Addressing Non-Revenue Water

Jeff Cunningham Sr. Sales Manager

CORE & MAIN

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Outline

- Understanding the terminology
- Utilizing the data you have
- What other tools are available

Gallons of water being pumped into the distribution system each billing period exceeds the gallons being sold.

Water Sold

Water Pumped

Result: Loss of Revenue for the Utility

Resources

- AWWA M36 Manual
- AWWA Free Water Audit Software





What exactly is Non Revenue Water?

Apparent Losses

Real Losses

Unbilled Metered Consumption

Unbilled Unmetered Consumption.

**This is water which does not provide *revenue potential* to the utility.

Term definitions created by the IWA/AWWA

Why is Non Revenue Water a better term to use than "Unaccounted for Water" ?

Apparent Losses

Real Losses

Unbilled Metered Consumption

Unbilled Unmetered Consumption.

(**This is water which does not provide revenue potential to the utility.)

"Unaccounted for Water" (usually expressed as a % of total water produced as "lost water") is a term that is confusing.

- Does not give a clear understanding of
- What the losses are
- Where the losses are occurring

Standard Water Balance Format

Start here

Move this direction



Categories of Authorized Consumption

Billed Metered – (Water metered, water billed). Commercial/industrial, Residential consumption taken from Billing records. Account for "lag time"

Billed Unmetered – (Water billed, <u>not</u> metered) Calculated/estimated uses based on Utility policy that defines unmetered uses. (some fire suppression connections, bulk sales (tanker truck loads), etc.

Unbilled Metered – metered use not billed) such as municipal uses. Ex. Schools, municipal uses (parks, pools, etc.)

Unbilled Unmetered – hydrant flushing, fire prevention, street cleaning, sewer flushing. Records kept but are usually estimates.

Unbilled Authorized Consumption

Unbilled Metered Consumption

Metered consumption authorized by the water utility, but, for any reason, is <u>deemed by utility policy</u> to be <u>unbilled</u>. This includes metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. It does <u>not</u> include water supplied to neighboring utilities (water exported) which may be metered but not billed.

Unbilled Unmetered Consumption.

Unbilled Authorized Consumption

- Unbilled Metered Consumption
 - Unbilled Unmetered Consumption.

Authorized Consumption not billed or metered. Includes water for fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests, etc. In most water utilities it is a small component which is very often substantially overestimated. This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended to apply the default value, which is 1.25% of the Water Supplied volume.

If the water utility <u>has</u> carefully audited the unbilled, unmetered activities occurring in the system, and has well validated data that gives a value substantially higher or lower than the default volume, then enter that own volume. The default approach is recommended for most water utilities.

Apparent Losses - unauthorized consumption + customer metering inaccuracies + systematic data handling errors

Apparent Losses are all types of inaccuracies associated with customer metering (worn meters, improperly sized meters, wrong type of meter for the water usage profile), systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).

Real Losses

Physical water losses from water system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows.

Developing Water Loss Mitigation Plans

What do we tackle first?

Look at NRW for what can be recovered



What **\$\$'s** are recoverable?

142.1

2,108.1

\$702,205

\$636,122

Apparent Losses

Real Losses

Controlling Apparent Losses

- Usually, the easiest to identify
- Many issues are located in the data
- This is our "low hanging fruit"

"4 Pillars" of Apparent Loss Management



NRW Management Team:

- ✓ Billing
- ✓ Meter Reading
- ✓ Customer Services
- ✓ Revenue Water
- ✓ Field Services
- ✓ System Development
- ✓ IT

Water Loss Control / Revenue Enhancement

A key component of reducing apparent losses is the meter.
 Is it correct? Is the data correct?



Meter = Cash register



AWWA Policy Statement (M-36) Metering

- Meter all water introduced into distribution system
- Meter all water distributed to users
- ** Metering provides basis of assessing users equitably, encourages responsible and efficient use of a precious resource

Commercial and Industrial Meters High Revenue Meters

Usually 10%-12% of the customers use 50% - 60% of the water.

