This presentation premiered at WaterSmart Innovations

watersmartinnovations.com
Beyond Water Audits into Asset Management –
The Process of Non-Revenue Water Reduction
and Revenue Enhancement Activities

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Presentation Overview:

• What does water loss mean
• Understanding your current level of losses
• Water loss economics
• Implementing a water loss reduction program that integrates into Asset Management
What does Water Loss Mean
Non-Revenue Water (NRW)

• Is the difference between the volume of water supplied and the volume of water billed to customers

• It consists of three elements with different values in $/gallon:
  – Real Losses
  – Apparent Losses
  – Unbilled Authorized Consumption

• Use this term instead of “unaccounted-for-water”
Industry Best Practice: IWA/AWWA Water Audit Methodology and Terminology
Real Losses

• Also called *Physical* Losses – water that enters the distribution system, but never reaches a user

• Includes:
  – Leakage on transmission and distribution mains
  – Storage tank overflows
  – Service Line leakage up to customer meter

• Reducing real losses creates an additional resource which reduces operating costs and can be used to defer capital expenditure
Apparent Losses

• Also called *Paper* or *Economic* Losses – water that reaches a user, but is not properly measured or paid for

• Includes:
  – Theft
  – Customer metering inaccuracies
  – Data handling errors

• Reducing Apparent losses increases revenue but creates no *new* water
Unbilled Authorized Consumption

• Could be metered or unmetered

• Does **NOT** include leaks and breaks

• **System operations and maintenance (unbilled unmetered)**
  - Fire fighting, pressure/flow testing, water quality or complaint flushing, sewer jet trucks, street sweeper trucks, line flushing after repair, tank draining for maintenance, etc.

• **City/County use (unbilled metered)**
  - Water plant, wastewater plant, city hall, fire station, police station, etc.
% Water Loss

• Volume of Real and Apparent Water Loss divided by your Water Supplied

• Percentages can vary widely from year-to-year as production and consumption vary
Water Loss Metrics

• Consider the volume of Real and Apparent Losses

• Metrics to consider for goal setting:
  – Real Loss volume per connection (or mile of main)
  – Apparent Losses per connection
  – Infrastructure Leakage Index (ILI)
Understanding current level of losses
AWWA Resources for Water Auditing

- AWWA Free Water Audit Software, v5.0
Assessing Current Level of Losses

AWWA Free Water Audit Software
awwa.org/waterlosscontrol
Now can I set targets?

- Not without good data
- Improving data scores on inputs
- Confidence in the results of the audit
- Low confidence in water audit can result in bad financial decisions
Bottom-up Data Validation

• Improve the data going into the audit
  – Production meter testing
  – Customer meter testing
  – Meter reading system evaluation
  – Billing system evaluation
  – Business process evaluation
Production Meter Testing

- Not just electronic calibration, verification of primary device accuracy
- Temporary metering device to compare measurement accuracy
Customer Meter Testing

• Test a random sample of customer meters for accuracy
• Plot results to develop meter accuracy curves and design meter replacement interval
Meter Reading and Billing System

• Errors in customer records
• Errors in billing system calculations
• Methods for adjustments
Water Loss Economics
$ Value of Non-Revenue Water

- **Real Loss**
  - valued at wholesale rate or variable production cost (usually)
  - Typically $0.14 - $1.50 per 1,000 gallons
  - Could use retail rate in water shortage conditions

- **Apparent Loss**
  - valued at retail rate or customer retail unit cost
  - Typically $2.00 - $5.00 per 1,000 gallons

- **Volume of Real Losses is typically higher**
- **$ Value of Apparent Losses is typically higher**

- **Unbilled Authorized is based on the type of use**
  - Valued at variable production cost (in water audit software)
  - May be political reasons that prevent recovery of some unbilled authorized
Simple Method per Activity

• Identify activities to reduce water losses
• For each activity:
  – $ per gallon saved (cost-effectiveness)
    - $\frac{\text{Implementation Cost (\$)}}{\text{Volume of Water Saved (gallons)}}$
  – Cost to implement
  – Volume of NRW reduced
  – Compare to other water sources
  – $ value of NRW reduced (based on type)
    - $\frac{\text{Value of Water Saved (\$)}}{\text{Implementation Cost (\$)}}$
  – Calculate benefit/cost ratio (>1 desired)
Set Economic Goals

