



ALLIANCE FOR WATER EFFICIENCY

**WATER EFFICIENCY
& CONSERVATION
SYMPOSIUM 2024**

AUGUST 6-8, 2024 | CHICAGO, IL

Water Loss: Policy, Planning, and Practice

Track A

Room 210

3:15pm-4:00pm



Water Loss Policy: Reflecting on the Past, Assessing the Present, and Anticipating Future Advancements **Drew Blackwell**

Director of Water Efficiency, Cavanaugh & Associates, NC



Reflecting on the Past

- Beecher Report
- Evolution of M36, FWAS, and WRF L1V Guidance



Beecher Survey

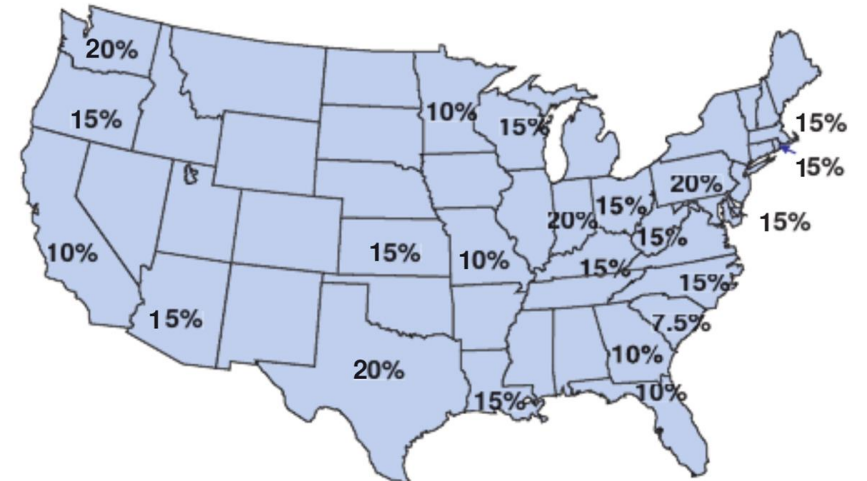
SURVEY OF STATE AGENCY WATER LOSS REPORTING PRACTICES

FINAL REPORT TO THE AMERICAN WATER WORKS ASSOCIATION

January 2002

Prepared by
Janice A. Beecher, Ph.D.
Beecher Policy Research, Inc.

FIGURE 1 Selected quoted standards from the States Survey Project



Source: Beecher Policy Research Inc., 2002
"Standards" are various forms of the inconsistently defined
"unaccounted-for" water percentage indicator.



Beecher Survey Conclusions

The results of the survey and analysis, summarized in Table 3, suggest a fair amount of state and regional policy activity regarding the issue of water losses.

However, the prevailing policies are not entirely clear, consistent, or operational.

Most of the identified policies are raising much-needed awareness of the loss issue and promoting better accounting and reporting, but most do not necessarily impose consequences through incentive or enforcement mechanisms.

The findings confirm the need to refine the definitions, measures, and standards for evaluating water losses. A uniform approach, advanced and adopted by authoritative organizations in the water industry, could play a vital role in policy development. It is not uncommon for public policies to refer to authoritative sources with regard to technical standards, such as those that might be developed for water losses.

A precursor to further policy development is the establishment of a uniform system of water accounting and the collection of valid and reliable data on water losses.

Better accounting will promote a common understanding of the water-loss issue, as well as appropriate benchmarks and standards. Eventually, best practices for water accounting and loss management may emerge and find reflection in water-loss policies, as future surveys might reveal.



Evolution of Industry Standards

M36 1st Ed. (1991)

M36 3rd Ed. (2009)

M36 4th Ed. (2016)

M36 5th Ed. (2022)

M36 2nd Ed. (1999)

AWWA Audit Software v1 (2003)

AWWA Audit Software v4 (2006)

AWWA Audit Software v5 (2010)

NORTH AMERICAN WATER LOSS 2015 Georgia (2014)

NORTH AMERICAN WATER LOSS 2017 California (2015)

NORTH AMERICAN WATER LOSS 2019 Tennessee (2016)

AWWA Audit Software v6 (2019)

NORTH AMERICAN WATER LOSS 2021 Texas (2021)

AWWA Compiler v4, v5 (2006)

WRF Real Loss Component Analysis Model (2010)

AWWA Compiler v6.0 (2022)

(2,000+ downloads)

>13,000 downloads AWWA Audit Software v5

~3,000 downloads to date



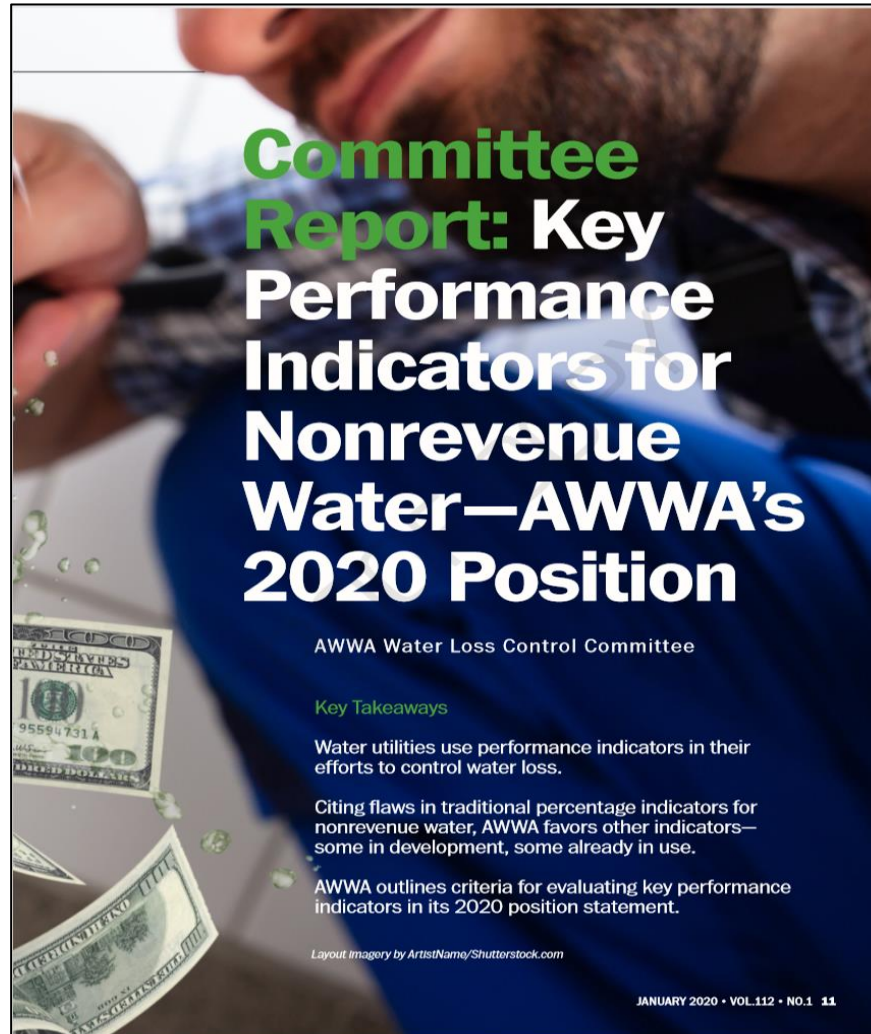
Assessing the Present

- AWWA TEC Survey of Governmental Water Loss Policies
- Recent examples



AWWA's 2020 Position on NRW KPIs

AWWA Water Loss Control Committee Report – December 2019



Committee Report: Key Performance Indicators for Nonrevenue Water—AWWA's 2020 Position

AWWA Water Loss Control Committee

Key Takeaways

- Water utilities use performance indicators in their efforts to control water loss.
- Citing flaws in traditional percentage indicators for nonrevenue water, AWWA favors other indicators—some in development, some already in use.
- AWWA outlines criteria for evaluating key performance indicators in its 2020 position statement.

