American Water Works Association California-Nevada Section

Water Loss Technical Assistance Program

Wave 3 Work Session
Early Adopter Track

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Today's Agenda

- Program Status
- Wave 2 Debrief
- Wave 4 Preparation:
  - Supporting Documentation
  - DVG Standardization
  - Example Calculations
  - Logistics!
- Next Steps in Water Auditing
- Immediate Next Step Planning

WAVE 3

1 2 3 4

March 2017 - May 2017

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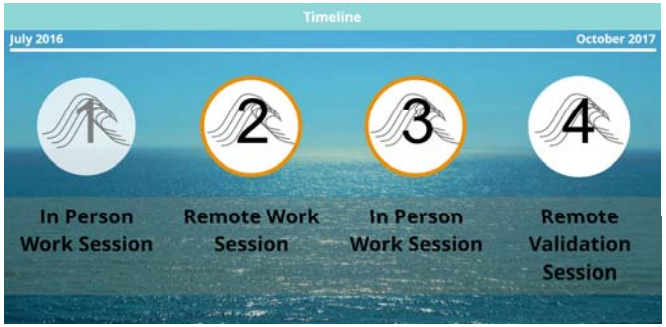
Water Loss TAP



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Water Audit

the water balance

SYSTEM INPUT VOLUME	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION	REVENUE WATER
			BILLED UNMETERED CONSUMPTION	
		UNBILLED AUTHORIZED CONSUMPTION	UNBILLED METERED CONSUMPTION	NONREVENUE WATER
			UNBILLED UNMETERED CONSUMPTION	
	WATER LOSSES	APPARENT LOSSES	CUSTOMER METER INACCURACIES	
			UNAUTHORIZED CONSUMPTION	
			DATA HANDLING ERRORS	
		REAL LOSSES		

the results

volumes of loss

values of loss

validity of loss

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Data Validity Guidance

Functional Focus Area	Water Audit Data Validity Level / Score				
	Level I (0-25)	**Level II** (26-50)	**Level III** (51-70)	**Level IV** (71-90)	**Level V** (91-100)
Audit Data Collection	Launch auditing and loss control team; address production metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps.	Establish/revise policies and procedures for data collection	Refine data collection practices and establish as routine business process	Annual water audit is a reliable gauge of year-to-year water efficiency standing
Short-term loss control	Research information on leak detection programs. Begin flowcharting analysis of customer billing system	Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc.	Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring	Refine, enhance or expand ongoing programs based upon economic justification	Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation
Long-term loss control		Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system.	Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process.	Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management	Continue incremental improvements in short-term and long-term loss control interventions
Target-setting			Establish long-term apparent and real loss reduction goals (+10 year horizon)	Establish mid-range (5 year horizon) apparent and real loss reduction goals	Evaluate and refine loss control goals on a yearly basis
Benchmarking			Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table)	Performance Benchmarking - ILI is meaningful in comparing real loss standing	Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service

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Wave 2 Debrief

HANDOUT!

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Wave 2 Debrief

Share Your Experience?

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Wave 2 Debrief

Observed Trends	Audit Impacts
• Water Audits are familiar (UWMPs, early adopters)	→ • Opportunities for refining audit inputs and institutionalizing audit practices
• Production meter accuracy testing is not standard *electronic calibration is much more commonly practiced*	→ • Uncertainty around accuracy of Water Supplied volumes
• Customer meter testing programs focus on targeted groups (large meters, old meters)	→ • Apparent Losses are estimated, reducing confidence in Real Loss estimation

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Wave 4 Preparation

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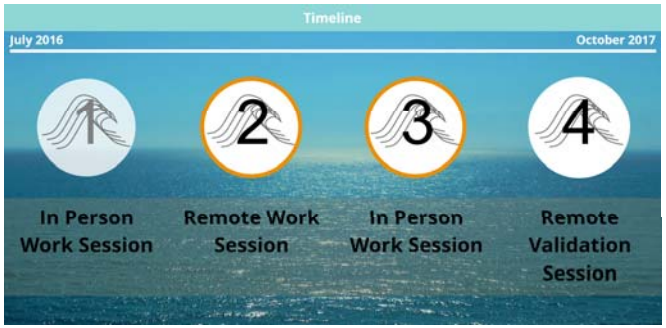
Water Audit Reminders



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Data Quality and Validation

- ***Data quality*** – the validity, or trustworthiness, of the data
- ***Data validation*** – a quality control process conducted to verify, and improve as needed, the data inputs and gradings of the water audits submitted by water utilities.
- ***Water Loss Audit validation*** – does not make data inputs or gradings "right" or "wrong", but merely aligns them with the actual conditions that occurred in the operation of the utility for the audit year
  - Level 1 -- Top down Data Review
  - Level 2 -- Top down Data Mining Review
  - Level 3 -- Bottom up Field Investigation

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Wave 4 Validation Session

Purpose of Level 1 Validation

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

goals: quality and consistency

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2016 UWMP Submitted Data - Unfiltered

	STATISTIC	2016 n = 292 min	2016 n = 292 median	2016 n = 292 max	UNIT
financial	Customer Retail Unit Cost	$0.00	$3.93	$180,097.61	$ / 1,000 gal
	Variable Production Cost	$0.00	$1,315.45	$25,007,000.00	$ / million gal
	NRW as % of Operating Cost	0.00%	3.54%	242305%	% of operating cost
volumetric	Apparent Losses	-4.34	6.36	122.3	gal/ serv conn / day
	Real Losses (serv conns)	-35	19.46	334.54	gal/ serv conn / day
	Real Losses (pressure)	-0.66	0.371	5.31	gal/ serv conn / day / psi
	ILI	-3.03	1.18	17.84	CARL / UARL
	Data Validity Score	2.35	75.33	98.27	points out of 100

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Wave 4 Validation Session

Purpose of Level 1 Validation

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

Level 1 Validation Tools:

- Discussion with Audit Team (Wave 4 Validation Session)
- SUPPORTING DOCUMENTATION

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Supporting Documentation

provides more detail on key values

Goal: show the source data and/or derivations used to get audit input

When compiling supporting documents, remember!

- excel spreadsheets, text files preferred over PDFs for tabular data
- include notes on any exceptions, corrections, or data gymnastics included in your audit input calculation

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Supporting Documentation

provides more detail on key values

REQUIRED	SUPPLEMENTAL
❑ Volume from Own Sources *broken down by month and meter*	❑ Customer Meter Inaccuracy derivation
❑ Water Imported *broken down by month and meter*	❑ Average Operating Pressure derivation
❑ Water Exported *broken down by month and meter*	❑ Customer Retail Unit Cost derivation
❑ Supply Meter Testing	❑ Variable Production Cost derivation
❑ Volume of Metered Consumption *broken down by month and charge code*	❑ System Schematic *showing locations of Supply and Export Meters*

Required Supporting Documents are critical for Level 1 Validation

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Supporting Documentation

EXAMPLES!

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Data Matrix Standardization

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Selecting A DVG

determine the **highest grade** where the utility **meets or exceeds all** criteria for that grade and all grades below it

Common questions

Navigating any subjective words

Dealing with unique scenarios

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Grade Focus

Those data grades dealing with the largest volumes carry the most weight in the DVS, and the reliability of the audit

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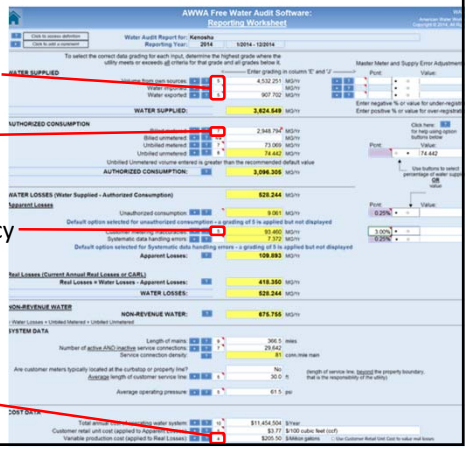
Grade Focus

Volume from own sources
Water imported/exported

Billed metered AC

Customer meter inaccuracy

Variable production cost



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Grade Focus

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 58 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Variable production cost (applied to Real Losses)
3: Customer metering inaccuracies

