

Welcome to the Webinar

- Webinar will be 60 minutes in length with time for questions.
- Audio is through your telephone or computer microphone & speakers.
- The webinar phone line will be muted during the presentation because we are recording.
- Questions can be typed in throughout the webinar and will be answered at the end by the speakers.

Alliance
for Water
Efficiency

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Purpose of This Webinar

- AWE is active in water loss work and considers it a priority
- Wanted to make it part of the Innovations in Efficiency Showcase Series, which showcases the work of AWE members in new trends, emerging technologies, and innovative approaches that are changing the field of water management
- Programs to recover non-revenue water help utilities to improve resiliency against a backdrop of rising price tags for infrastructure improvements and uncertain water availability
- Emerging field of water audit validation and how this new best practice is conducted in an increasing number of utility systems

Alliance
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Efficiency

AWE: Innovations in Efficiency Showcase

The Emerging Field of Water Audit Validation



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Water Audits 101

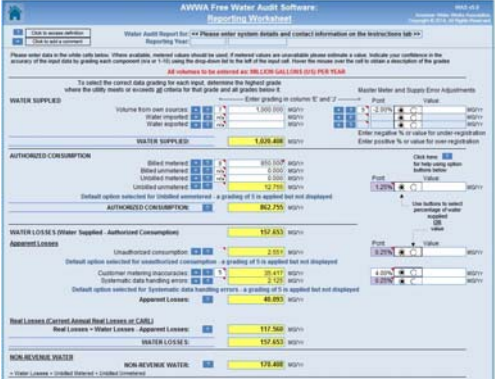
what are our distribution system losses?

WATER SUPPLIED	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION	REVENUE WATER
			BILLED UNMETERED CONSUMPTION	
		UNBILLED AUTHORIZED CONSUMPTION	UNBILLED METERED CONSUMPTION	\$\$\$
		UNBILLED UNMETERED CONSUMPTION		
		CUSTOMER METER INACCURACIES	NONREVENUE WATER	
	WATER LOSSES	\$\$\$ APPARENT LOSSES		UNAUTHORIZED CONSUMPTION
\$\$\$		DATA HANDLING ERRORS		
💧 REAL LOSSES		💧		

- *Mass balance – process of elimination*
- *Account for all water*
- *Accuracy matters!*

Water Audits 101

- Goals of Top Down Water Audit: **Assess Volumes of Water Loss**
- **Water Audit Software:**
 - collects water balance volumes, cost data, and system data
 - considers data validity
 - determines total volumes of water losses
 - Apparent Losses
 - Real Losses
 - Non-Revenue Water
 - calculates performance indicators



The screenshot shows the 'APWA Free Water Audit Software Reporting Worksheet'. It displays various water audit metrics in MG/DY (Million Gallons per Day). Key values include:

- WATER SUPPLIED: 1,626,488 MG/DY
- AUTHORIZED CONSUMPTION: 862,755 MG/DY
- WATER LOSSES (Water Supplied - Authorized Consumption): 763,733 MG/DY
- WATER LOSSES (Water Supplied - Real Losses - Apparent Losses): 157,853 MG/DY
- NON-REVENUE WATER: 178,488 MG/DY

Water Audit Results Across the Country

- *Water Research Foundation 4372B*
- many audits are **unrealistic**
 - more training (ie GA, TN) produces fewer unrealistic audits
 - even level 1 validation doesn't fully eliminate unrealistic audits


	CA	DRBC	GA	TN	TX
total audits	300	517	452	629	2,646
# of unrealistic audits	100	130	74	122	1,065
% of unrealistic audits	33%	25%	16%	19%	40%


sources of uncertainty:

- data source quality (primary measurement or secondary data management)
- methodology (use of the software, selection of data)


Levels of Validation

Different levels of review and investigation to confirm water audit inputs

Self-Reported	Level 1	Level 2	Level 3
<ul style="list-style-type: none"> No validation Accuracy and reliability have not been confirmed 	<ul style="list-style-type: none"> Examined for inaccuracies evident in summary data and application of methodology Data validity grades assigned to inputs accurately reflect utility 	<ul style="list-style-type: none"> Investigations of raw data and archived reports of instrument accuracy corroborate volumes Best sources of data to inform the water audit have been identified and applied 	<ul style="list-style-type: none"> Bolstered by field tests of instrument accuracy The estimate of Real Losses has been confirmed through pilot leak detection, Component Analysis of Real Losses, and/or minimum night flow analysis.

Project 4639 




Validation in Action!



