Colorado Water Loss Initiative
Stage 1

Background

- 2010: HB10-1051 passed
  - Covered entities selling >2,000 Acre Feet per year
  - Requirement for water use and conservation reporting
  - Includes reporting on water loss
- February 1, 2012: CWCB adopts Guidelines and reports to legislature regarding the Guidelines.
- June 30, 2014: Annual covered entity reporting for the previous calendar year began.
- 2015: Colorado Water Loss Pilot Program

Why the CWLI?

By participating in the CWLI, you will demonstrate that your utility has employed the M36 methodology in your annual reporting.

You will also learn more about your utility’s water distribution efficiency and data systems!

You will be able to start water loss control planning.
Colorado Water Loss Initiative
Stage 1

Water Loss Program Benefits

- Training and assistance to implement the AWWA M36 Methodology
- Contribute to broader conservation efforts
- Provide insight for utility operation & revenue improvement

Water Loss Program

Goals:

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

Timeline

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
<tbody>
<tr>
<td>Year</td>
<td>2019</td>
<td>2020</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Your Water Loss Team

Who should participate from your utility?

- Supply & Operations
- Customer Metering
- Billing & Finance
- Management

Who is responsible for

- supplying audit data?
- submitting the audit?
- coordinating schedules?
Colorado Water Loss Initiative
Stage 1

Who should be a part of my Water Loss Control team?
- Finance
- Assistant General Manager/COO
- Customer Metering
- Communications Director/PIO
- Operations Supervisor
- Public Works Director
- Witness Protection Program

Your Water Loss Team
What work can your Team expect?

<table>
<thead>
<tr>
<th>Stage</th>
<th>Work Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>In-person work session</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Teleconference work session</td>
</tr>
<tr>
<td>Stage 3</td>
<td>In-person work session</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Teleconference validation session</td>
</tr>
</tbody>
</table>

compilation of CY18 water audit and supporting docs
compilation of CY19 water audit and supporting docs

AWWA M36
Foundations, Data Sources & Developing the Inputs

AWWA Water Audit:
- What is a water audit?
- What are water audit volumes?

Water Audit
1. Systematically account for known water volumes to estimate volumes of Water Loss.
2. Evaluate data source reliability.
3. Communicate water distribution efficiency.

The Water Balance
1. Account for volumes...

- Mass balance – process of elimination
- Account for all water
- Accuracy matters!
Colorado Water Loss Initiative
Stage 1

Water Losses
1. ...Estimate volumes of Water Loss!

Apparent Losses  Real Losses

Water Audit
2. Evaluate data reliability

Complete? Consistent? Accurate?

MONTHLY TOTAL PRODUCTION

Does the data story make sense?

Water Audit
3. Communicate water distribution efficiency

customized performance indicators

financial value of Water Losses

$ $ $ 

Water Audit Volumes
The big volumes...

Water Supplied
Authorized Consumption
Water Losses

each volume is composed of sub-volumes

Water Supplied

WATER SUPPLIED

BILLED AUTHORIZED CONSUMPTION
BILLED UNMETERED CONSUMPTION
BILLED UNAUTHORIZED CONSUMPTION

WATER LOSSES

APPARENT LOSSES
REAL LOSSES
CUSTOMER METER INACCURACIES
UNAUTHORIZED CONSUMPTION
DATA HANDLING ERRORS
NONREVENUE WATER
AUTHOR. METERED CONSUMPTION
AUTHOR. UNMETERED CONSUMPTION
UNBILLED METERED CONSUMPTION
UNBILLED UNMETERED CONSUMPTION
NONREVENUE WATER

WATER AUDIT VOLUMES

VOLUMES
VALUES
VALIDITY
Colorado Water Loss Initiative
Stage 1

**Water Supplied**

- [inputs] — [exports]
  - Volume from Own Sources
  - Water Exported
  - Water Imported
  - captures all the potable water input to the distribution system to serve your customers

**Water Supplied**

*Volume from Own Sources*

- groundwater
- surface water

Which meters?

Where are the meters?

**Water Supplied**

*Water Exported*

- bulk water sales
- supplements to raw/reclaimed systems

Which meters?

How is Water Exported tracked?