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VOLUME FROM OWN SOURCES – DVG CRITERIA	ADDITIONAL GUIDANCE
1. Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.	
2. 25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted.	Manufacturer testing certificate for newly installed meter does not qualify as accuracy testing
4. 50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted.	% of source metric is for volume, not meter count Occasional = within last 5 years but less than annually, for <90% of source flow
6. At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Accuracy testing = precise & independent volumetric measurement in-situ against subject meter for at least 90% of the source flow by volume OR Calibration = alignment of flow range conversion with signal span output (4-20) and SCADA output
8. 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Must have both accuracy testing AND calibration for 90% of the source flow
10. 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology.	3rd party M36 review = testing and calibration practices have been closely scrutinized for compliance with procedures described in the M36 Manual Must have both accuracy testing AND calibration for 90% of the source flow

WATER IMPORTED - DVG CRITERIA	ADDITIONAL GUIDANCE
1. Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	
2. 25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing.	Manufacturer testing certificate for newly installed meter does not qualify as accuracy testing
4. 50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	% of source metric is for volume, not meter count Occasional = within last 5 years but less than annually, for <90% of source flow
6. At least 75% of imported water sources are metered, meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Accuracy testing = precise & independent volumetric measurement in-situ against subject meter for at least 90% of the source flow by volume OR Calibration = alignment of flow range conversion with signal span output (4-20) and SCADA output
8. 100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy.	Must have both accuracy testing AND calibration for 90% of the source flow
10. 100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.	Must have both accuracy testing AND calibration for 90% of the source flow

BILLED METERED – DVG CRITERIA	ADDITIONAL GUIDANCE
4. At least 75% of customers are metered……only very limited meter accuracy testing is conducted. Customer meters are replaced only upon complete failure. Computerized billing records exist, but only sporadic internal auditing conducted.	Very limited testing (reactionary) = complaint based or consumption flag testing only Sporadic = less than annual
6. At least 90% of customers are metered……only limited meter accuracy testing is conducted. Regular replacement is conducted for the oldest meters. Computerized billing records exist with annual auditing of summary statistics conducting by utility personnel.	Limited testing (proactive) = more than reactive testing (per DVG of 4), targeted to certain subsets but not representative sampling of full meter population Summary statistics = total volumes year to year
8. At least 97% of customers are metered……regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics occurs annually by utility personnel, and is verified by third party at least once every five years.	Regular testing (proactive) = testing certain subsets but not representative sampling of full meter population, with the results directly utilized to dictate maintenance and replacement activities Detailed statistics = at least down to the charge code level, Third party audit = sampling review on select accounts If presently in a meter changeout or conversion project, OK to treat new meter installations as 'testing' for audit year installed +1 year (2-year horizon)
10. At least 99% of customers are metered……statistically significant customer meter testing and replacement program in place on a continuous basis. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years.	Statistically significant testing and replacement = proactive large meter testing targeted based on revenue and small meter testing based on random representative sampling, results directly utilized to dictate maintenance and replacement activities Third party audit = full billing database query and analysis of raw data to rebuild to the summary consumption volumes

CUSTOMER METERING INACCURACY	ADDITIONAL GUIDANCE
2. …Customer meters are tested for accuracy only upon customer request.	Input is an estimate, not calculated.
4. …Meter accuracy testing is conducted annually for a small number of meters (more than just customer requests, but less than 1% of inventory). A limited number of the oldest meters are replaced each year. Inaccuracy volume is largely an estimate, but refined based upon limited testing data.	Limited replacement = replaced if failed Volume *inferred* for full meter population but informed only from reactive test data, such as complaint tests or consumption flagged tests
6. …Routine, but limited, meter accuracy testing and replacement occur. Inaccuracy volume is quantified using a mix of reliable and less certain data.	Routine = proactive Volume *calculated* for full meter population based on proactive test data but less than representative sampling
8. Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for various types of meters.	Ongoing = annual Volume *calculated* for full meter population based on proactive test data from representative sampling
9. Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Statistically significant number of meters are tested in audit year. This testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for these meters.	Statistical significance = testing program margins of error have been analyzed
10. …Ongoing meter replacement occurs according to a targeted and justified basis. Regular meter accuracy testing gives a reliable measure of composite inaccuracy volume for the customer meter population. New metering technology is embraced to keep overall accuracy improving. Procedures are reviewed by a third party knowledgeable in the M36 methodology.	Targeted and justified = proactive large meter testing targeted based on revenue and small meter testing based on random representative sampling, results directly utilized to dictate maintenance and replacement activities 3rd party M36 review = testing program and input calculations have been closely scrutinized for compliance with procedures described in the M36 Manual by third party

VARIABLE PRODUCTION COST – DVG CRITERIA	ADDITIONAL GUIDANCE
4. … Electric power and treatment costs are reliably tracked and allow accurate weighted calculation of unit variable production costs based on these two inputs and water imported purchase costs (if applicable). …	If only primary costs included, DVG of 4 (power, chemicals and/or purchase water costs)
6. …Pertinent additional costs beyond power, treatment and water imported purchase costs (if applicable) such as liability, residuals management, wear and tear on equipment, impending expansion of supply, are included in the unit variable production cost, as applicable. All costs audited internally on an annual basis.	*Some but not all* secondary costs have been evaluated and incorporated including but not limited to damages paid from claims from line breaks, wear and tear on dynamic equipment, residuals management and impending expansion of supply. If some of the secondary costs are not applicable, the *basis* for this should be documented.
8. ….all pertinent primary and secondary variable production and water imported purchase (if applicable) costs tracked. The data is audited at least annually by utility personnel, and at least once every three years by a third-party knowledgeable in the M36 methodology.	*All* secondary costs have been evaluated and incorporated as applicable. For any deemed not applicable, the *basis* for this should be documented. 3rd party M36 review = input calculations have been reviewed by a water loss expert
10. Either…. 1) Third party CPA audit of all pertinent primary and secondary variable production and water imported purchase (if applicable) costs on an annual basis, or: 2) Water supply is entirely purchased as bulk water imported, and the unit purchase cost - including all applicable marginal supply costs - serves as the variable production cost. If all applicable marginal supply costs are not included in this figure, a grade of 10 should not be selected.	*All* secondary costs have been evaluated and incorporated as applicable. For any deemed not applicable, the *basis* for this should be documented. 3rd party M36 review = input calculations have been reviewed by a water loss expert

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Wave 4 Sequence

Schedule your team's call

Complete & upload your audit (CY16 or FY16/17) and SDs

Wave 4 call + any actions from the session

Get final validation document from PM Team

Submit Level 1 validated water audit package to DWR

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Wave 4 Sequence

Schedule your team's call
Dates between 5/1/17 and 9/15/17

Complete & upload your audit (CY16 or FY16/17) and SDs
If CY – schedule for May-July

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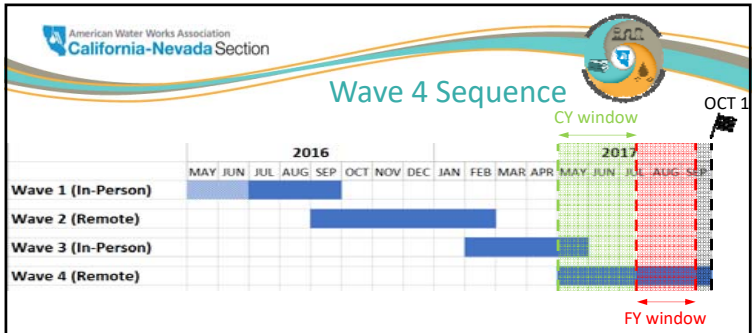
Wave 4 Sequence



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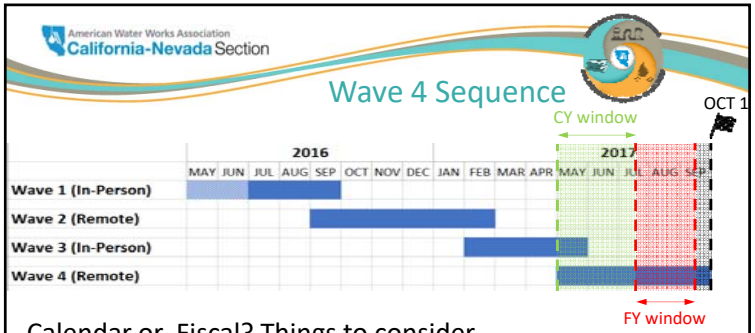

Calendar or Fiscal? Things to consider.