California Level 1 Water Audit Program: Water Loss TAP

WAVE 1	WAVE 2	WAVE 3	WAVE 4
in-person work session	teleconference work session	in-person work session	teleconference validation session

Georgia Level 1 Water Audit Program

Accuracy in the Water Balance

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

Where does error sneak in!?

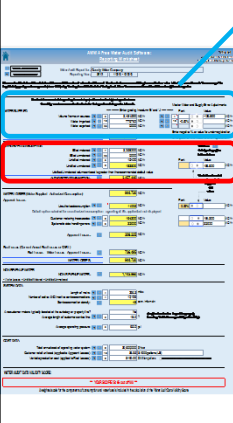
- Primary instrumentation
- Secondary data management, archival, and summary
- Interaction with data and methodology; estimation

inaccuracy & uncertainty in inputs → inaccuracy & uncertainty in results*

* especially for systems with low levels of loss

Accuracy in the Water Balance


the accuracy of our two most important volumes in the water balance makes a big difference!





SYSTEM INPUT VOLUME	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION	REVENUE WATER
		BILLED UNMETERED CONSUMPTION	UNBILLED METERED CONSUMPTION	
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System Input Review


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


#1 – Meter wear 

#2 – Meter location 


#3 – Meter selection 



#4 – Meter programming 

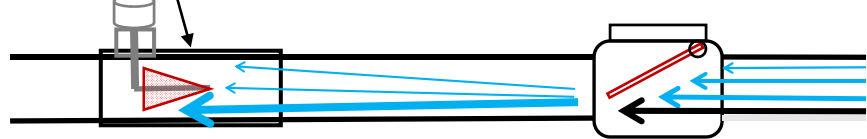
#5 – Flow data archiving 

System Input Review



Accuracy results from MFR test bench: 99.5%

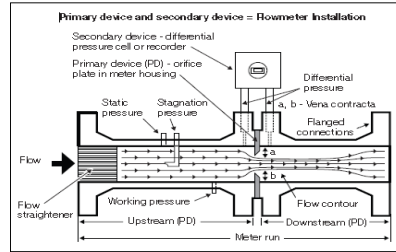
Accuracy results from in-situ test: 142.2%



Courtesy MESCO

System Input Review

- **Flow (Accuracy) Testing** confirms the accuracy of the primary device – the element that measures the flow of water
- **Signal Calibration** confirms the functions of the secondary device – which is a data transfer device, typically a differential pressure cell, chart recorder, or similar device
- Many water utilities regularly calibrate their secondary devices, but do not regularly verify the primary device by regular flow accuracy testing. Thus, inaccuracies can be carried through to reports



Orifice Plate Flowmeter components (Source: AWWA M36 Publication, 4th Ed.)



Bank of Differential Pressure Cells connected to flowmeters (Courtesy of Louisville Water Company)

System Input Review

Flow Data Archiving


- Production flow data should be reviewed every business day for data gaps
- Gaps occur due to:
 - Unplanned interruption: lightning strike, power failure
 - Planned interruption: instrumentation calibration
- Gaps in water flow data should be quantified and added back to the daily total


(Source: AWWA M36 Publication, 4th Ed.)


Example of Water Pumping Data Gaps an		
8/15/2012, hrs	High Service Pumping Rate, mgd actual flow	High Service Pumping Rate, mgd raw recorded data
0:00	8.69	8.69
1:00	8.65	8.65
2:00	8.32	8.32
3:00	8.11	8.11
4:00	7.94	0
5:00	8.02	0
6:00	8.44	0
7:00	8.98	0
8:00	9.34	0
9:00	9.25	0
10:00	9.17	0
11:00	9.12	9.12
12:00	9.27	9.27
13:00	9.22	9.22
14:00	9.08	9.08
15:00	8.99	8.99
16:00	9.14	9.14
17:00	9.18	9.18
18:00	9.25	9.25
19:00	9.22	9.22
20:00	8.82	8.82
21:00	8.78	8.78
22:00	8.75	8.75
23:00	8.71	8.71
0:00	8.68	8.68
Total	212.43	151.29
Average	8.85	6.30
Difference		2.55


System Input Review


SYSTEM INPUT VOLUME	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION	REVENUE WATER
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REAL LOSSES				




#1 – Meter wear 

#2 – Meter location 

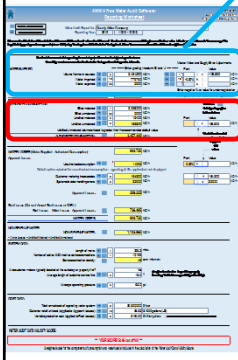
#3 – Meter selection 

#4 – Meter programming 

#5 – Flow data archiving 

Accuracy in the Water Balance


the accuracy of our two most important volumes in the water balance makes a big difference!