**Water Supplied**

*Master Meter Error Adjustment*

How accurate are Water Supplied meters?

electronic calibration
volumetric accuracy testing
Source Meter Testing

Impact of System Input Meter Error

100% increase in loss assessment

Base Case vs Production Meters

Authorized Consumption

Billed Metered
Consumption

Billed Unmetered
Consumption

Unbilled Metered
Consumption

Unbilled Unmetered
Consumption

Authorized Consumption

Billed Metered
Consumption

Billed Unmetered
Consumption

Unbilled Metered
Consumption

Unbilled Unmetered
Consumption

Other Authorized Consumption

System Input Volume

Authorized Consumption

Billed Authorized Consumption

Billed Unauthorized Consumption

Unbilled Authorized Consumption

Unbilled Unauthorized Consumption

WATER LOSSES

APARENT LOSSES

UNBILLED METERED CONSUMPTION

UNBILLED UNMETERED CONSUMPTION

REAL LOSSES

A lot of data

Duplicates

Missing Data

Zero Reads

Outliers

One summary number

How much water is used for all intended purposes?

How accurate are tracking mechanisms?

A Colorado Water Loss Initiative
Stage 1
Colorado Water Loss Initiative
Stage 1

Other Authorized Consumption

<table>
<thead>
<tr>
<th>Billed Unmetered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unbilled Metered</td>
</tr>
<tr>
<td>Unbilled Unmetered</td>
</tr>
</tbody>
</table>

- District use?
- City use?
- Special customers?
- Exemptions?

Now we know Water Losses!

<table>
<thead>
<tr>
<th>WATER SUPPLIED</th>
<th>AUTHORIZED CONSUMPTION</th>
<th>UNBILLED AUTHORIZED CONSUMPTION</th>
<th>REVENUE WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>REAL LOSSES</td>
<td>APPARENT LOSSES</td>
<td>CUSTOMER METER INACCURACIES</td>
<td>NONREVENUE</td>
</tr>
<tr>
<td>WATER LOSS</td>
<td></td>
<td>REAL LOSSES</td>
<td>WATER LOSSES</td>
</tr>
</tbody>
</table>

Water Losses

\[ \text{Water Supply} - \text{Authorized Consumption} = \text{Water Losses} \]

$ \$ \$

Real Losses  Apparent Losses

Apparent Losses

- water volume that reaches an end user
  - but is not registered or properly tracked
  - (and so you’re not paid)

often referred to as “paper losses”

reducing Apparent Losses increases revenue

but creates no new water

$ $$$
Colorado Water Loss Initiative
Stage 1

Apparent Loss – Categories
How much water is delivered but not registered (or paid for)?

- Unauthorized Consumption
- Metering Inaccuracy
- Data Handling Errors

Apparent Loss – Value

<table>
<thead>
<tr>
<th>Customer Meter Accuracy</th>
<th>Value of Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>$20 Service Charge + $30 Variable Charge = $50</td>
</tr>
<tr>
<td>100%</td>
<td>$20 Service Charge + $30 Variable Charge = $50</td>
</tr>
</tbody>
</table>

Real Losses
often referred to as “physical losses”