1) Time needed to gather complete audit data, compile audit & SDs, do validation call, follows ups as needed, and submit to DWR.
2) Bi-monthly billing and window for data availability
3) Proximity of audit results to coming budget/planning cycle
4) Reporting timeframe for other reports you submit
5) Affects of *not* prorating BMAC when CY vs FY

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Supporting Documents

REQUIRED	SUPPLEMENTAL
❑ Volume from Own Sources *broken down by month and meter*	❑ Customer Meter Inaccuracy derivation
❑ Water Imported *broken down by month and meter*	❑ Average Operating Pressure derivation
❑ Water Exported *broken down by month and meter*	❑ Customer Retail Unit Cost derivation
❑ Supply Meter Testing	❑ Variable Production Cost derivation
❑ Volume of Water Sold *broken down by month and charge code*	❑ System Schematic *showing locations of Supply and Export Meters*

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Changes from Wave 2 audit to Wave 4 audit?

More or less availability of information and supporting documents

Changed understanding from utility staff and their articulation of answers to the interview questions

Changed practices from wave 2 to wave 4

Additional guidance on DVG

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WAVE 4

1 2 3 4

May 2017 - September 2017

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WAVE 4

www.northamericanwaterloss.org

SAVE THE DATE
December 3 - 5, 2017
Paradise Point Resort · San Diego, CA
Presented by: California-Nevada Section
In cooperation with the American Water Works Association, the Alliance for Water Efficiency and the NAWL 2017 Conference Planning Committee.

SPRING CONFERENCE
APRIL 10-13, 2017
Disneyland Hotel
Anaheim, CA
California-Nevada Section

ANNUAL FALL CONFERENCE
OCTOBER 23-26, 2017
Atlantis Casino Resort
Reno, NV
California-Nevada Section

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Next Steps in Water Auditing

Interpreting Water Audit Results

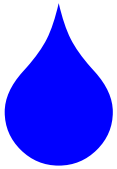
Interpreting Results

- ✓ Complete Water Audit
- ✓ Supporting Documentation Compiled
- ✓ Level 1 Validation

informed next steps on water loss assessment and intervention

Water Audit Results

volumes values validity



next steps must take all of these insights into account

Accuracy & the Water Audit

Data Validity Grades

- qualify the source of data for each input
- describe instrument maintenance and testing, data management technologies, and utility review procedures
- a higher data validity score tends to indicate better data

do high DVGs always correspond to accurate audit data?

Accuracy & the Water Audit

accuracy of metering & measurement

accuracy of secondary data storage systems

frequency and depth of data review

querying and compilation of data

accuracy of audit results

examples that may sneak in error…

lag time in billing data

inaccuracy in production meters

overlooked non-potable volumes

SCADA sampling frequency & archiving design

high DVGs possible while these errors persist

Critical Questions

1) Where are the biggest uncertainties in my water audit? How do they impact my results? → *Priority Areas for Data Improvement*

2) What does my water audit tell me, even given those uncertainties? → *Potential for Water Loss Control*

Critical Questions

1) Where are the biggest uncertainties in my water audit? How do they impact my results?

Consider:

- Data Validity Grades and Criteria as a guide
- Audit Team Deliberation!
  remember: DVGs do not describe accuracy

Critical Questions

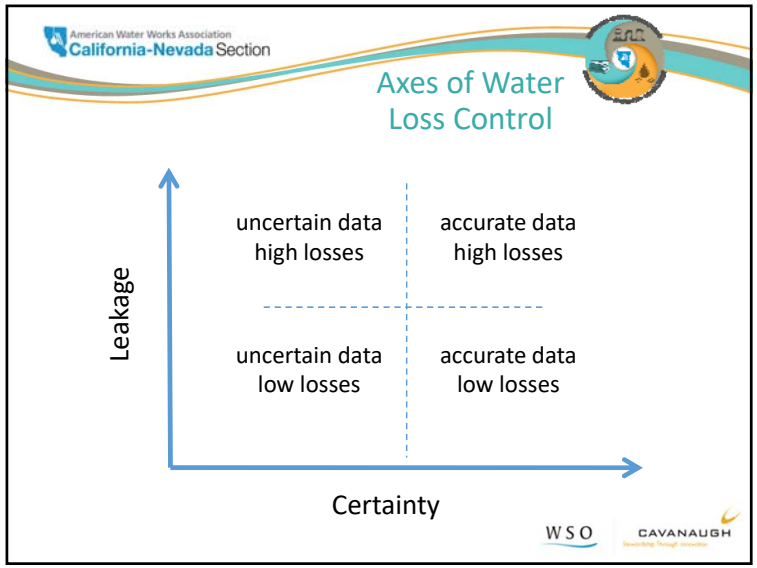
2) What does my water audit tell me, even given uncertainties?

Consider:

- Volumetric Performance Indicators
- Costs of Losses

are there immediate opportunities for savings?

how do these volumes and costs compare to other utility activity?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Axes of Water Loss Control
uncertain data high losses
accurate data high losses
uncertain data low losses
accurate data low losses
Leakage
Certainty
WSO
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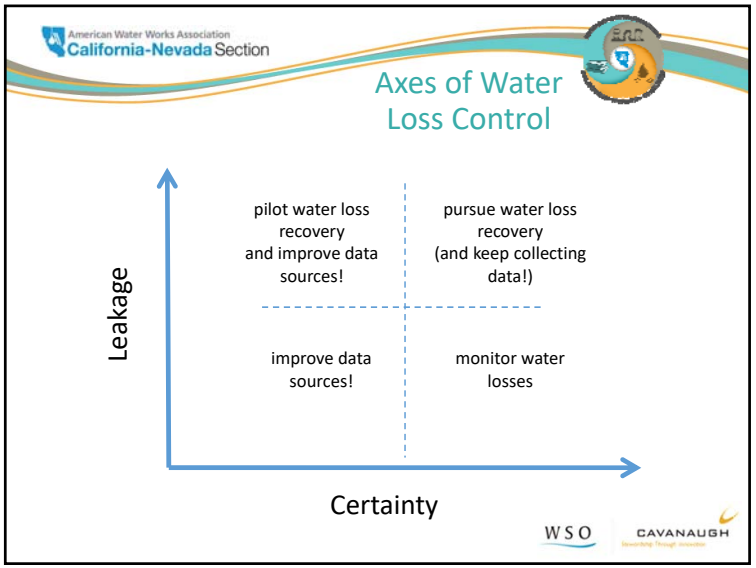
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Axes of Water Loss Control
pilot water loss recovery and improve data sources!
pursue water loss recovery (and keep collecting data!)
improve data sources!
monitor water losses
Leakage
Certainty
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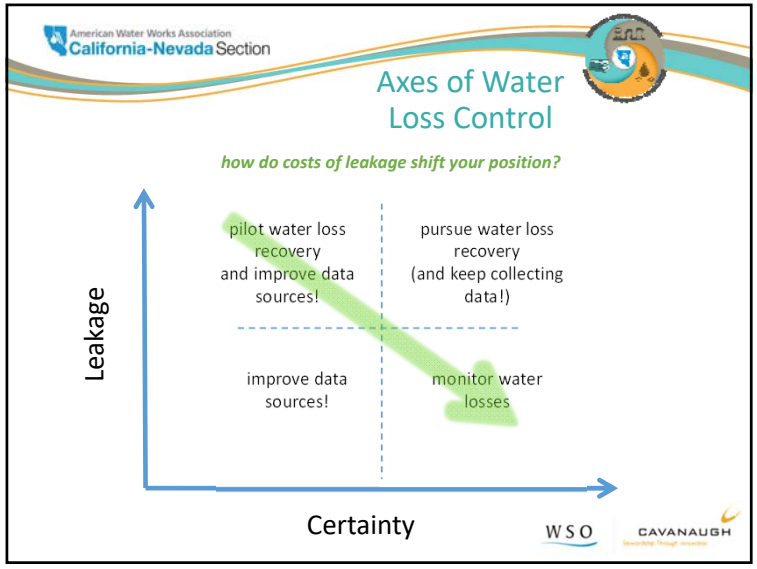
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Axes of Water Loss Control
how do costs of leakage shift your position?
pilot water loss recovery and improve data sources!
pursue water loss recovery (and keep collecting data!)
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Leakage
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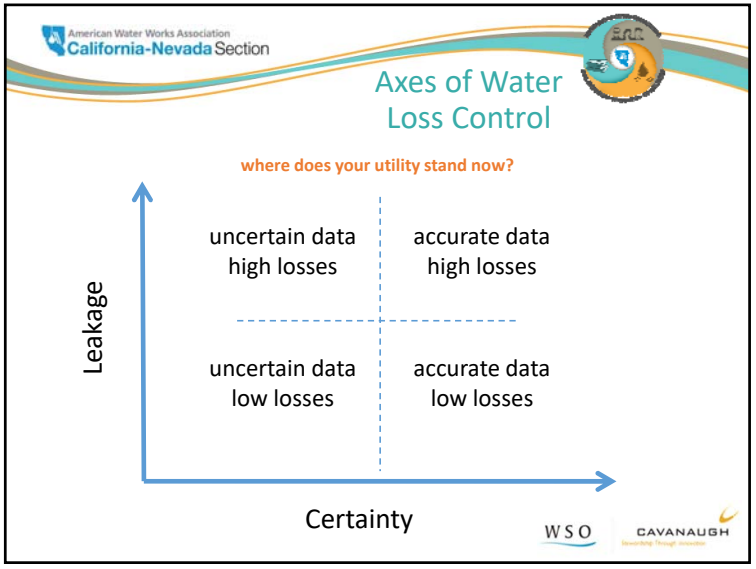
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Axes of Water Loss Control
where does your utility stand now?
uncertain data high losses
accurate data high losses
uncertain data low losses
accurate data low losses
Leakage
Certainty
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Wave 3 Workshop