 Test and repair industrial and commercial meters

• Replace obsolete meters





Billed Meters: 13,475 total



Billing Data Sample

10% statistically Significant Random Sample 95% confidence level

<u>Size</u> **Number** % of sample 0.625 1227 89.23% 0.75 43 3.12% 32 2.32% 1.25 0 1.5 18 1.31% 1.81% 25 2 3 0.43% 6 4 5 0.36% 6 0.29% 4 8 0.29% 4 0.07% 12

0

Average annual revenue per sampled meter record

Cu. Ft. **Meter Size** Revenue \$211.17 0.625 6,737 0.75 11,946 \$311.29 20,718 \$490.64 1.25 no data no data \$3,770.29 1.5 76,194 \$1,878.73 2 97,335 \$7,991.87 505,217 3 \$7,923.42 470,220 4 6 2,336,430 \$42,795.00 9,496,130 \$127,088.00 8 12 13,382,700 \$179,486.00

Controlling Meter Inaccuracies

Meter Right Sizing

Meter Testing

Meter Change-outs

Sizing of Water Meters

Meter standards were set by AWWA early 1900's

- C 700 standards (701-718)
- M6 manual on selection, installation, and testing
- M33 manual on flow meters
- M22 manual on service line sizing and meter sizing

Meters should be selected based on the following parameters

- Quality and Performance
- Lifecycle and maintenance
- Cost and warranty
- Manufacturer support
 - Track record and historical performance

Sizing of Water Meters

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User Needs

Fixture Evaluation

• AWWA manual – M22

Proper Meter Installation

**Meter standards do not include meter setting standards. Meter setting practices <u>are</u> addressed in the M6

- Setting needs to be plumb and level
 (*meters work better in horizontal plane*)
- Readily accessible for servicing, reading, testing
- Remove/install meter without piping/plumbing issues
- **Electrical Grounding**
- Protect from freezing
- Operational inlet/outlet valves (bypass line for critical user)
- Minimum pressure loss
- Public Safety Considerations

Testing Methodology

Refer to the AWWA M-6 Manual

- ✓ Test specs are for meter test bench situations
- ✓ Field testing (testing meters "on site") requires following a <u>strict methodology</u>.

**M-6 does not spell out <u>field testing</u> requirements.

Refer to the meter manufacturer specs
 Newer style meters require different testing approach

Testing Frequency

Table 5-2 in the M-6 manual lists for every State, PSC regulations for Meter testing by size

16 states have no regulations (pp. 53, table 5-2)

(My Opinion) - The rest do not appear to be adequate to meet sound economic business practices...

... for example, <u>Arizona</u> has no statement for meter testing frequency per M-6 manual (pp. 53, table 5-2)

How often should you be testing meters?

Consequences of not maintaining meters

These are <u>your</u> cash registers!

(** Do you think it is ok to loose 10% - 20% of your money?)

All your <u>operating money</u> comes from collecting the revenue generated by the meters!

Make sure everyone pays for their fair share

Sewer revenues often based on meter readings! (** Maybe you can get the sewer department to help fund the meter testing program!)

Meter Change Out Programs

- Develop Business Case to decide on needs
- Decide level of new installations (retro fits, AMI/AMR, complete new meters)
- While you are at it, what else can you add to the project?

Meter Change outs



Source: AwwaRF 2007

Reason for AMI/AMR



AMR – Automated Meter Reading

 Mobile Meter Reading (Efficient Reading with Monthly Data)

AMI – Advanced Metering Infrastructure

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• Fixed Network Meter Reading (Daily or Hourly Data)

AMA – Advanced Metering Analytics

 Powerful Analytics Based Software Platform / Two-way Fixed Network Meter Reading (Useful and Meaningful Proactive Information)

Meter Reading Averages

Direct Read Meters (manual) 200 to 350 reads per day **Touch/Wand Reading Systems** 300 to 450 reads per day Radio Frequency – Handheld (walk-by mode) 1,800 to 2,200 reads per day **Radio Frequency – Mobile Interrogator (drive-by)** 6.500 to 8,000 reads per day Fixed Network (Advanced Metering Infrastructure) Multiple reads per meter per day (24/7 upload)





Data Handling Errors

- Wrong number of fixed zeroes (newer registers not programed correctly)
- Can be in the meter or in CIS (billing)
- Meters that are not being billed (Detector Checks, some FM's)
- Accounts that are being billed as sewage or trash only and not as water
- MINIMUM BILL ACCOUNTS

AMI Can Help Identify Non-Revenue Water



No AMI Data?- Basic Monthly Review



Digital journey

CONTROL

SCADA, Pump Controllers, PLCs, Loop Controllers

MODEL

Hydraulic Models, BioWin, Canary, Storm Water Scenarios

TREND Reports, Historical Analysis, Data Aggregation

MONITOR Reports, UI, Messaging, Alarms

MEASURE

Location, Elevation, Flow, Level, Pressure, Age, Microorganisms, Turbidity, Disinfectants/DBPs, Inorganics, Organics, Radionuclides, Conductivity, pH/ORP, Algae, Temperature, Taste & Odor, Soil Conditions, Friction, Acoustics