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JANUARY 2020 • VOL.112 • NO.1 11



Source: AWWA Water Loss Control Committee Report (2020) with naming convention updated

2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicators: Uses and Limitations

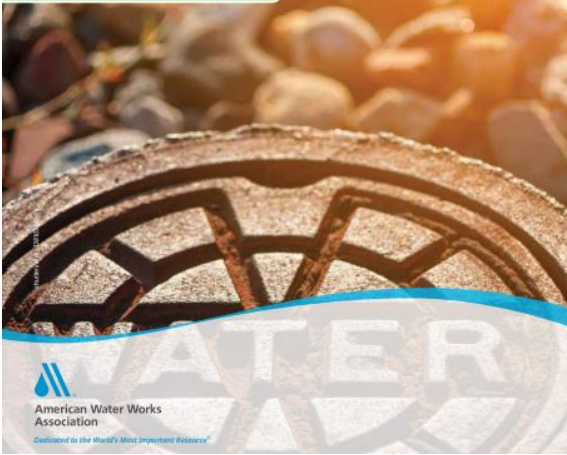
Type	Indicator	Description	Suitable Purposes					Uses and Limitations	Principal Users
			Assessment	<u>Bench- marking</u>	Target- Setting	Planning	Tracking		
Attribute	Apparent Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Apparent Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess loss cost level	Utility, Regulators
	Real Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Real Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess loss cost level	Utility, Regulators
	Unavoidable Annual Real Loss (UARL)	Calculated by Free Water Audit Software	✓				✓	Reveal theoretical technical low level of leakage	Utility, Regulators
Volume	Unit Apparent losses (vol / conn / day)	Strong and understandable indicator for multiple users	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utilities Regulators
	Unit Real Losses ^A (vol / conn / day)	Strong and understandable indicator for multiple users	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utilities, Regulators, Policy Makers
	Unit Real Losses ^B (vol / pipeline length / day)	Strong and understandable indicator for use by utilities with low connection density	✓	✓	✓	✓	✓	Data collection and assessment of systems with “low” connection density	Utilities, Regulators, Policy Makers
	Unit Total losses (vol / conn / day) New KPI	Strong and understandable indicator; suitable for high-level performance measurement	✓				✓	High level indicator for trend analysis. Not appropriate for target-setting or benchmarking	Utilities, Customers
	Infrastructure Leakage Index (ILI)	Robust, specialized ratio KPI; can be influenced by pressure and connection density.	✓	✓			✓	Benchmarking after pressure management is implemented	Utilities
Value	Apparent Loss Cost Rate (value / conn / year) New KPI	Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is very useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs.	✓			✓	✓	Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates	Utilities, Regulators, Customers
	Real Loss Cost Rate (value / conn / year) New KPI		✓			✓	✓		Utilities, Regulators, Customers
Validity	Data Validity Tier (DVT)*	Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity.	✓	✓		✓	✓	Assess caliber of data inputs of the water audit	Regulators, Utilities




Table 2 AWWA Water Audit Method – Key Performance Indicators (2020)



Governmental Policies for Drinking Water Utility Water Loss Control

Survey Results of Water Loss Control Policies



-  **Minimum Standards:**
 - AWWA M36 Water Balance
 - Data Validity Assessment
 - Level 1 Validation
-  **Minimum Standards:**
 - AWWA M36 Water Balance
 - Data Validity Assessment
 - No Level 1 Validation (Self-Reported)
-  **Minimum Standards:**
 - AWWA M36 Water Balance
 - No Data Validity Assessment
 - No Level 1 Validation (Self-Reported)



The Good News



Increase in Water audit data submission

Increase in utilization of the AWWA Water Audit Methodology

The AWWA FWAS is the recognized tool for standardized water audit data collection

AWWA's key performance indicators have garnered considerable attention from agencies



Still Work to be Done

Most agencies do not use the AWWA FWAS as their water audit data collection tool

Most agencies do not require water audit data validation.

“Unaccounted-for” water percentage language is still the most common indicator in use.

Policy and program changes still pose a challenge.

Agencies without AWWA programs remain wed to a dated, imprecise methodology with limited change.



Opportunities for Improvement

Continued adoption of programs based on the AWWA Water Audit Methodology.

Wider embrace of AWWA's key performance indicators.

Establishment of consistent, rational, and workable performance targets for agencies to employ.

Capacity Development (TMF) Utilization

Means to monitor and evaluate agency program success and cost-effectiveness.



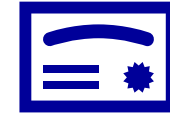
6

States Requiring Level 1 Water Audit Validation (CA, GA, HI, IN, QBC, TX*)



4

States With Water Audit Validator Certification Programs (CA, GA, IN, QBC)



8

States Requiring Water Auditing without Level 1 Validation (CO, FL, NV, MN, NM, NV, TN, WI)



2

States with Pending Water Auditing Legislation (NJ, VA)



2

States Reviewing Current Water Loss Control Policy (NJ, WA)



8

AWWA Section Water Loss Control Committees,
1 State Established Committee
(CA-NV, CO, GA, IN, KY-TN, NJ, SC, TX)



Anticipating Future Advancements

- Opportunities to Advance AWWA Best Practices



Opportunities to Advance AWWA Best Practices



Anticipating Future Advancements

- Continue to evolve water loss industry standard tools
- Increasing awareness in water loss control
- Innovative/Complimentary solutions such as Leakage Emissions Initiative
- Incentivizing the use of AWWA best practices
- Local regulations
- Continue collaborative nature of water loss control – policymakers need expertise from water loss experts and the utilities themselves. Policy as inseparable from practical outcomes.



Thank you!

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CAVANAUGH

Stewardship Through Innovation



Putting It All Together: From Planning to Progress and Everything in Between

Amy McNulty

Water Efficiency Manager, Irvine Ranch Water District, CA





Irvine Ranch
Water District



WATER LOSS CONTROL PLAN

AWE CONSERVATION & WATER
EFFICIENCY SYMPOSIUM

AUGUST 7, 2024

AMY MCNULTY

IRVINE RANCH WATER DISTRICT

AGENDA

- Background
 - Foundational programs
 - Technical assistance
- Water Loss Control Plan
 - Purpose
 - Programs
 - Policy
 - Planned activities



ABOUT IRWD

A not-for-profit local public agency serving residents and businesses throughout central Orange County.