LUNCH!

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Next Steps in Water Auditing

Supply Meter Testing

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Supply Metering

High flowrate applications

Venturi, Orifice, Magnetic, Ultrasonic

Medium, low flowrate applications

Turbine, Propeller, Positive Displacement

36-inch Venturi Meter
(Source: Primary Flow Control)

60-inch magnetic flowmeter being installed in Philadelphia, PA

Insertion magnetic flowmeter in use on a 30-in. pipeline in Birmingham, Al

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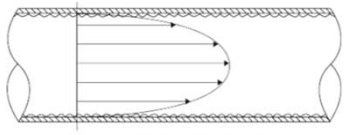
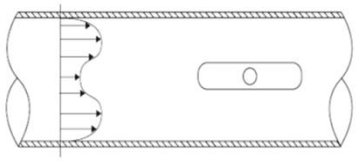
Basic Pipeline Hydraulics

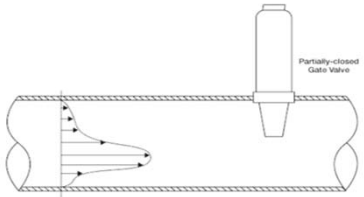
(Source AWWA M36 Publication, 4th Ed.)



Parabolic velocity profile with rough interior wall
This bullet-shaped profile is typical of many older pipelines that remain in service



Velocity profile skewed by butterfly valve located closely downstream



Velocity profile is shifted due to downstream flow obstruction

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Proper Meter Siting

Flowmeter Type	Recommended Lengths of Straight Pipe* (stated in terms of number of upstream pipe diameters for the given metering application)
Venturi	4–10 diameters—depending on the type of any flow-disturbing obstruction in the pipeline
Orifice	5 diameters
Flow tube	4–10 diameters—depending on the type of any flow-disturbing obstruction in the pipeline
Pitot tube	10 diameters
Propeller	5 diameters
Turbine	25 to 30 diameters
Turbine (with flow-straightening element)	10 diameters
Magnetic	5 diameters
Ultrasonic (Doppler shift)	7–10 diameters
Ultrasonic (pulse transmission†)	7–10 diameters (and 5 diameters downstream)

*Information is based on engineering judgment and conservative best practice observed in the water industry by AWWA Water Loss Control Committee members (Source: AWWA M36 Publication, 4th Ed.)

†Includes transit time flowmeters

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Proper Meter Siting

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Proper Meter Siting

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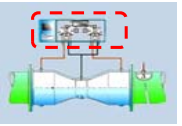
What Constitutes a Meter?

Primary Device: Measuring Element

Conducts the measurement

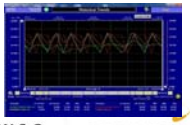
Secondary Device: Register, Transmitter

Converts, communicates the measurement



Tertiary Device: Remote Database

Records, archives the measurement



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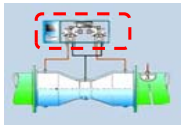
Accuracy Testing v. Calibration

Primary Device: Accuracy Testing

Independent measurement for comparison

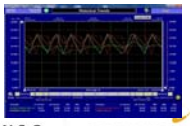
Secondary Device: Calibration

Checks alignment of primary measurement to register and signal output



Tertiary Device: Calibration

Checks alignment of secondary signal to SCADA output



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Supply Meter Testing

Insertion type

Clamp-on

Comparative apparatus

Volumetric displacement

Factory bench test

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Supply Meter Testing

Insertion type

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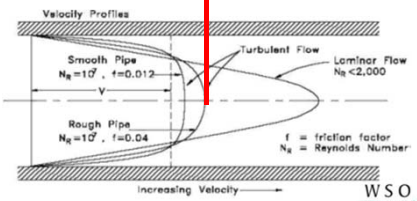
Supply Meter Testing

Insertion type



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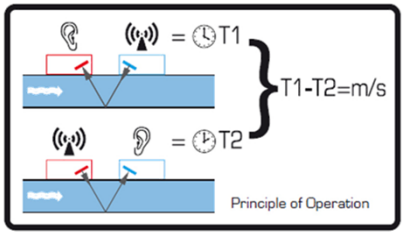
Supply Meter Testing

Clamp-on



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Supply Meter Testing

Clamp-on (ultrasonic)

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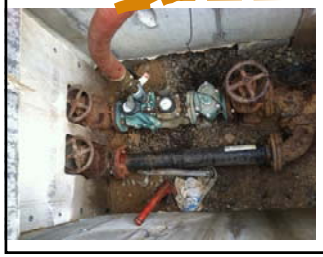
Supply Meter Testing

Comparative apparatus



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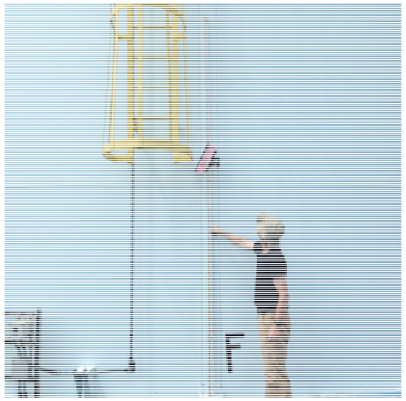
Supply Meter Testing

Volumetric displacement



Reservoir or clearwell adjacent to a water treatment plant

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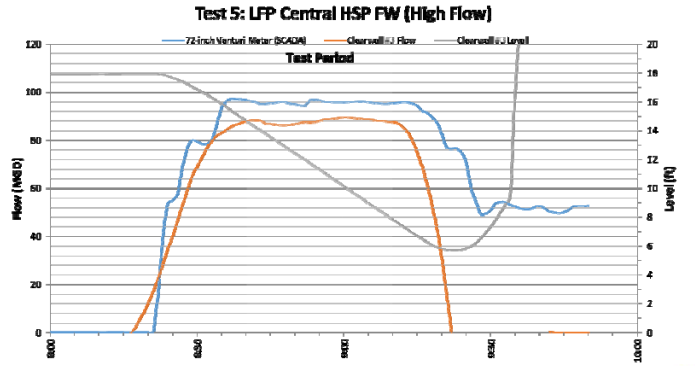
Drawdown Test



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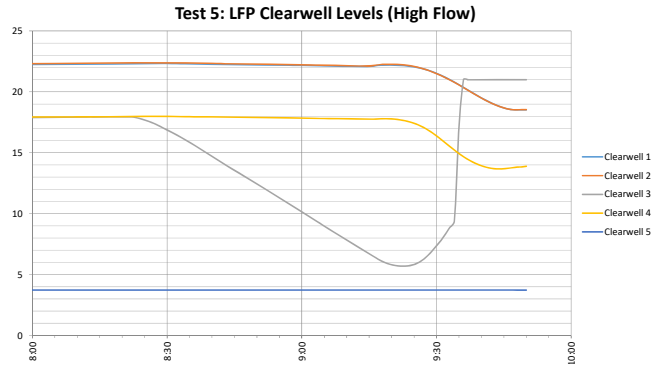
Clearwell Levels During Test