SYSTEM INPUT VOLUME	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION	REVENUE WATER
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REAL LOSSES				


Authorized Consumption Review


SYSTEM INPUT VOLUME	AUTHORIZED CONSUMPTION	BILLED AUTHORIZED CONSUMPTION	BILLED METERED CONSUMPTION	REVENUE WATER
		UNBILLED AUTHORIZED CONSUMPTION	BILLED UNMETERED CONSUMPTION	
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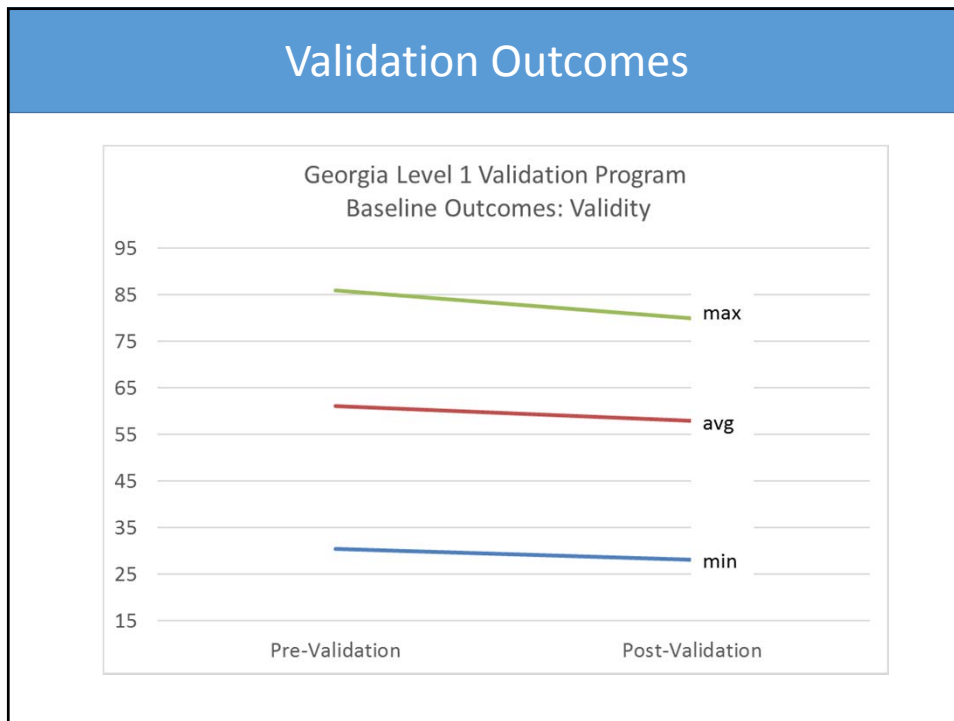