ASSETS



Tanks, Reservoirs, Pumps, Pipe, Valves, Hydrants, WTP, WWTP, Flushers, Samplers, Meters, PRV, Vehicles, Security, Tools, Wells, Backflow Preventer, PRV (Pressure Reducing Valve), Chem Feed, IT Hardware, Sensors, Communications Control

Model

Trend

Monitor

Measure

Assets



Internal Use Only

Device Access



Internal Use Only

Alarm insight



Billing insight

Billing Export

Billing Date Created Cycle Meters Stale Meters User Used For Billing Status Downloads \rm Export 🛨 Stale meters \sim Sep 01 2024 Sep 03 2024 12:11 PM EDT All Meters 14128 31 sblaylock@crownpoint.in.gov \checkmark COMPLETE \checkmark \sim Stale meters Aug 01 2024 Aug 02 2024 01:57 PM EDT All Meters 14096 40 nedwards@crownpoint.in.gov COMPLETE 🛨 Export \checkmark \rm Export 🛨 Stale meters \sim Jul 01 2024 Jul 03 2024 11:02 AM EDT 14084 30 ✓ COMPLETE All Meters ebudde@crownpoint.in.gov \checkmark Stale meters \sim Jun 01 2024 Jun 04 2024 10:31 AM EDT All Meters 14065 41 nedwards@crownpoint.in.gov COMPLETE 🛃 Export \sim \checkmark COMPLETE \rm Export 🖶 Stale meters May 01 2024 May 02 2024 01:43 PM EDT 14046 43 sblaylock@crownpoint.in.gov All Meters \checkmark 🖶 Export 🛃 Stale meters \sim Apr 01 2024 Apr 04 2024 12:26 PM EDT All Meters 14033 40 ebudde@crownpoint.in.gov COMPLETE \rm Export \sim Apr 01 2024 Apr 04 2024 11:31 AM EDT 14021 36 COMPLETE Stale meters All Meters ebudde@crownpoint.in.gov \sim \checkmark 🖶 Export 🛃 Stale meters Mar 01 2024 All Meters 14006 29 nedwards@crownpoint.in.gov COMPLETE Mar 06 2024 04:51 PM EDT \sim Feb 01 2024 Feb 05 2024 11:16 AM EDT 13954 63 ebudde@crownpoint.in.gov \checkmark COMPLETE 🛨 Export 🖶 Stale meters All Meters \checkmark ♣ Stale meters \sim Jan 01 2024 Jan 03 2024 10:57 AM EDT All Meters 13932 75 sblaylock@crownpoint.in.gov COMPLETE Export

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Generate Export

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District Metering areas

Features and Benefits

- Segment the system into manageable zones
- Quantify the water losses for each zone/area
- Monitor water loss in those areas
- Use the natural network topology to minimize hardware
- Traditional DMA's have a single flow entry
- Virtual DMA's can operate with multiple flow entry points by placing additional meters and leveraging AMI

	Full network	vDMA 1	vDMA2	vDMA3
NRW	30%	11%	21%	55%



Virtual DMA

Water Loss Dashboard Zone 2 - Daily Loss Zone 2 - Hourly Water Loss : -O- SUM(losses) -O- SUM(parent usage) -O- SUM(usage) 2024-10-29 250k 200k 451k 150k 100k mumm 50k -50k -100k 22 23 24 25 26 27 28

Zone 2 - C	urrent Usage	e		0 0 0
meter id 👙	radio_id 🛊	account_id 😄	asset_address ≑	usage 🚽
77101797	19674840	2040	E VIRGINIA ST	1790 🔺
20340712	58958046	6181	SE FIRST ST X	1360
21582432	19654578	4700	HARRIET ST	1240
89312415	84634842	4720	HARRIET ST	1140
76775567	19634548	1140	N GRAND AVE	1080
77189696	82940504	2640	E BLACKFORD AVE	870
21580720	82919722	4000	S DENBY AVE	760
18580925	91879822	3371	W MICHIGAN ST	700
74425277	85645496	3485	LINE ST	670
77188870	82905862	3520	MAXWELL AVE	620 -

Zone 2 - Virtual Meter

SUM(losses)	SUM(usage) 💠	SUM(parent usage) 🖨	timestamp 💠
451k 🔺	128k	579k	2024-10-29
2.54M	1.03M	3.57M	2024-10-28
3.42M	1.15M	4.57M	2024-10-27
2.23M	1.04M	3.27M	2024-10-26
1.45M	1.01M	2.46M	2024-10-25
941k	1.03M	1.97M	2024-10-24
1.89M	1.05M	2.94M	2024-10-23
1.56M	1.06M	2.62M	2024-10-22
1.44M	1.06M	2.5M	2024-10-21
274k	1.15M	1.43M	2024-10-20