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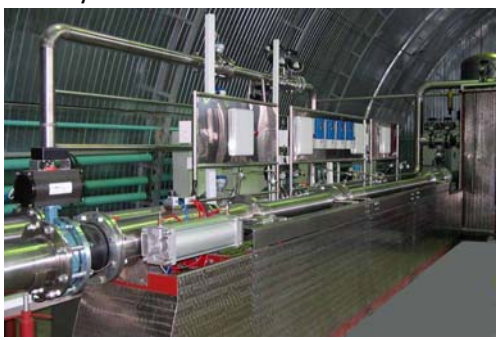
Supply Meter Testing

Factory bench test



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Supply Meter Testing

Factory bench test

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Supply Meter Testing

Other considerations

- Flow rates
- Test location (if insertion or clamp-on)
- Test duration

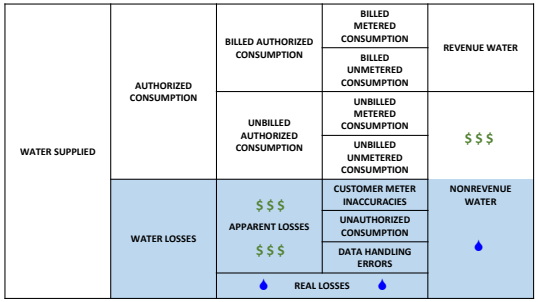
Summary

Method	Advantages	Limitations
Insertion type 	Minimize the unknowns by verifying the flow condition and inside area of the pipe, can make this a very reliable method No interruption to operations	Requires a good test site! Lower test flowrates can affect uncertainty Specialized equipment and expertise required
Clamp-on 	Easier to do, no tap required No interruption to operations	Requires a good test site! Signal distortion depending on pipe material can affect accuracy, and there's no verification of flow conditions via flow profile or of inner diameter
Comparative apparatus 	More control over the flow condition and the test reliability	Typically only practical for smaller line applications Supply is interrupted during test
Volumetric displacement 	Can be reliable method Potentially done internally and frequently	Requires a reservoir nearby, reliable field verification of reservoir geometry, including internal components (baffles etc) and all associated plumbing/valves Level sensing must be calibrated and reliable Production is typically interrupted during test
Factory bench test 	Get to test it under ideal conditions	Only tested under ideal conditions! Not practical for larger meters Meter is out of service for test

Next Steps in Water Auditing

Customer Meter Testing Programs

Understanding Water Losses



Total Water Loss Volume … What's Next?

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Understanding Water Losses

TOTAL WATER LOSS

Apparent Losses

Real Losses

we start with estimation of Apparent Loss

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Goals of Meter Testing in Water Loss Control

- Study accuracy of the meter stock
- Calculate an Apparent Loss volume* due to metering inaccuracy
- Inform proactive management of meter stock's accuracy

in the Water Balance, our understanding of Apparent Losses directly impacts our understanding of Real Losses

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Small Meter Testing Programs

1. Design Meter Test Sample
2. Test Meters
3. Analyze & Apply Results

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Small Meter Testing Programs

1. Design Meter Test Sample

- Representative and random meter sample → *remember our goal is to appreciate the accuracy of the **whole population***
- What sample size is big enough?

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Small Meter Testing Programs

2 Test Meters

- Careful with meter transport
- Test at low, medium, and high flows
- Document thoroughly
  - include reference volume, testing flow rate, meter totalizer reads, all meter information
  - compile data in analysis-friendly format

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Small Meter Testing Program

3 Analyze & Apply Test Results

- Organize all test results
- Analyze accuracy findings *
- Consider confidence limits
- Calculate Apparent Loss Volumes

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Small Meter Testing Program

3 Analyze & Apply Test Results

Accuracy Results Analysis Considerations

- Averaging across flow rate results
  - time-weighting
  - volume-weighting and consumption profiling
- Handling stuck meters

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Analyzing Results

example

Meter Size	Meter Population	Test Sample Size	Volume-Weighted Average Accuracy	95% Confidence Limit of Accuracy
5/8”	13,548	66	92.0%	4.0%
3/4”	1,392	10	98.5%	0.4%
1”	2,145	20	96.9%	2.3%
1-1/2”	311	5	94.0%	3.8%
2”	391	13	97.6%	1.7%

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Analyzing Results
example

Calculating Apparent Losses:
what are the volumetric impacts of inaccuracy?

Meter Size	Volume Recorded During Audit (MG)	Volume-Weighted Average Accuracy	Apparent Losses During Audit (MG)
5/8"	691.53	92.0%	60.13
3/4"	94.10	98.5%	1.43
1"	314.74	96.9%	10.07
1-1/2"	133.96	94.0%	8.55
2"	295.89	97.6%	7.28

the more consumption, the more important accuracy!

Small Meter Testing Takeaways

- Value of random sampling
- Average across different flow rate results
- Add layer of consumption to calculate Apparent Losses due to meter inaccuracy

---

- Appreciate spread of results, confidence limits
- Tread carefully re: correlations
- Continue to test for more insight

Large Meter Testing

- Fewer, more important meters!
- Individual assessment
- Prioritize by consumption
- Flow profiling is key

1. Design Meter Test Sample
2. Test Meters
3. Analyze & Apply Results

Next Steps in Water Auditing

Leakage & Pressure Management

After the Water Balance…

Complete AWWA Water Balance:	Remaining Assessments:
✓ Volume of Apparent Losses	→ Where are losses occurring?
✓ Volume of Real Losses	→ What types of leakage?
✓ Performance Indicators	→ Cost-effective strategies?
✓ Data Validity Score	
✓ TAP Preparation	

Why Component Analysis?

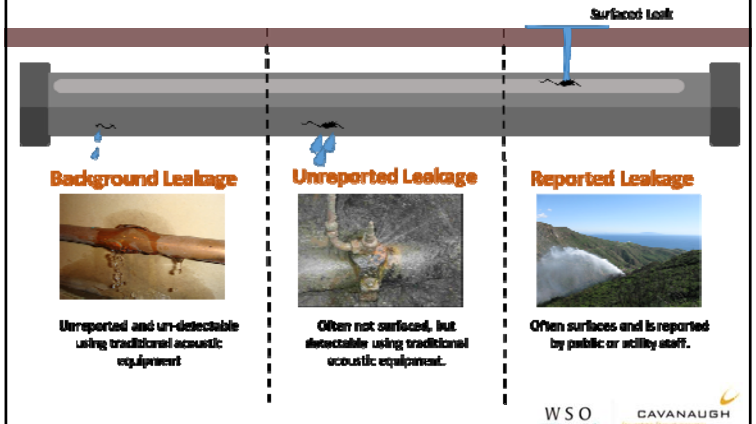
Different types of leakage

should be addressed

with different intervention strategies!

≠ (eureka!)

Types of Leakage



Background Leakage

drips and seeps at joints and fitting

- can't be detected with traditional acoustic leak detection
- depends on infrastructure condition
- very pressure sensitive

often a significant portion of total Real Losses!

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Reported Leakage

leakage that the public and staff discover and report

- usually visible
- usually destructive
- volume of loss depends on response time

often a smaller portion of total Real Losses than expected!

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Unreported Leakage

leakage that the utility can discover with proactive leak detection

- ongoing, moderate flow rate
- can be detected with traditional acoustic leak detection
- depends on leak detection survey frequency

often cost-effective to recover!

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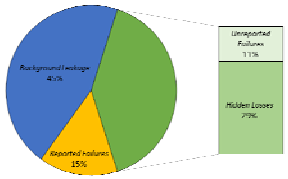
Component Analysis of Real Losses

1 AUDIT SOFTWARE

2 COMPONENT ANALYSIS MODEL



WATER AUDIT → TOTAL REAL LOSSES → REPORTED / UNREPORTED / BACKGROUND

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Component Analysis Model

For **how long** do leaks flow?

At **what rate** do leaks flow?

