

Non-Revenue

Unmetered/Unbilled

Metered/Unbilled

Apparent Losses

Real Losses

- Churches?
- Cemetery?
- Town Shop?
- System Flushing?
- Hydrant Exercising?
- Street Cleaning?
- Construction?

- Theft?
- Meter Inaccuracies?
- Systematic Data handling Errors?

- Unreported Leakage?
- Reported Leakage?
- Background Leakage?
Collect Distribution System Description

Measure Water Supplied to the Distribution System

Quantify Billed Authorized Consumption

Calculate Non-Revenue Water

Quantify Unbilled Authorized Consumption

Quantify Water Losses

Quantify Apparent Losses

Quantify Real Losses

Assign Costs of Apparent and Real Losses

Calculate Performance Indicators

Compile the Water Balance
map shamelessly borrowed from http://www.washingtonstatesearch.com/United_States_maps/Colorado/maps/Colorado_State_map.jpg
Water Provider Characteristics

- 47 Audits Performed (2 phases of audits)
- Private and Public Organizations
- Number of Connections
  - 24 to 10,000 plus (median~250) (13 >1,000)
- Rural to Suburban
  - Including Small Towns and Cities
Water Provider Characteristics

- 47 Audits Performed (2 phases of audits)
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- ~1 Billion Gallons Per Month (collectively)
  - 36,400 AF annually
  - From 7,000 to 4,500,000 gallons per day
“Data! Data! Data! I cannot make bricks without clay.” — Sherlock Holmes
Stories about material failures
Stories about replacing the old with the new
Stories about superb accuracy in measurements
Data Requested

- Produced Water (or Water Treatment Plant (WTP) Influent)
- Water into Distribution (WTP Effluent)
- Master Metering (where, calibration history, etc.)
- Water Sold (bonus if by customer type)
- Listing of Unbilled Uses
- Estimates of Unbilled Uses
- Meter Types, Numbers, Sizes, Ages
- Billing and Meter Reading Schedules
- Meter Testing and Replacement Practices
- Distribution Piping Diameters, Materials, Lengths
- Distribution Line Leak Detection and Repair Practices
- Recent History of Leaks
- CIP Budgets and Past Operating Budgets
- Stories of Best Management Practices/Lessons Learned
Initial Findings

- Nearly All Organizations Maintain Much of These Data in Accessible Formats;
  - or they found benefit in gathering it
- Just Organizing the Data Helps Find Gaps
  - Lack of meters/meter testing
  - Inconsistency in data collection
  - Need for improved record keeping
  - Differentiates “estimates” from “measurements”
  - Better understanding of data use in water loss management
  - Breaking silos (Cross-organization communications)
- Embarrassment Factor
Initial Findings

- None of the Audited Organizations:
  - Has All the Data Needed to Perform the Audit Completely (as prescribed in M-36)
    - Documented “estimation techniques” for Authorized Unbilled Consumption
    - Documented meter accuracy data (for either master meters or customer meters)
    - Formal water loss management programs
- Few had:
  - Documented water loss reporting
- All had annual budgets for:
  - Leak and distribution line repair
  - Meter replacement (not all had meter testing)
  - CIP for water line replacement
Collect Distribution System Description

Measure Water Supplied to the Distribution System

Quantify Billed Authorized Consumption

Calculate Non-Revenue Water

Quantify Unbilled Authorized Consumption

Quantify Water Losses

Quantify Apparent Losses

Quantify Real Losses

Assign Costs of Apparent and Real Losses

Calculate Performance Indicators

Compile the Water Balance
Calculations

- Non-Revenue Water
- Estimated Authorized Unbilled Consumption
- Estimated Apparent Losses (as % of Sold)
  - Meter Inaccuracy
  - Unauthorized Use
  - Systematic Errors
- Estimated Real Losses
  - CARL
- Developed Performance Indicators
Calculations

0.99 Billion Gal
Month

0.16 Billion Gal
Month

0.83 Billion Gal
Month

Non-Revenue

Average Non-Revenue Water – 16.7%
Value of Non-Revenue Water - $ 500K/month
Estimated Non-Revenue Water (as % of Water Produced)\textsuperscript{a}

\textsuperscript{a} does not include RO reject, but does include small system filter backwash
Non-Revenue Water can vary from positive to negative variations come from changing periods of data collection, changing system conditions.
Three Case Studies Comparing Water Sold to Non-Revenue Water
Calculations

0.16 Billion Gal
Month

Water Produced

Non-Revenue

Water Sold

Unmetered/Unbilled

Metered/Unbilled

Apparent Losses

Real Losses
### Calculations

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Produced</td>
<td>0.16 Billion Gal Month</td>
</tr>
<tr>
<td>Water Sold</td>
<td>0.014 Billion Gal Month</td>
</tr>
<tr>
<td>Unmetered/Unbilled</td>
<td>0.034 Billion Gal Month</td>
</tr>
<tr>
<td>Authorized Unbilled</td>
<td>0.113 Billion Gal Month</td>
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</table>

- **Non-Revenue**

- **Unmetered/Unbilled**
  - Authorized Unbilled Consumption - $44K/Month*

- **Apparent Losses**
  - Apparent Losses - $106K/month

- **Real Losses**
  - Real Losses - $350K/month

- 7 entities with Authorized Unbilled Consumption greater than 25% of Non-Revenue Water
- 6 entities claim zero Authorized Unbilled Consumption
A Word About Performance Indicators

“All Models are Wrong, Some Models are Useful”

George E.P. Box Science and Statistics
A Word About Performance Indicators

- Real Losses
  - All other uncertainties impact accuracy of this calculation
  - M-36 Characteristic Parameters Valuable but,…
    - CARL – Current Annual Real Losses
    - UARL – Unavoidable Annual Real Losses (includes Reported and Unreported Leakage plus UBL) (may not be applicable to entities with < 3,000 connections)
      - About ½ of Audited Entities Have CARL< estimated UARL
    - UBL – Unavoidable Background Leakage
    - ILI – Infrastructure Leakage Index
Major Recommendations

- Move Toward Consistent Temporal Data Collection
- Conduct Meter Inspections/Testing
  - Production Meters
  - Prioritized Customer Meters (size, age, etc.)
- Meter Unmetered, Unbilled Uses (for those with these ~25% of audited entities)
  - City Parks
  - Cemeteries
- Implement BMPs
Recommended BMPs

- Maintain Leak Repair Records
- Tracking of Authorized Unmetered Uses
  - What are they?
  - How quantified?
- Coordinate Data Management with Engineering with Finance
  - Monthly Tracking of Non-Revenue Water, etc.
- Develop Storage Tank Level Monitoring Program
- District Metered Areas (DMAs)
- Conduct Regular Third Party System Wide Audits
Thank You

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