- Low level of losses that is economically feasible to seek (system specific)
  - ELAL – Economic Level of Apparent Losses
  - ELL – Economic Level of Leakage
Example Application

• Economic Intervention Frequency of Active Leakage Control
• CI = Cost of complete system leak survey
• CV = Variable Production Cost
• RR = rate of rise of leakage (use two years of water audits)
• CI = $250/mile (rule of thumb or calculation of actual)
• CV = $0.45/kgal (VPC from water audit)
• RR = 0.27 kgal/mile/day
• EIF = 40 months
• EP% = 30% (Economic Percentage of the system)
• Annual Budget = $300,000

\[ EIF = \sqrt{0.789 \times \frac{CI}{CV} \times \frac{1}{RR}} \]
Water Research Foundation Model: Project #4372a

- Extension of AWWA Water Audit Software
- Importance of Data Validation
- Contextualized Performance Indicators
- Break Frequency Research
- Tools for developing water loss control strategies
  - Location & Response Time Improvement
  - Pressure Management
  - Proactive Leak Detection

Real Loss Component Analysis: A Tool for Economic Water Loss Control
Funded by WaterRF and EPA
Research Report Publication and Model Release in May/June 2014
Implementing a water loss reduction program that integrates into Asset Management
NRW Process

Initial Assessment
(top-down audit)

Implementation of Intervention Activities

Economic and Business Case Evaluation of Water Loss Reduction and Revenue Recovery Interventions
- meter replacement/repair, leak detection, pipe condition assessment and repair/replace, operations optimization (pressure management), etc

Detailed Assessment (bottom-up activities)
- meter accuracy testing, component analysis, meter reading and billing system audit, business process evaluation, etc
Real Loss Reduction

- Activities to reduce Real Losses

- Affected by your Infrastructure Conditions

- Influenced by your Variable Production Cost

- Frequency and technique of Active Leakage Control program

- Average system pressure
Apparent Losses Reduction

• Activities to reduce Apparent Losses
  - Replace inaccurate meters
  - Reduce/eliminate theft and illegal consumption
  - Ensure accuracy of analysis from archived data and data used for billing/water balance
  - Up-to-date accounting of customers and water use. No data transfer errors.

• Affected by your meter reading and billing system practices
• Influenced by your Customer Retail Unit Cost
• Frequency and technique of customer meter testing program
Identify areas of system with highest losses

- Subdivide system and perform sub-audits to compare and prioritize activities (District Metered Areas)
Use asset information to direct activities

### TABLE 3

**Breaks and Leaks by Pipe Material**

*Summary of breaks and leaks between 1993 through 2013 from AIMS database*

<table>
<thead>
<tr>
<th>Material</th>
<th>Breaks</th>
<th>Leaks</th>
<th>Total Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Iron</td>
<td>10,279</td>
<td>3,428</td>
<td>13,707</td>
</tr>
<tr>
<td>Ductile Iron</td>
<td>146</td>
<td>1,051</td>
<td>1,197</td>
</tr>
<tr>
<td>Asbestos Cement</td>
<td>820</td>
<td>718</td>
<td>1,538</td>
</tr>
<tr>
<td>Cement Stovepipe</td>
<td>3,396</td>
<td>1,166</td>
<td>4,562</td>
</tr>
<tr>
<td>Other/Unknown</td>
<td>608</td>
<td>319</td>
<td>927</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>15,249</strong></td>
<td><strong>6,682</strong></td>
<td><strong>21,931</strong></td>
</tr>
</tbody>
</table>
Connections to Asset Management

• Likelihood of Failure/break history/rehab schedule
• Targeting leak detection
• Before/after monitoring of pressure and leakage
• DMA/subzone monitoring and audits
Conclusions

- Improve data first, then evaluate methods to reduce losses
- Understand the financial impact of the components of water losses
- Non-revenue water reduction activities affect and are related to asset management
- Non-revenue water programming should be ongoing
Dec 8-9, 2015
Conference & Exposition
www.gawp.org

- Over 60 speakers from the United States and around the world
- Technical sessions on water auditing, loss control program implementation, addressing Non-Revenue Water through billing, theft, metering, leakage, pressure, energy and asset management, and regulatory policy development across North America
- Case studies for growing implementation of established IWA/AWWA best practices and innovations for Water Loss Management
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