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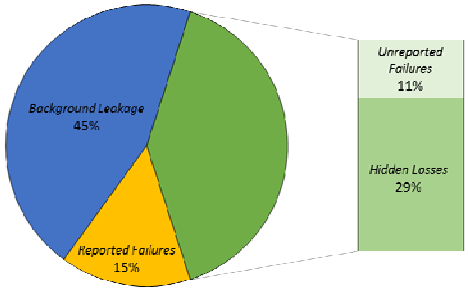
Example Real Loss Profile



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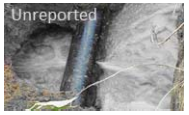
The Toolbox

Background Leakage
Unreported and un-detectable using traditional acoustic equipment.
Tools
Pressure Management
Main & service replacement
Reduction in number of joints/fittings

Unreported Leakage
Often does not surface but is detectable using traditional acoustic equipment.
Tools
Pressure Management
Main & service replacement
Reduction in number of joints/fittings
Proactive Leak Detection

Reported Leakage
Often surfaces and is reported by public or utility workers.
Tools
Pressure Management
Main & service replacement
Optimized repair time



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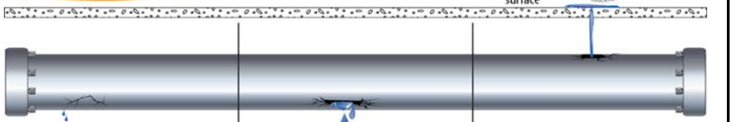
Which Tools?



Background Leakage
Unreported and un-detectable using traditional acoustic equipment.
Tools
Pressure Management
Main & service replacement
Reduction in number of joints/fittings

Unreported Leakage
Often does not surface but is detectable using traditional acoustic equipment.
Tools
Pressure Management
Main & service replacement
Reduction in number of joints/fittings
Proactive Leak Detection

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Often surfaces and is reported by public or utility workers.
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Main & service replacement
Optimized repair time

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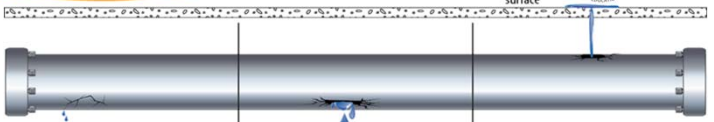
Which Tools?



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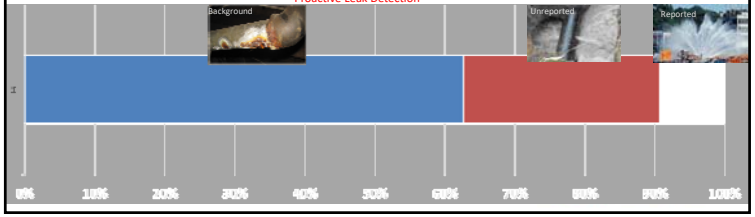

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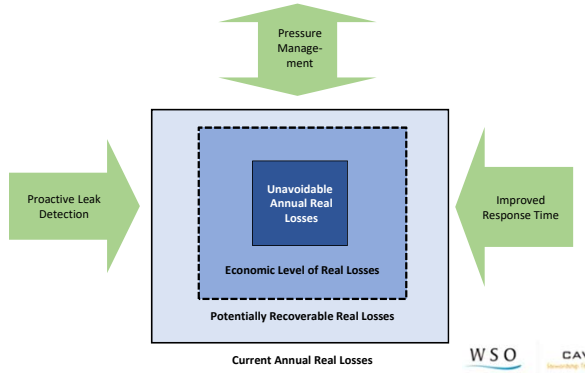
Now What?

Once you have a complete Component Analysis,

you can design a water loss control program.



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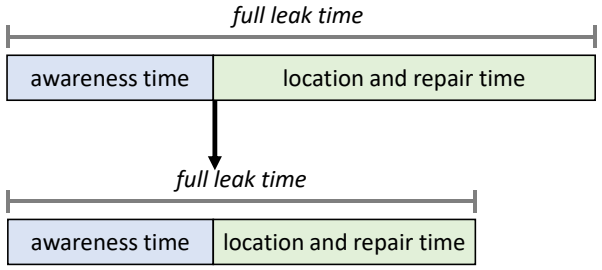
Response Time Improvement



faster, better repairs reduce leakage volume

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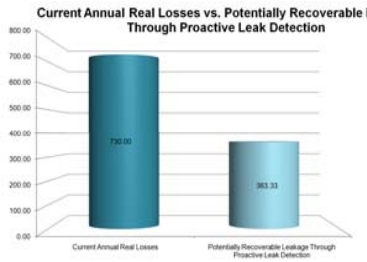
Proactive Leak Detection



determine the

economic intervention frequency

(how often and how extensively you sound for leaks)

to recover **Unreported Hidden Leakage**

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Rate of Rise of Leakage

Proactive leak detection combats the **Rate of Rise of Leakage**

(the natural increase of leakage in a system)

by surveying for leaks at an *optimized frequency*

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Pressure Management

Pressure – Leakage Relationship

- *Pressure direct affects leakage flow rates*
- *Pressure directly affects frequency of breaks*
- *See the photos of a leak on the next three slides*

Photos & Pressure Management Slides courtesy of Kenneth J. Brothers, Commissioner of Public Works, Niagara Region, Canada & Allan Lambert, ILMSS, UK (2009)

Pressure Impacts

- Leakage
- Energy Costs
- Catastrophic vs. routine repairs
- Fewer customer service outages and plumbing breaks
- Deferred Asset Replacement