181 square miles

20% of Orange County



122,000

Service connections

465,000

Residents served

600,000

Daytime population served



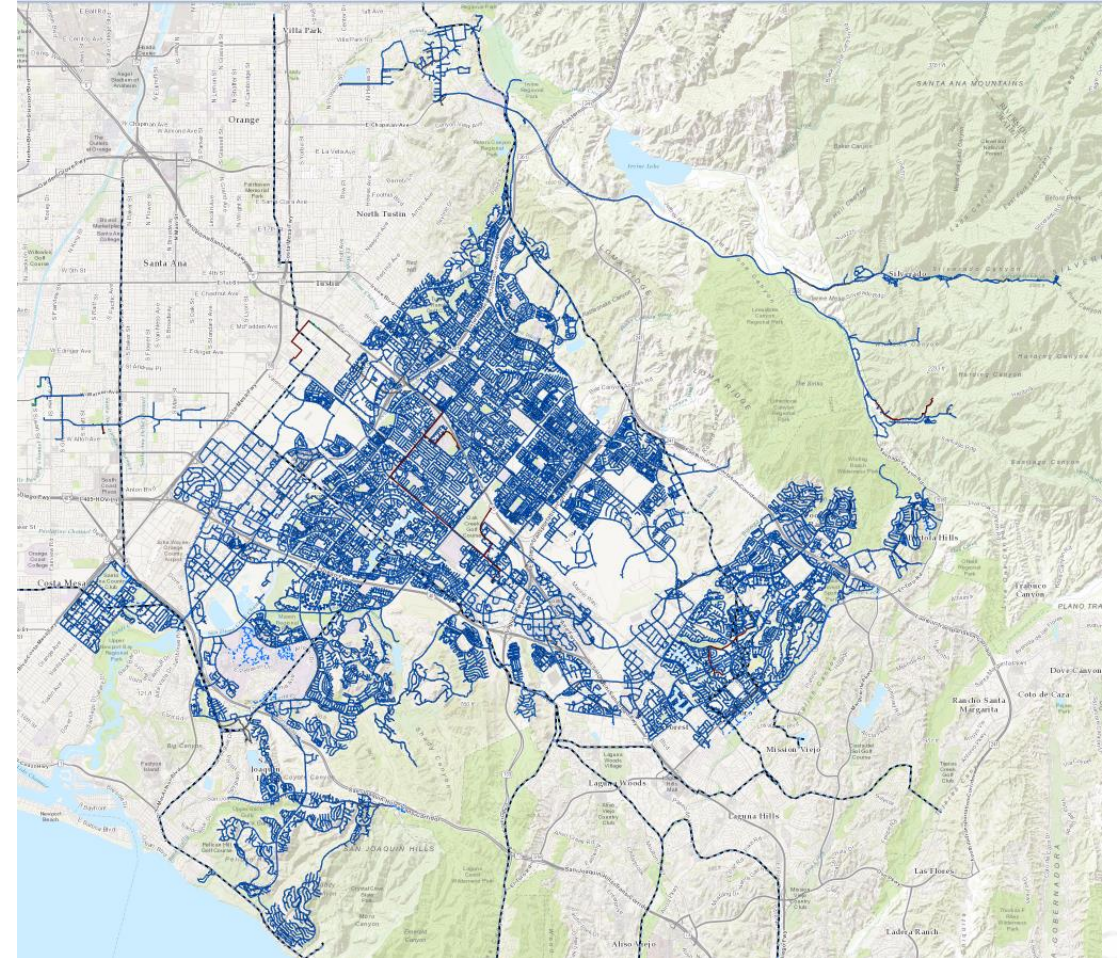
Serving all or parts of:

Irvine
Lake Forest
Newport Beach
Tustin
Costa Mesa
Orange
Unincorporated Orange County

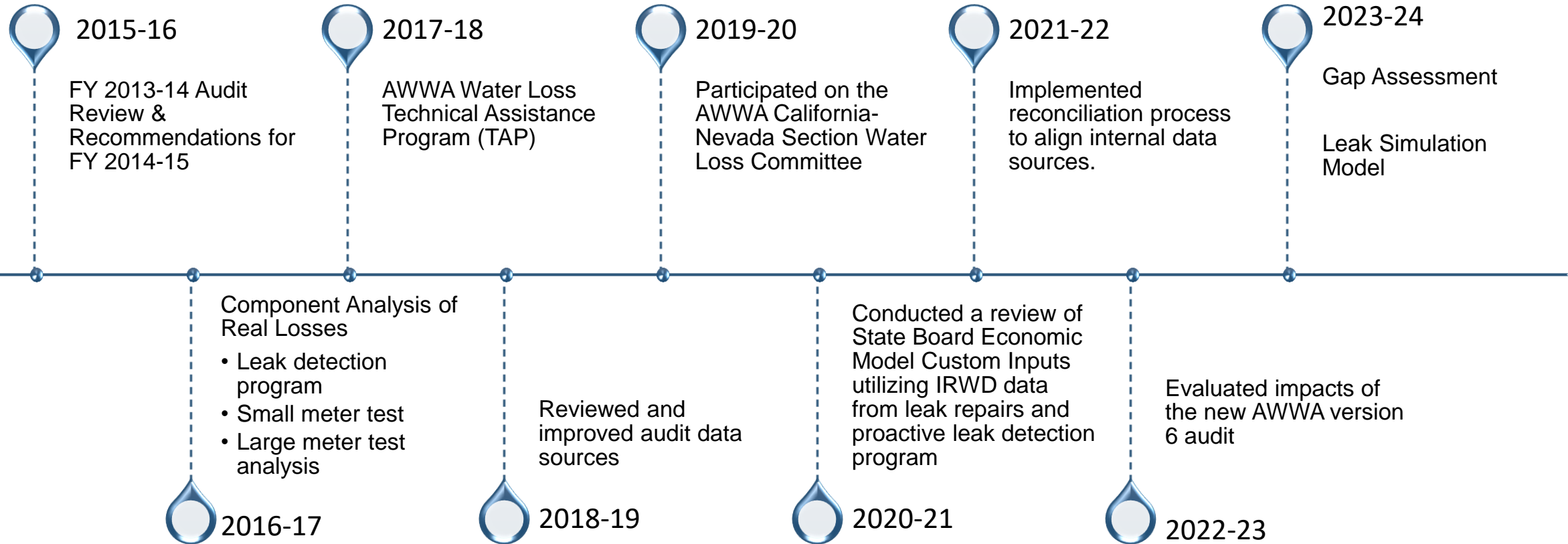


BACKGROUND – FOUNDATIONAL PROGRAMS

- Proactive leak detection
- Lifetime based customer meter maintenance and replacement
- Annual supply meter testing (calibration)
- Annual water loss audits



BACKGROUND – TECHNICAL ASSISTANCE



DATA IMPROVEMENTS CAN CHANGE AUDIT RESULTS

	INDICATOR	FY 13-14	FY 14-15	FY 16-17	UNITS
	FINANCIAL PERFORMANCE INDICATORS				
1	Non-Revenue as % by volume of Water Supplied	10.7%	7.1%	6.8%	
2	Non-Revenue as percent by cost of operating system	14.7%	15.1%	17.1%	
3	Annual cost of Apparent Losses	\$1,275,162	\$714,816	\$828,315	Customer retail unit cost
4	Annual cost of Real Losses	\$3,756,605	\$3,672,216	\$3,200,547	Variable prod. cost
	OPERATIONAL EFFICIENCY PERFORMANCE INDICATORS				
5	Apparent Losses per service connection per day	12.7	7.4	6.8	gal /conn/day
6	Real Losses per service connection per day	38.1	28.3	20.8	gal /conn/day
7	Real Losses per service connection per day per PSI	0.5	0.3	0.3	gal/conn/day/ PSI
8	Unavoidable Annual Real Losses (UARL)	2,037	2,270	2,501	AF / yr
9	Current Annual Real Losses (CARL)	4,404	3,241	2,579	AF / yr
10	Infrastructure Leakage Index (CARL/UARL)	2.2	1.4	1.03	
	DATA VALIDITY PERFORMANCE INDICATOR				
11	Data Validity Score	75	78	76	scale 1- 100