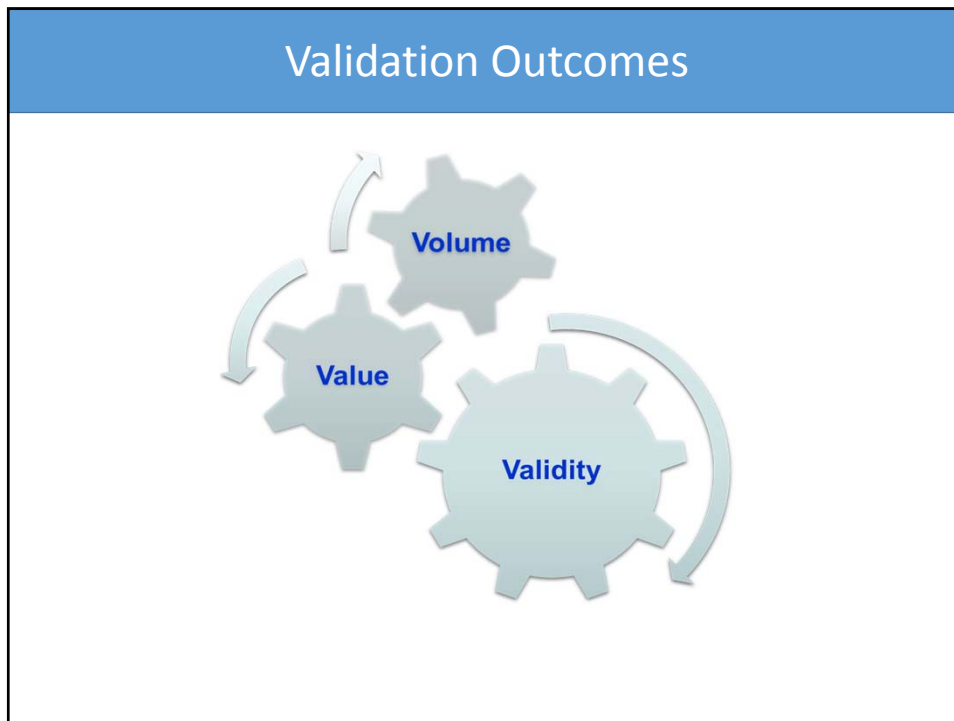
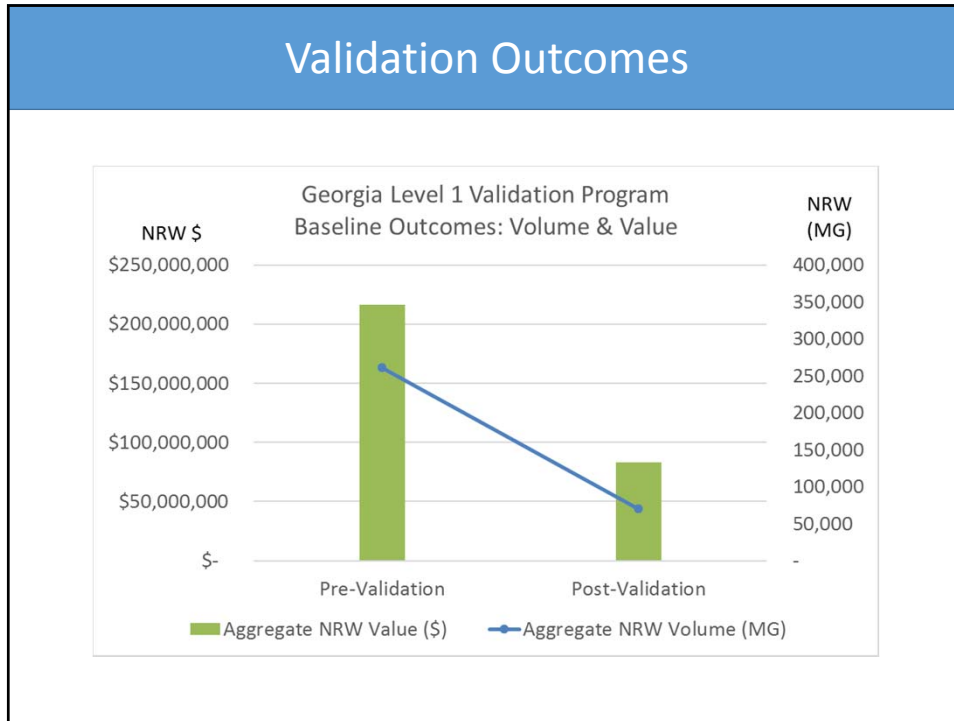
#6 – Redundant volumes 