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Low Pressure

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Mid Pressure

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High Pressure

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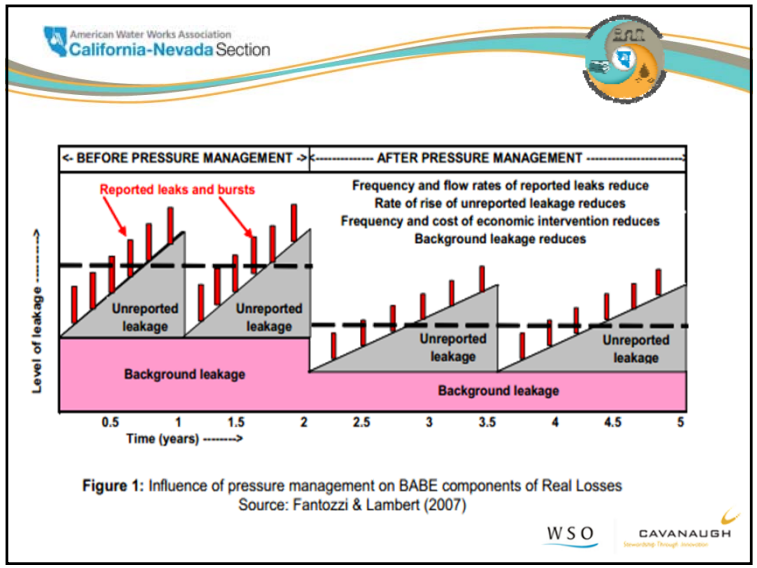
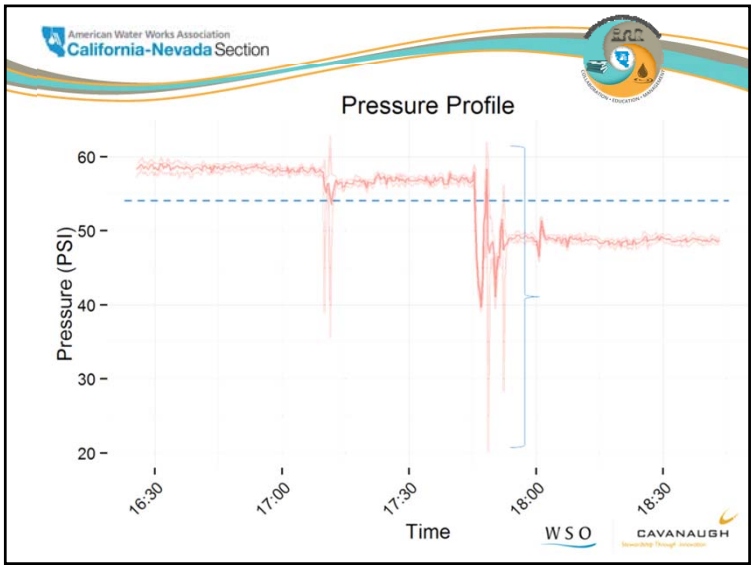
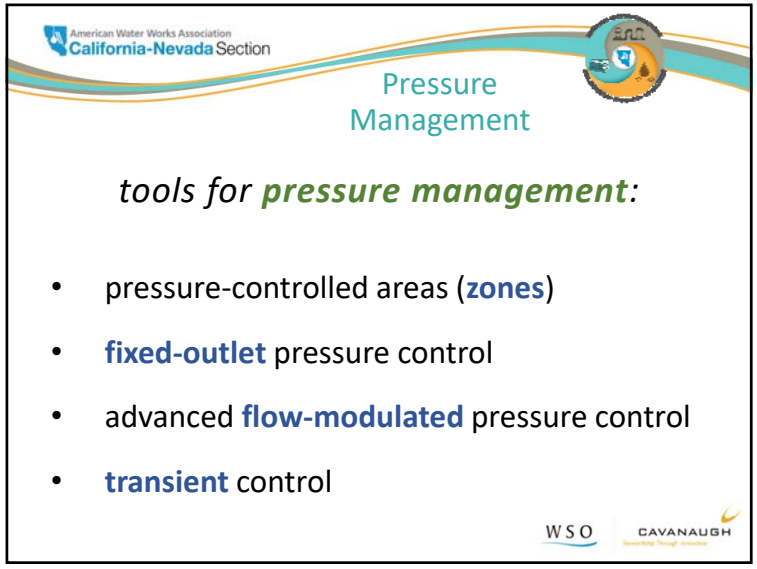
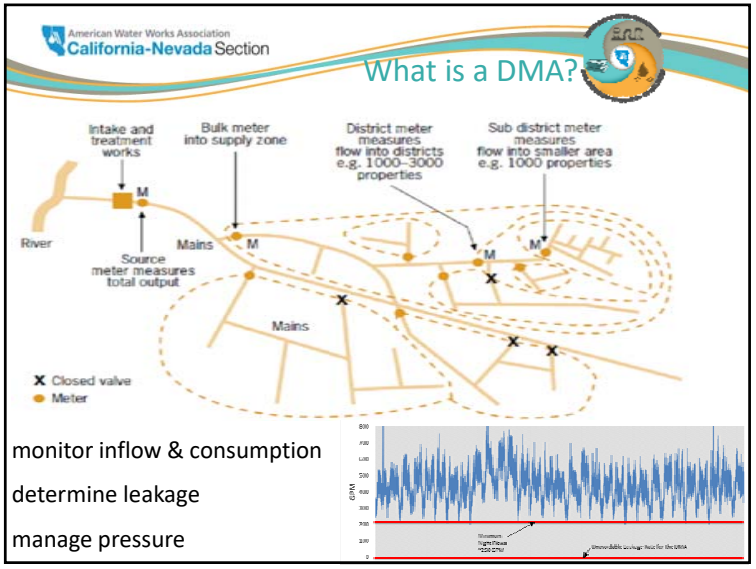
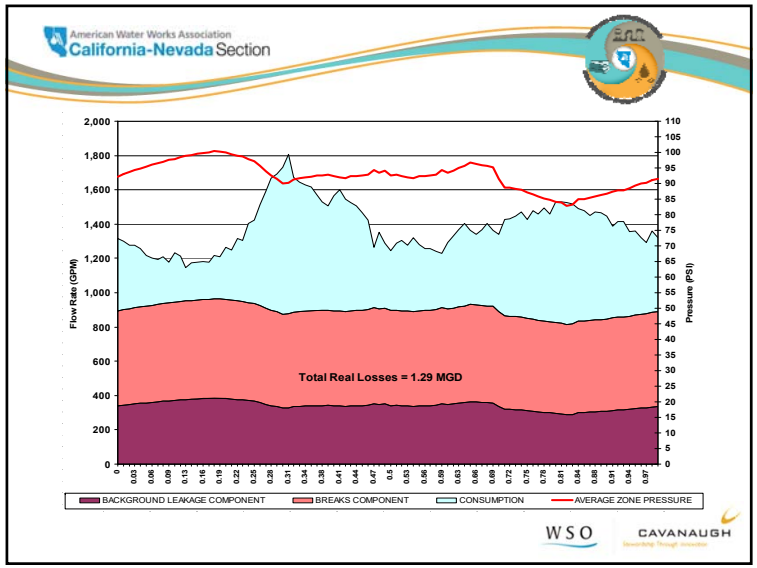


Figure 1: Influence of pressure management on BABE components of Real Losses
Source: Fantozzi & Lambert (2007)





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Flow Rate (GPM)
Pressure (PSI)
Total Real Losses = 1.29 MGD
BACKGROUND LEAKAGE COMPONENT
BREAKS COMPONENT
CONSUMPTION
AVERAGE ZONE PRESSURE
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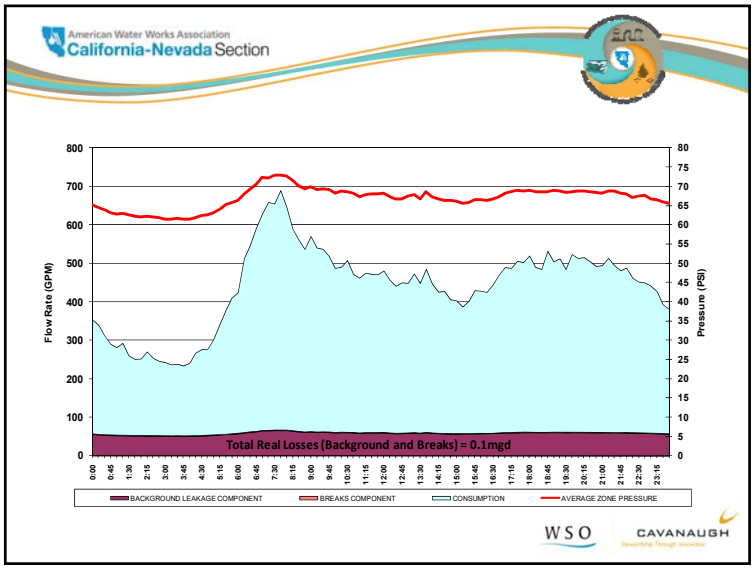
American Water Works Association
California-Nevada Section
Flow Rate (GPM)
Pressure (PSI)
Total Real Losses (Background and Breaks) = 0.1mgd
BACKGROUND LEAKAGE COMPONENT
BREAKS COMPONENT
CONSUMPTION
AVERAGE ZONE PRESSURE
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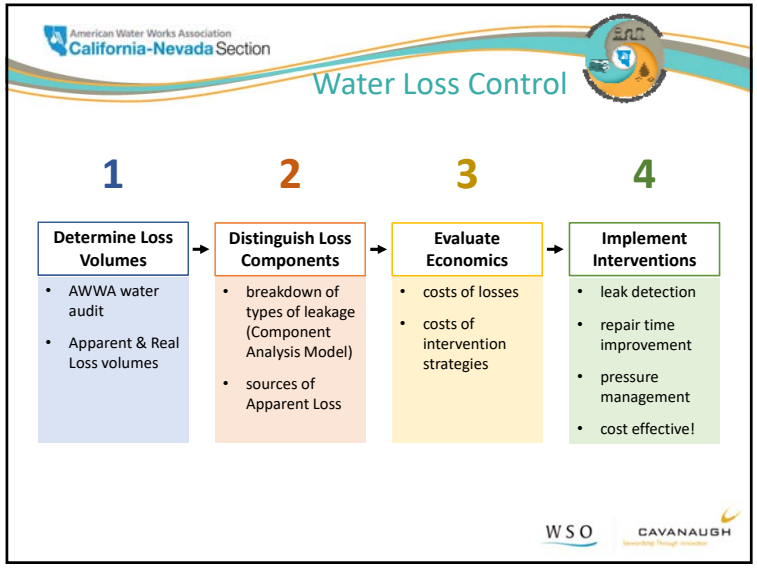
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Water Loss Control
1
2
3
4
Determine Loss Volumes
AWWA water audit
Apparent & Real Loss volumes
Distinguish Loss Components
breakdown of types of leakage (Component Analysis Model)
sources of Apparent Loss
Evaluate Economics
costs of losses
costs of intervention strategies
Implement Interventions
leak detection
repair time improvement
pressure management
cost effective!
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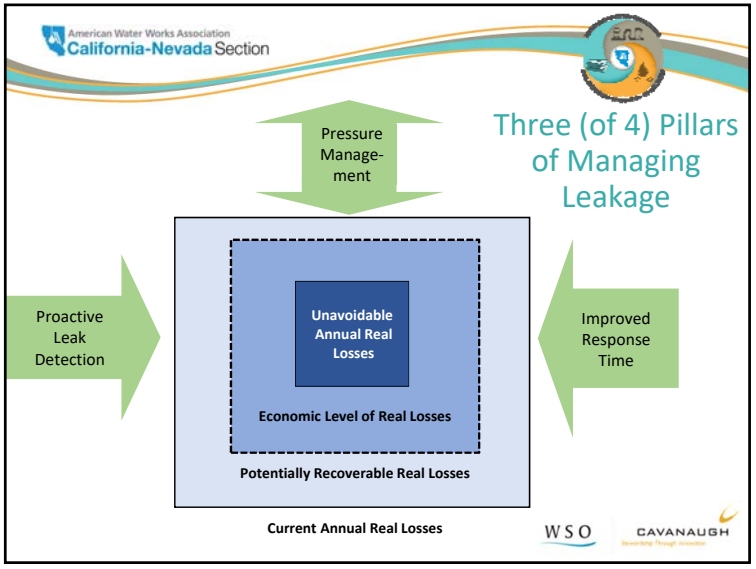
American Water Works Association
California-Nevada Section
Three (of 4) Pillars of Managing Leakage
Pressure Manage-ment
Proactive Leak Detection
Improved Response Time
Unavoidable Annual Real Losses
Economic Level of Real Losses
Potentially Recoverable Real Losses
Current Annual Real Losses
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Next Steps!