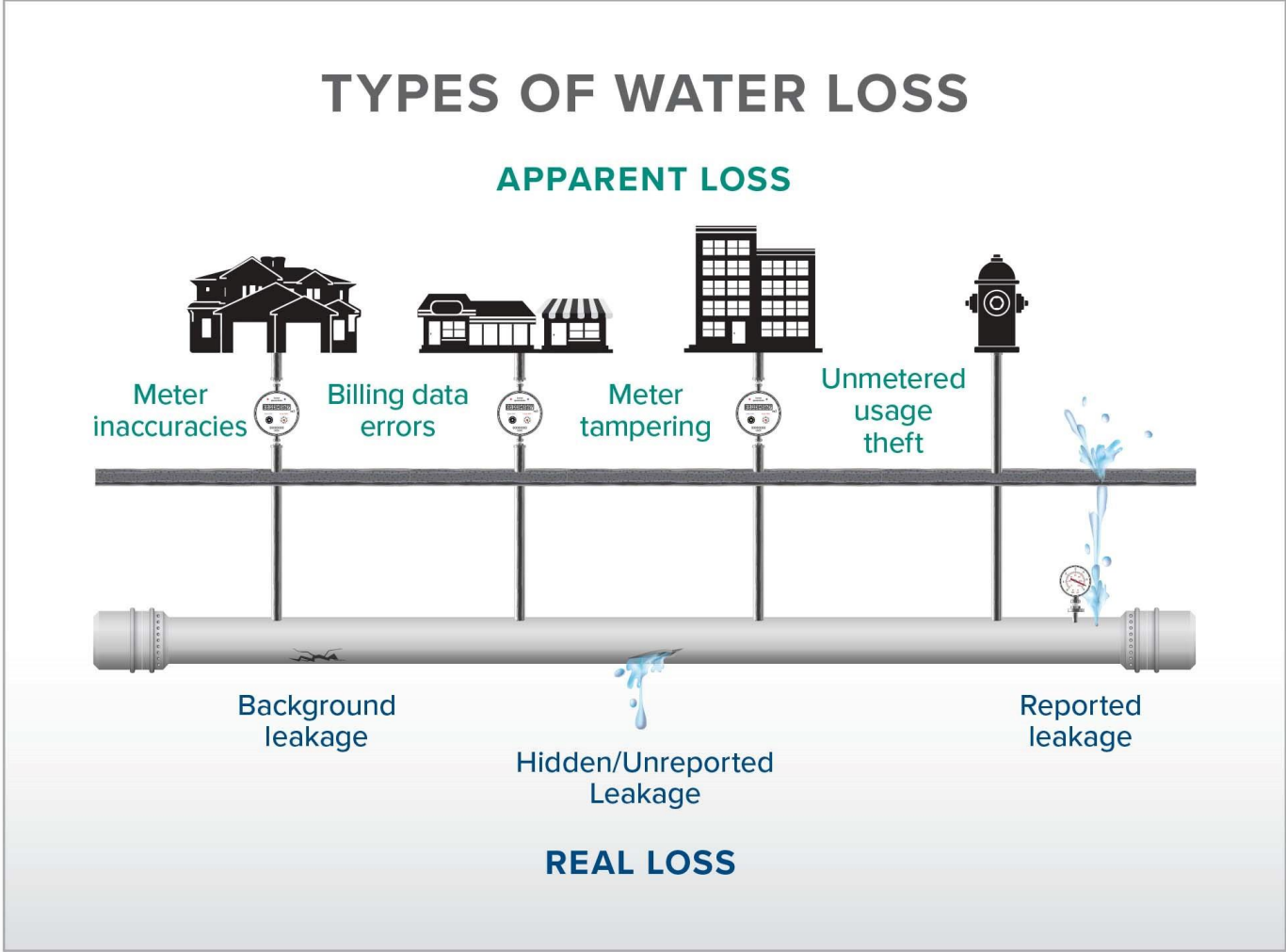
WATER LOSS CONTROL PLAN PURPOSE

- Help plan, coordinate and manage activities related to water loss
- Provide support for program budget requests
- Incorporate results from water loss technical assistance
- Adapt programs to new data and technology
- Maintain a record of previous programs and activities

Water Loss Control Plan
2024



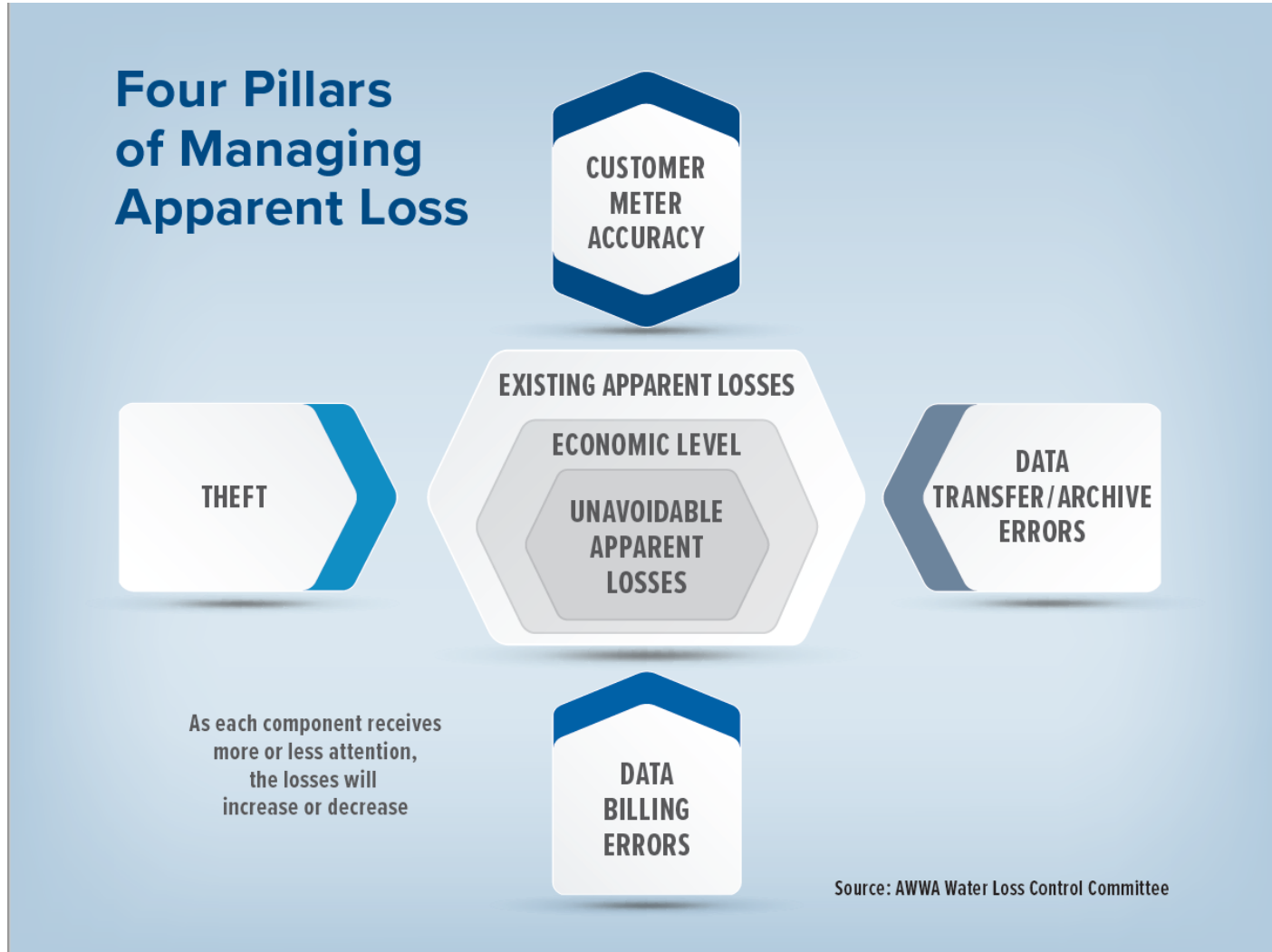
PLAN ORGANIZATION



WATER BALANCE

Water Supplied	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water
		Unbilled Unmetered Consumption		
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Customer Meter Inaccuracies	
			Data Handling Errors	
	Real Losses			