Managing Data

Flushing Report 😭

ally Table and Map Usage Chart Usage Table

Flushing Usage Table

Show 200 v entries

timestamp 👙	rick 💠	witherington 👙	prospect ridge 🛛 👙	timberbrook 👙	2nd ave 👙	pike county 🔅	childs road 👙	113 live oak 🛛 🎄	audubon	2nd ave	green cottage 👙
2024-10-30 13:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 12:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 11:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 10:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 09:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 08:00	800	290	170	470	490	370	690	0	210	280	0
2024-10-30 07:00	1960	2280	710	1120	1900	3380	2860	0	2640	2990	0
2024-10-30 06:00	1120	1620	480	980	1400	3100	2110	0	2420	1660	0
2024-10-30 05:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 04:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 03:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 02:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 01:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-30 00:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 23:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 22:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 21:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 20:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 19:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 18:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 17:00	0	0	0	0	0	0	0	0	0	0	0
2024-10-29 16:00	0	0	0	0	0	0	0	0	0	0	0 🚽

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Demand and usage profile



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New Technologies Expanding AMI Applicability

- Distribution system leak detection
- Conservation
- **Backflow detection**
- Automatic shutoff \bullet
- Sensors



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AMI Software – Meter Readings and Other Data, System Management

- On- and off-cycle reads
- Meter, consumption database
- High and low alarms
- Standard and custom reports
- Queries
- System security, backup







- MIU communications
- Meter tampering
- Network collector alarms
- Network collector communications
 - Data discrepancies
- Remaining battery life

Xvlem vue – NRW Reporting and analytics **go∝ai**gua 🖓 🖗 🕼 🧰 malbors 🏢 E Leoks / Port de Segunt / Dashboard

A A SEN O SEN 17/01/2021 → 01/02/2021 JERARQUÍA CLIENTE 🛛 🖓 Aigües de Sagunt Dashboard Water balance Service connections Flow metrics Pressure Alarms Sensors O-Leaks 🕨 💭 Almardà 🖉 🔳 🐨 💭 Port de Sagunt 🖉 Alarms Details Type of connection Hydraulic efficiency A 5p-01 යිං G 50-02 81,05% 72,73% 71,41% 75,35% 75,35% 69,05% △ 23 Alarms D 5p-03 Domestic (87 %) □ Sp-04 Industrial (11 X) Total network length O Extreme leaks ▶ 🗐 Sp-05 Seasonal domestic (1 %) A 5p-06 ber of service connections Levels 12/46 Manicipal service (1 %) G 50-07 Number of main lines Other (<1 39 Sensors with alarm 1108 📮 Sp-08 🎫 Total D Sp-09 27.625 01/27 D1/28 01/80 01/31 □ Sp-10 A 50-11 D Sp-12 8 Sp-13 Canet d'en Sp-13.1 Churruca PLATA Sagunto Berenguer G Sp-14 (0110) A Sp-15 IJ Sp-16 50-17 G So-18.1 Sepes (41) Sp-18.2 Ingruinsa G 50-19 G Sp-Parc Sagunt D Sp-Pol. Cami La Mar D Sp-Polideportivo D Sp-Traida Cota 55 J Sp-Traida Blap A Parc Sagurit Sp-Traida Sectores (1) LJ Sp01-2 Contadores Municipales Non No alarms to digita

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Xvlem Vue – water production analytics

WATER AVAILABILITY

WATER PRODUCTION COSTS

WATER PRODUCTION SOURCE

BED VOLUME CALCULATIONS



Bill Metered Authorized Consumption=Revenue

AUTHORIZED CONSUMPTION

Billed Metered:	n	g	8	5,409.823	MG/Yr
Billed Unmetered:	n	g	n/a	0.000	MG/Yr
Unbilled Metered:	n	g	9	4.260	MG/Yr
Unbilled Unmetered:	n	g	10	90.120	MG/Yr

5,504.203 MG/Yr

choose entry option:

custom 90.120

MG/Yr

Utility Challenges - Budgetary

- Programs needed to address challenges
 - Infrastructure replacement
 - Water quality and regulations
 - Workforce management
 - Source water protection & security
 - Climate change
- Increasing debt service to pay for capital projects
- Increasing O&M expenses for energy, chemicals, staffing, etc
- New rate structures to improve revenue stability & affect customer behavior

Controlling NRW

- More money in the bank- lower production/purchase costs
- More realistic rate structures
- Promote conservation
- Avoid unnecessary expenses
- Equitable billing for your customers

Questions?

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Thank You!

jeff.cunningham@coreandmain.com