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Wave 4 Sequence

Schedule your team's call

Complete & upload your audit (CY16 or FY16/17) and SDs
Reminder: Download a fresh v5.0 of the audit software to compile your Wave 4 audit at www.awwa.org/waterlosscontrol

Wave 4 call + any actions from the session

Get final validation document from PM Team

Submit Level 1 validated water audit package to DWR

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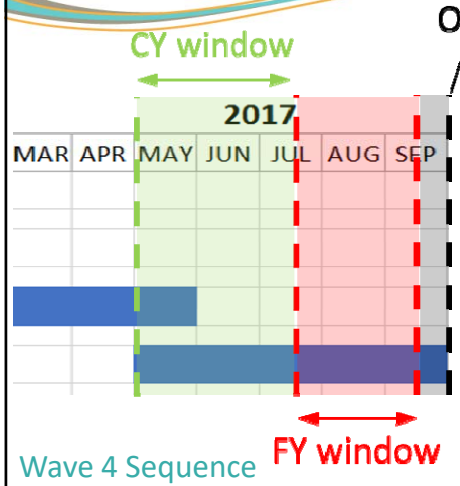


Schedule your team's call

Complete & upload your audit (CY16 or FY16/17) and SDs

Wave 4 call + any actions from the session

Get final validation document from PM Team

Submit Level 1 validated water audit package to DWR

Wave 4 Sequence

WSO CAVANAUGH

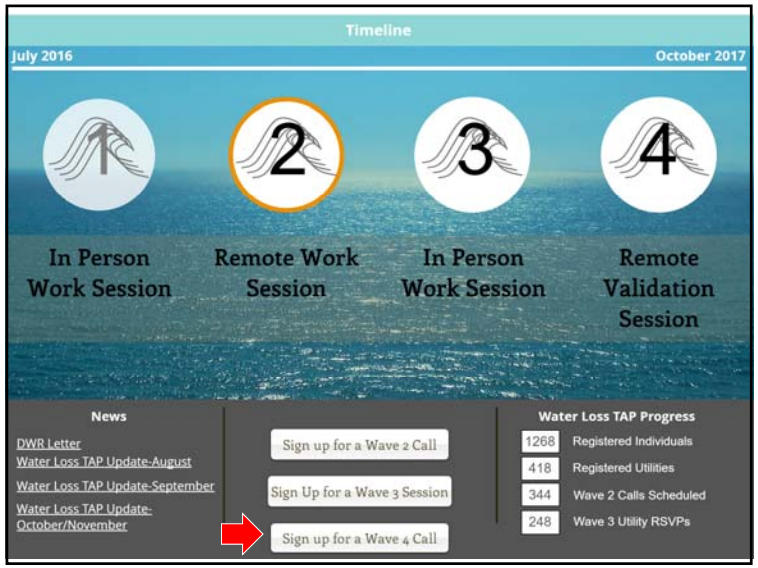
American Water Works Association California-Nevada Section

Wave 4 Sequence

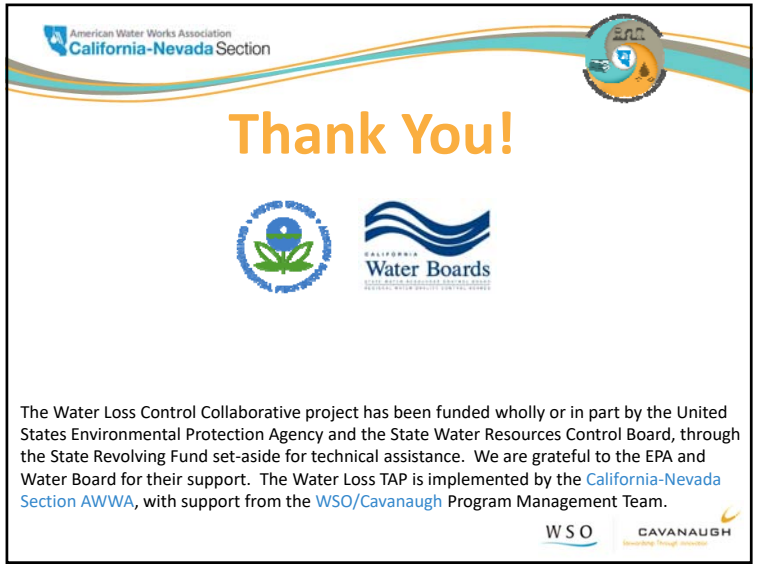
Schedule your team's call
When will the audit & docs be complete?
Complete & upload your audit (CY16 or FY16/17) and SDs
When will your team meet to prep for the call?
Wave 4 call + any actions from the session
When will your team meet post-call for any actions needed?

Get final validation document from PM Team
Submit Level 1 validated water audit package to DWR

WSO CAVANAUGH


Timeline
July 2016
October 2017
2
3
4
In Person Work Session
Remote Work Session
In Person Work Session
Remote Validation Session
News
DWR Letter
Water Loss TAP Update-August
Water Loss TAP Update-September
Water Loss TAP Update-October/November
Sign up for a Wave 2 Call
Sign Up for a Wave 3 Session
Sign up for a Wave 4 Call
Water Loss TAP Progress
1268 Registered Individuals
418 Registered Utilities
344 Wave 2 Calls Scheduled
248 Wave 3 Utility RSVPs


American Water Works Association
California-Nevada Section
WAVE 4
www.northamericanwaterloss.org
NORTH AMERICAN WATER LOSS 2017
SAN DIEGO, CALIFORNIA
SAVE THE DATE
December 3 - 5, 2017
Paradise Point Resort · San Diego, CA
Presented by: California-Nevada Section
In cooperation with the American Water Works Association, the Alliance for Water Efficiency and the NAWL 2017 Conference Planning Committee.
SPRING CONFERENCE
APRIL 10-13, 2017
Disneyland Hotel
Anaheim, CA
ANNUAL FALL CONFERENCE
OCTOBER 23-26, 2017
Atlantis Casino Resort
Reno, NV
WSO
CAVANAUGH


American Water Works Association
California-Nevada Section
Thank You!
Water Boards
The Water Loss Control Collaborative project has been funded wholly or in part by the United States Environmental Protection Agency and the State Water Resources Control Board, through the State Revolving Fund set-aside for technical assistance. We are grateful to the EPA and Water Board for their support. The Water Loss TAP is implemented by the California-Nevada Section AWWA, with support from the WSO/Cavanaugh Program Management Team.
WSO
CAVANAUGH