APPARENT LOSSES



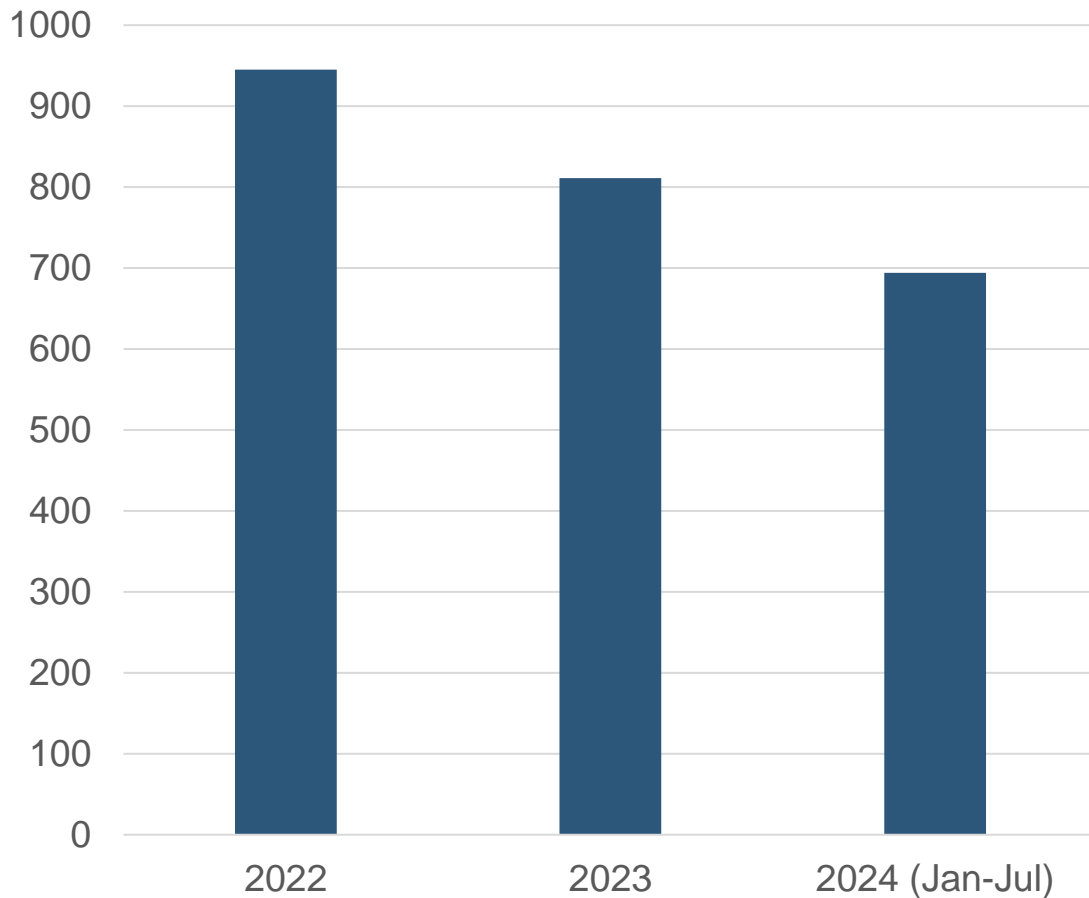
APPARENT LOSS PROGRAMS

- Meter replacement programs
 - Lifetime based on meter size
 - Performance based on read accuracy
- Meter tampering
- Unauthorized usage
 - Firelines
- Back billing



MALFUNCTIONING METERS

Double Zero & Field Test Results

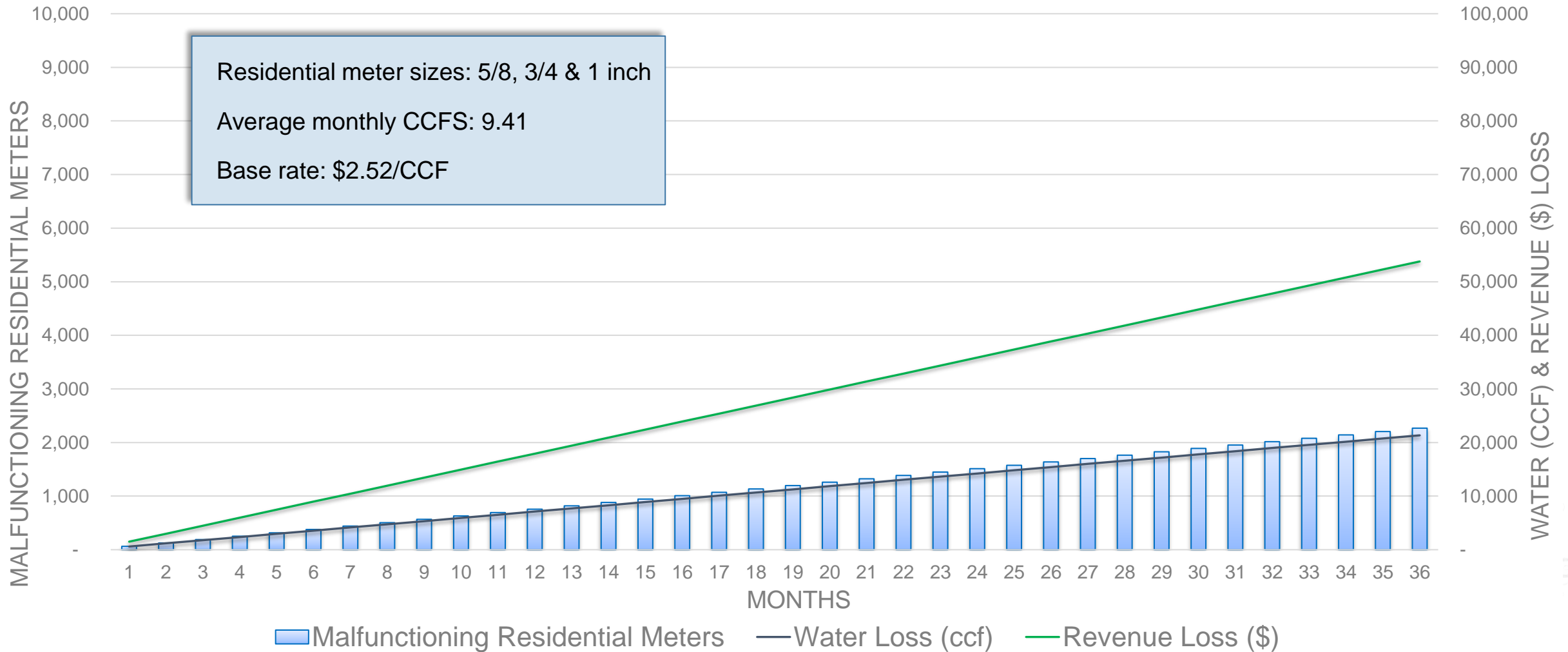


Detection Criteria

- Double zero: register stops when last two digits are zeros.
 - Automatically sent for replacement without field test due to this known issue.
- Zero usage for two or three consecutive months, and previously had usage.
 - Meters are field tested and sent for replacement if not operating.