- leaks
- seeps
- breaks

Real Losses

~~~

reducing Real Losses creates an additional resource

- can reduce operating costs
- can defer capital expenditure

Let’s walk through it again...

System Input

- Authorised Consumption
- Unauthorised Consumption
- Real Losses
- Non-Revenue Water

Water Losses

- Billed Authorised Consumption
- Unbilled Authorised Consumption
- Apparent Losses
- Real Losses

Revenue Water

- Billed Water Exported
- Billed Unauthorised Consumption
- Unbilled Authorised Consumption
- Unauthorised Consumption
- Customer Metering Inaccuracies
- Systematic Data Handling Errors
- Reported Leaks
- Unexpected Leaks
- Background Leakage
Colorado Water Loss Initiative
Stage 1

QUIZ!

District facility use
Tank overflow
AMR Device transmission failure
Well water lubrication
Firefighting
Main breaks
Flat-rate condominiums
Parks department irrigation
Single-family indoor use
Under-registered customer meters

AWWA Free Water Audit Software

Functions of the AWWA Software:
- Complete a water balance
- Document data validity grades
- Calculate performance indicators
- Identify areas for improvement

Sheets that require data entry:
- Instructions
- Reporting Worksheet
- Performance Indicators
- Comments
- Water Balance
- Dashboard
- Grading Matrix
- Service Connection Diagram
- Definitions
- Loss Control Planning
- Example Audits
- Acknowledgements

the rest are references, results, and diagrams
Colorado Water Loss Initiative
Stage 1

AWWA Free Water Audit Software
for each input into the audit software...

Data Validity Grades
- qualitative but specific
- 1 through 10
- capture utility practices

Data Gathering
For each input into the audit software...

VOLUMES
DATA
VALIDITY
GRADES

Filling out the Software
1. Gather data and supporting documents
2. Review data for each input:
   complete? consistent? accurate?
3. Enter the input.
4. Comment on source of data, quality of data, etc.
5. Select a data validity grade for each input

Volumetric Inputs ➔ Water Balance

System Data
Infrastructure information
- Length of Mains (includes hydrants laterals)
- Count of service connections (active and inactive)

Operating Pressure
used to calculate a technical minimum volume of leakage

Cost Data
Total Annual Operating Cost
How much are Apparent Losses worth?
Customer Retail Unit Cost
How much are Real Losses worth?
Variable Production Cost
Colorado Water Loss Initiative
Stage 1

Performance Indicators

Results Dashboard

Common Exercise:
Developing the Inputs

Data Validity Grading

WRF #4372B:
WATER AUDITS IN THE UNITED STATES: A REVIEW OF DATA VALIDITY AND RESULTS

WRF #4639:
ESTABLISHING WATER UTILITY GUIDANCE AND METHODOLOGY FOR WATER AUDIT VALIDATION

If a Water Audit is self-reported in the forest, is it valid?
Purpose of Level 1 Validation

1) review of audit methodology and volume determination
2) review of Data Validity Grade selection

goods: quality and consistency

Data quality matters!

inaccuracy & uncertainty in inputs → inaccuracy & uncertainty in results

- Instruments
- Databases
- People
- Missing information

Sources of error:

Data Validity Grades

- qualitative but specific
- assess best practice implementation
- 1 through 10

Data Quality Grades must meet all criteria (and all criteria for lower scores) to select a given score

How do I find the grading criteria?

1) hover over data validity score box to reveal comment box
2) select “Grading Matrix Tab”

The BEST(?) Number

100
Colorado Water Loss Initiative
Stage 1

The BEST(?) Number

Report Card

A
B
C
D
F

DVS=62?!

Common Exercise:
Data Validity Grades

Preparation for
Stage 2 Work Session

Stage 2 Prep

STAGE 1

STAGE 2

STAGE 3

STAGE 4

in-person work session

teleconference work session

in-person work session

validation session

What to Prepare

1. Water Audit (AWWA Water Audit Software v5.0)
2. Supporting Documentation
3. Questions on Methodology, Inputs, Results

Supporting Documentation

Required
- Completed AWWA Free Water Audit Software (Excel Spreadsheet)
- Volume from Own Sources broken down by month and finished water supply meter
- Water Imported broken down by month by meter
- Water Exported broken down by month by meter
- Supply meter testing and/or calibration documentation
- Authorized Consumption broken down by month and use type (e.g., charge status, water type, customer class)

Supporting Documentation

Supplemental
- System schematic showing at least locations of Own Source, Import, and Export meters
- Customer Meter Inaccuracy derivation
- Average Operating Pressure derivation
- Customer Retail Unit Cost derivation
- Variable Production Cost derivation
Colorado Water Loss Initiative
Stage 1

Scheduling Your Session

• Teleconference will be scheduled between May and July
• Primary contact will need to coordinate the time that works for your team members

Scheduling Your Session

Stage 2 Scheduling is now open....GO!

Some light reading...

AWWA M36 Water Research Foundation Reports
2811: Evaluating Water Loss and Planning Loss Reduction Strategies
2928: Leakage Management Technologies
4372: Water Audits and Real Loss Component Analysis

Textbooks AWWA WLCC Free Water Audit Software ©
current version 5.0

www.coloradowaterloss.org

Thank You!

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