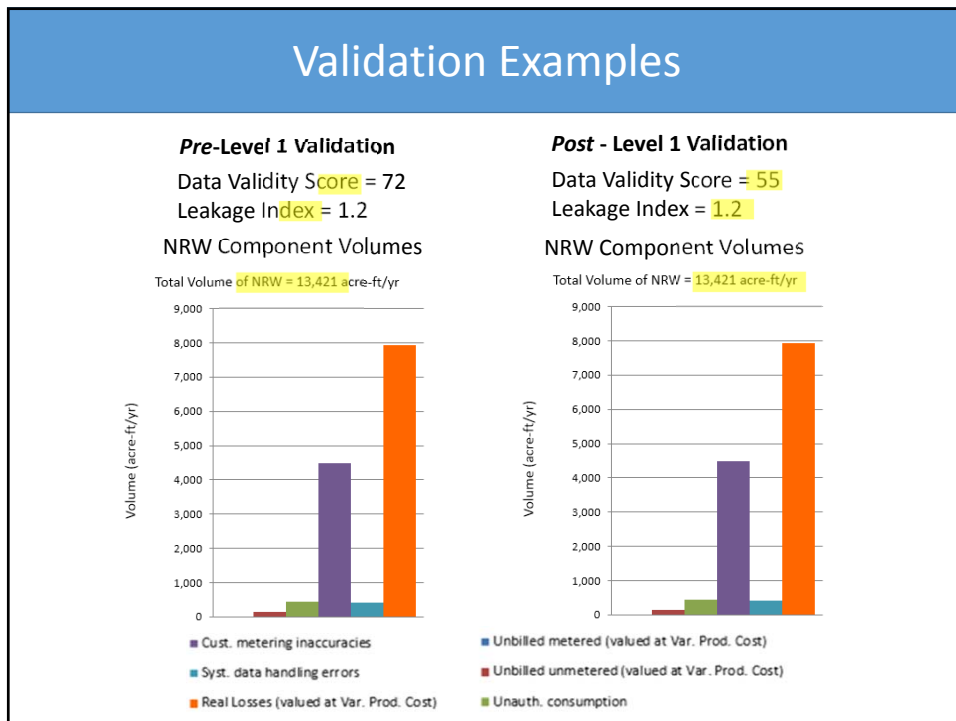
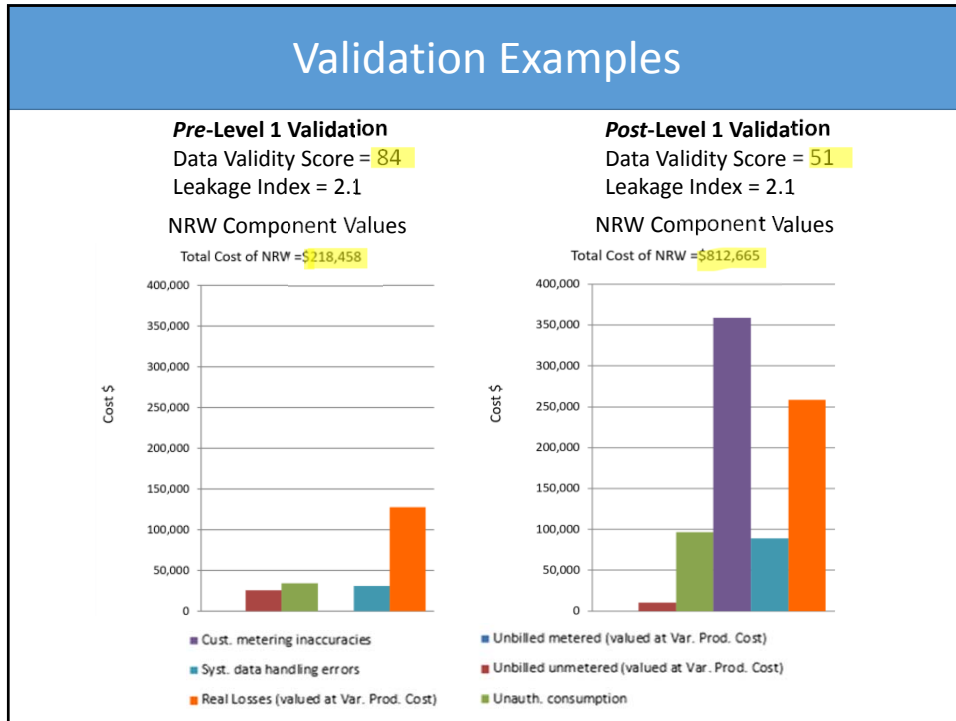
#8 – Missing volumes 

#7 – Non-potable volumes 

#9 – Mismatched timeframes 







Validation Examples

Validation Examples

A summary of your Data Validity Grades. This will provide a solid frame of reference for your Water Audit. A summary of your Data Validity Grades. This will provide a solid frame of reference for your Water Audit.

Comments on Data Validity Grade

Category	Findings	Provided for Water 27
SCADA data	SCADA data is not used to calculate flow	Yes
Flow meters	Flow meters are not used to calculate flow	Yes
Other data	Other data is not used to calculate flow	Yes
Water loss	Water loss is not used to calculate flow	Yes
SCADA data	SCADA data is used to calculate flow	Yes
Flow meters	Flow meters are used to calculate flow	Yes
Other data	Other data is used to calculate flow	Yes
Water loss	Water loss is used to calculate flow	Yes

WSO CAVANAUGH

Value of Validation

1

Discussions
about data
sources & best
practices
unveils so
much

2

Water Audits
benefit from
scrutiny
(internal &
third party!)

3

Accuracy
Paves the Way
for Action!

In Closing...

- Many thanks to our speakers! Have any questions? Type them in and we will answer them now!
- A PDF of the presentation as well as a link to the recorded webinar will be available within a few days.
- Our next webinar will be January 5 at 11:00 Central and will cover Federal Advocacy for Water Efficiency.
- There will also be a webinar in February on the results of our Landscape Peak Reduction Study.
- *Stay tuned!*

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***Thank You for
Attending the
Webinar!***



Alliance for Water Efficiency

To promote the efficient and sustainable use of water

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