WATER & REVENUE LOSS

PERFORMANCE BASED METER REPLACEMENT



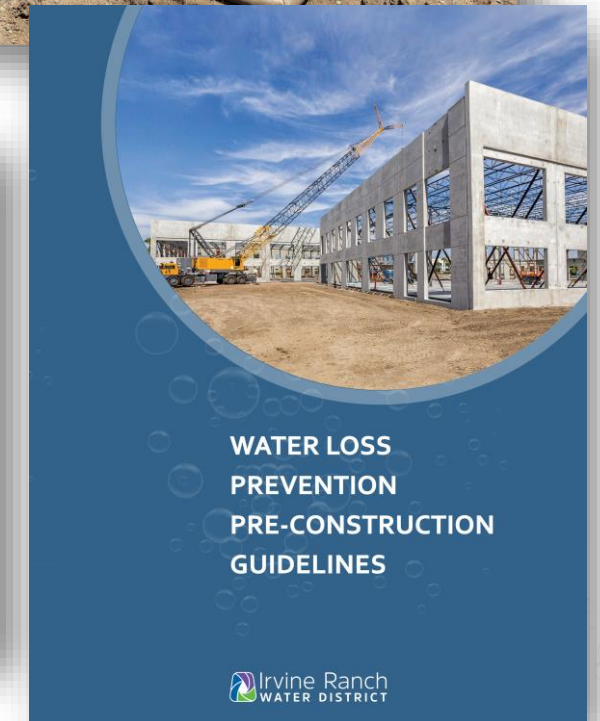
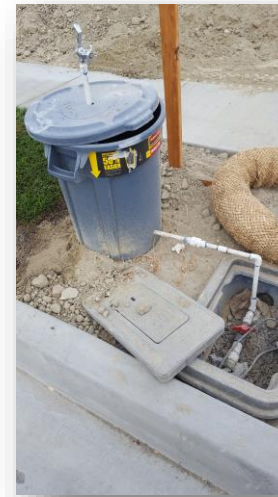
UNAUTHORIZED USAGE

Common types

- Construction site and mobile unmetered hydrant use
- Meter boxes without meters

Pre-Construction Brochure

- Cross-connection dangers
- Do's and Don'ts
- District connection policy
- Escalating enforcement plan



PRIVATE FIRELINE USAGE

- ~ 4,500 private fireline accounts
- Billed based on:
 - Pipe diameter
 - Number of hydrants
 - Not billed for usage
- Target high use accounts
 - Unauthorized connections
 - Leaks
- Other issues
 - Bypass meters turned off or stolen
 - Meters not read “90 route”



FIRELINE INVESTIGATIONS

- Out of 4,000 firelines
- 759 had high usage
- 176 investigated
- 43 had leaks
- 16.58 AF measured on bypass meter since 2022

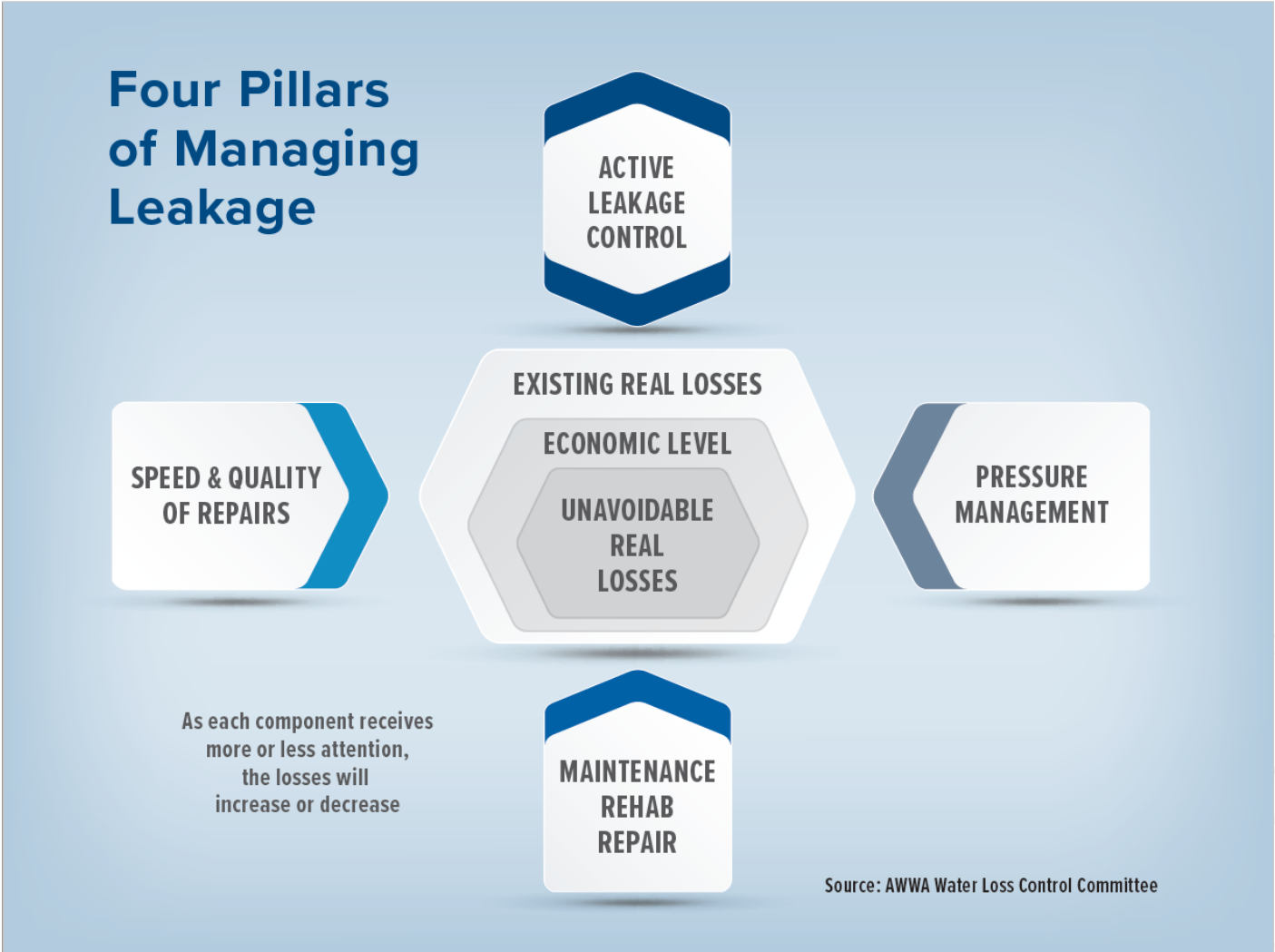


BACK BILLING

- Malfunctioning meters
 - Volume calculated based on historical use or peer group
- Firelines
 - 3 accounts have been billed
 - Construction rate \$3.25
 - Base rate \$2.65
 - Wasteful rate \$16.46
 - Pipe diameter multiplier

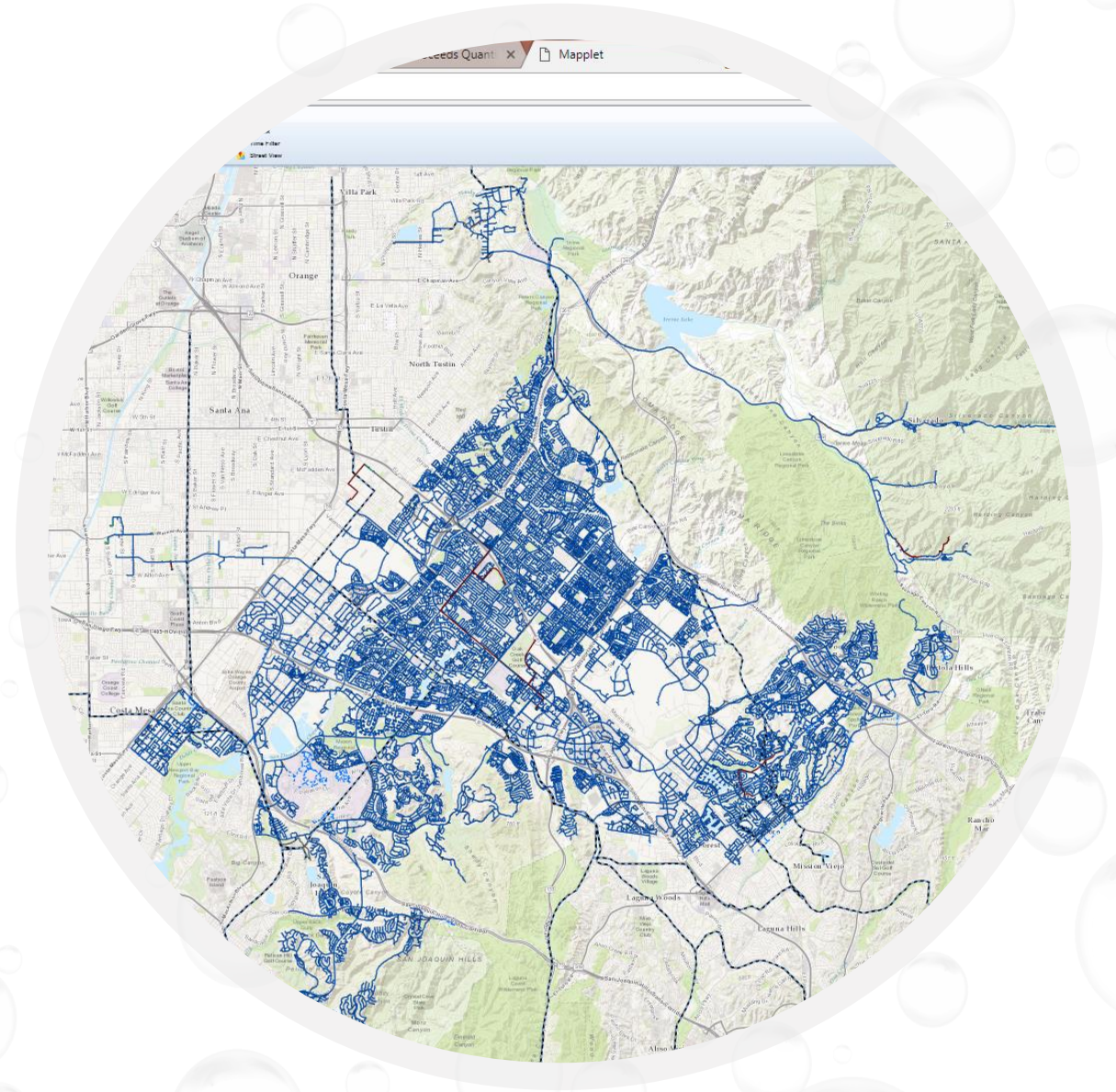


REAL LOSSES



REAL LOSS PROGRAMS

- Leak Detection Program
 - Acoustic walking residential and commercial development
 - Drive major arterial streets for mainlines
- Future
 - Considering sensors to monitor system pressure



DISTRICT POLICIES

IRWD Rules and Regulations

- Prohibits diversions, tampering and unpermitted fire hydrant connections
- Fireline use is for fire fighting only
 - All other use deemed wasteful
 - Subject to revocation of service which would require customer to provide fire watch protection

Rates and Charges

- Wasteful rate and non-compliance charges

Future

- Include language to address unauthorized connections to private firelines, leaks, and ownership/customer is always known
- Bill fireline usage routinely?

PLANNED ACTIVITIES AND PROGRAMS

- Technical activities
 - Water audit gap assessment
 - Leak simulation modeling
 - Component Analysis of Real Losses
 - Capital Improvement Plan
- Sewer pipe cleaning – metering
- Firelines
- Policy
- Water Loss Control Plan updates
 - Align with 2-year budget cycle
 - Reflect new data, methods and technologies



Irvine Ranch
Water District



QUESTIONS

Pilot Prep: Making the Most of Leak Detection & Recovery Work

Kate Gasner

Vice President, Water Loss Consulting, E Source, OR



E Source

Water Loss Consulting

Services for California Water Utilities

Kate Gasner, Vice President



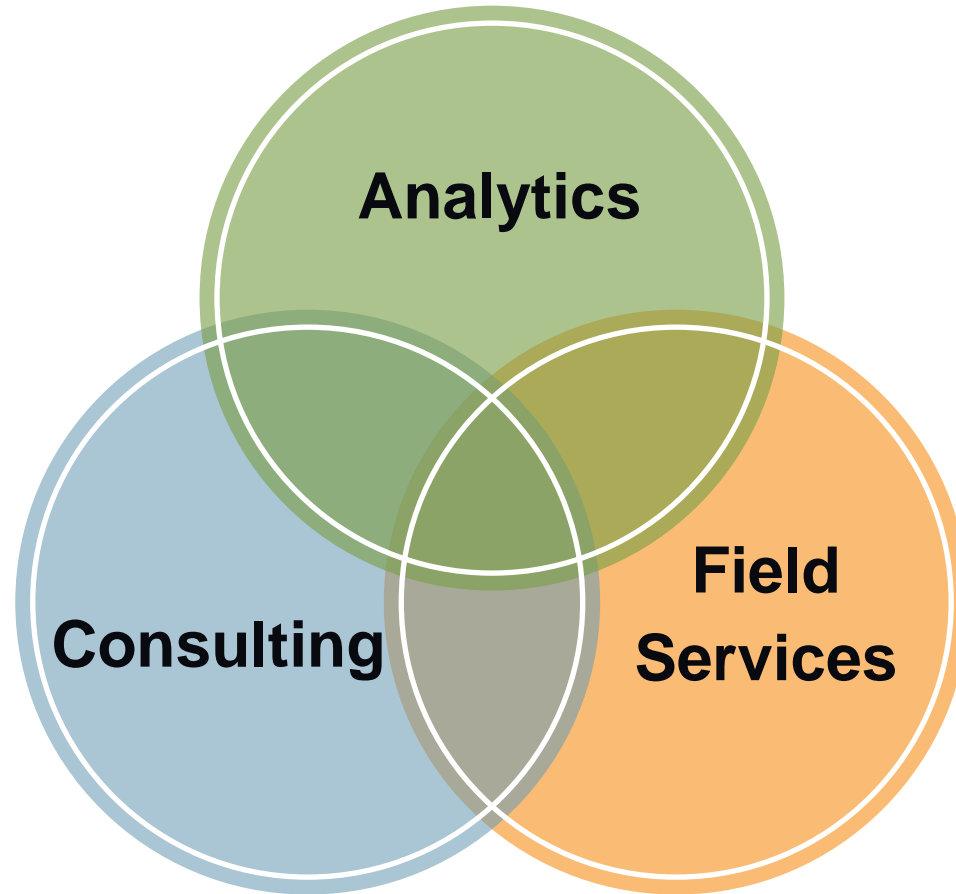
We know utilities.

June 20, 2024

© Proprietary and confidential

Water Loss Consulting, E Source

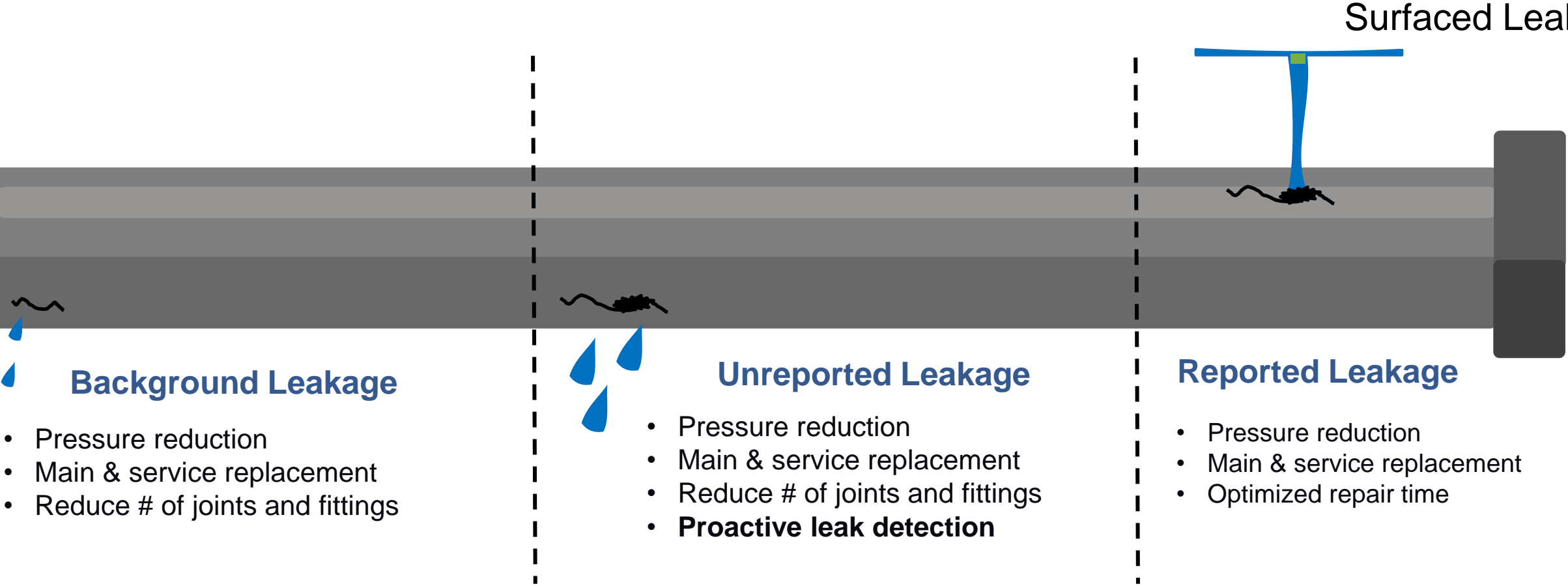
Applied data science to seek evidence-based recommendations.



Consensus building and stakeholder empowerment

Real-world implementation experience grounds all our work.

Leakage Recovery Interventions



- Background Leakage**
- Pressure reduction
 - Main & service replacement
 - Reduce # of joints and fittings

- Unreported Leakage**
- Pressure reduction
 - Main & service replacement
 - Reduce # of joints and fittings
 - **Proactive leak detection**

- Reported Leakage**
- Pressure reduction
 - Main & service replacement
 - Optimized repair time

Leak Detection Technology Experience

Unreported Leakage

Acoustic Survey



Manual Leak
Detection

Acoustic Logger



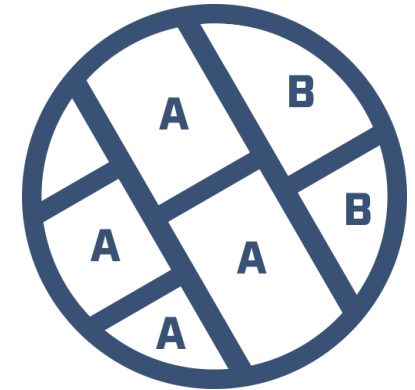
Sensors deployed
throughout system to
capture leak noise

Remote Imaging Analysis



Satellite or Aerial
Images analyzed for
anomalies

District Metered Areas



Loss monitoring in
sub-regions

Phases of Unreported Leakage Recovery Work



Planning & Preparation

- **Main goals of leakage recovery pilot program?**
- Mapping!
- Anticipated challenges?
- Team development and cross-department involvement
 - Operations; repair crews; customer service/public relations/marketing

Planning & Preparation



Deployment



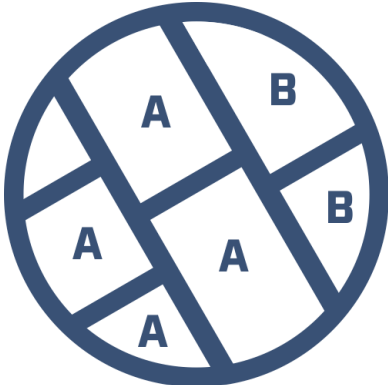
Survey initiated.



Sensors installed and data collection and monitoring begins.



Satellite or aerial images captured and assessed.



DMAs “installed”, data collection and monitoring begins

Investigation & Pinpointing



*Pinpointed
location of
suspected leak*

*Experience with sounding an area
for leak noise is critical.*

Repair

Leak Repair Crew Capacity?

Commitment to Repair or
Threshold for Repair Action?

Special Budget for Pilot Leak
Repair?

Unsurfacing Leaks!



Documentation

- **What:** Leak findings and leak characteristics (infrastructure failure type, flow rate, repair costs, etc)
- **Where:** which database? Existing or new? Work orders involved?
- **Who:** Field crews? Technology provider?
- **When:** Multiple points of data collection (leak finding, leak investigation, leak repair)

Analysis & Reflection

- **Cost Data:** Cost per leak found
 - Labor included?
 - Repair included?
- **Savings Data:**
 - Volume saved per leak found
 - Avoided leakage calculations (counter-factual data!?)
 - Value of water saved calculations?
- False positives
- False negatives
- Rate of findings

Phases of Unreported Leakage Recovery Work



Thank you!



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VP, Water Loss Consulting

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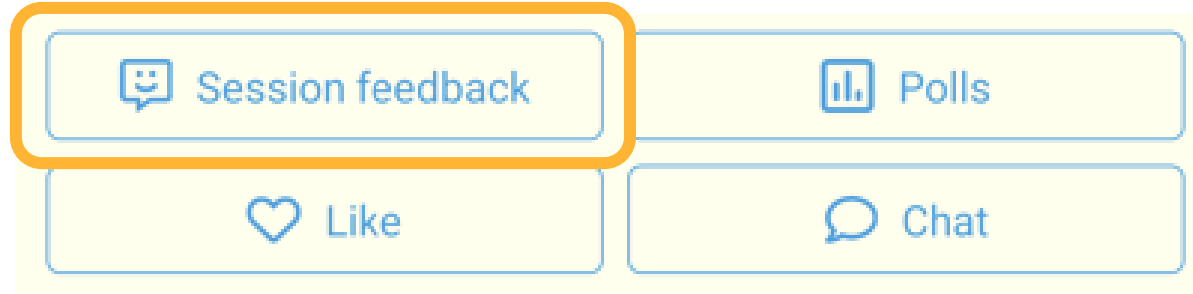
Audience Q&A



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