WATER AUDIT LEVEL 1 VALIDATION

REDUCING UNCERTAINTY AND IMPROVING WATER LOSS MANAGEMENT

OCTOBER 16, 2024

Delaware River Basin Commission

DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

CAVANAUGH

AGENDA

- Why Water Audit Validation matters
- How the Water Audit Validation is performed
- What the Water Audit Validation
- A tie to leakage and carbon emission reductions

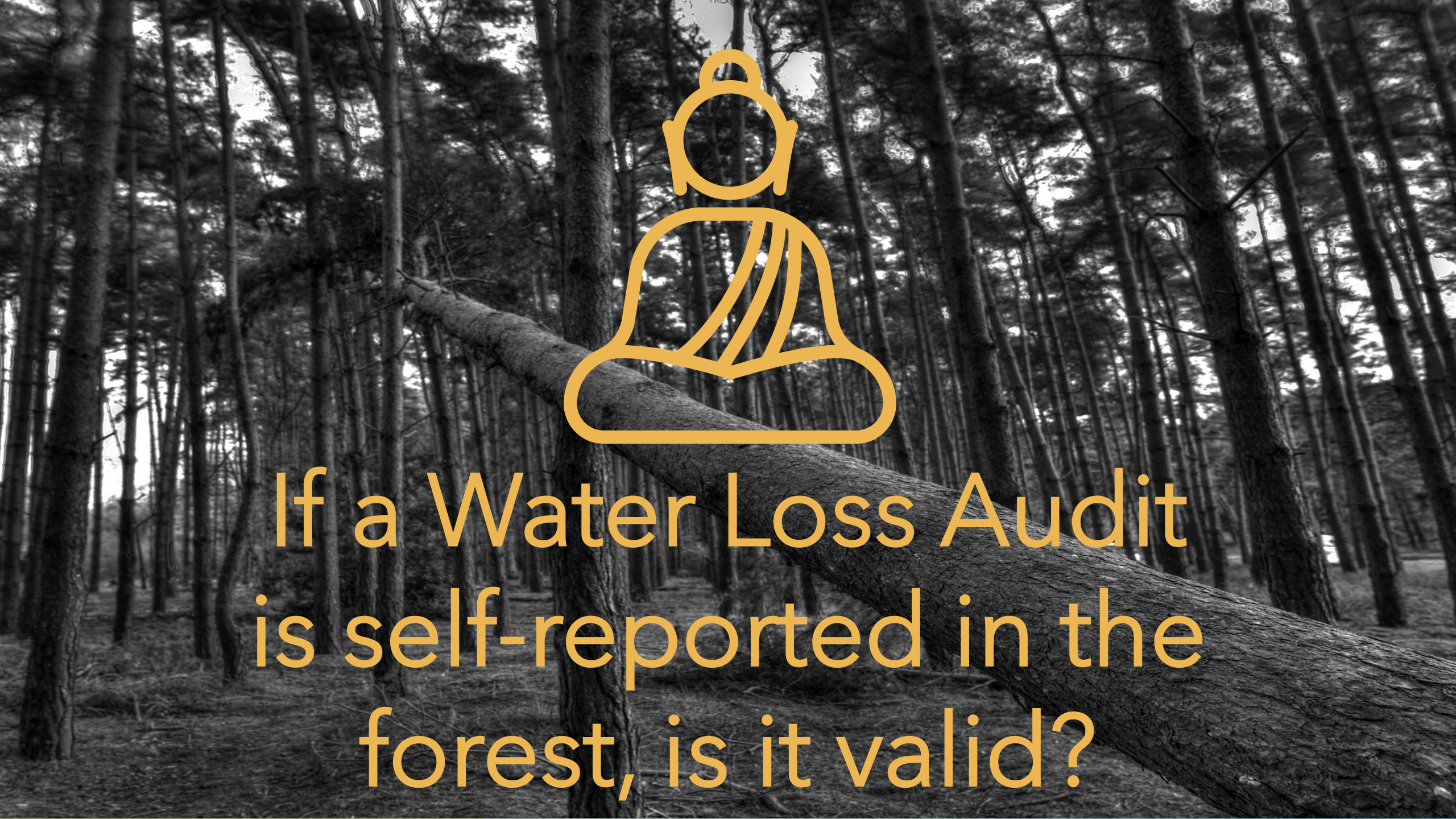
SPEAKERS

Drew Blackwell
drew.blackwell@cavanaughsolutions.com

Relevant Roles:
Secretary, AWWA Water Loss Control Committee
Board Member, Alliance for Water Efficiency
Co-author, *WRF 5057 Level 1 Water Audit Validation Guidance Manual*
Director of Water Efficiency, Cavanaugh

Andrew McCarthy
andrew.mccarthy@cavanaughsolutions.com

Relevant Roles:
Member, IWA Water Loss Specialists Group
Member, American Biogas Council
Co-author, *AWWA Committee Report: Leakage Emissions Initiative*
Business Development Manager, Cavanaugh

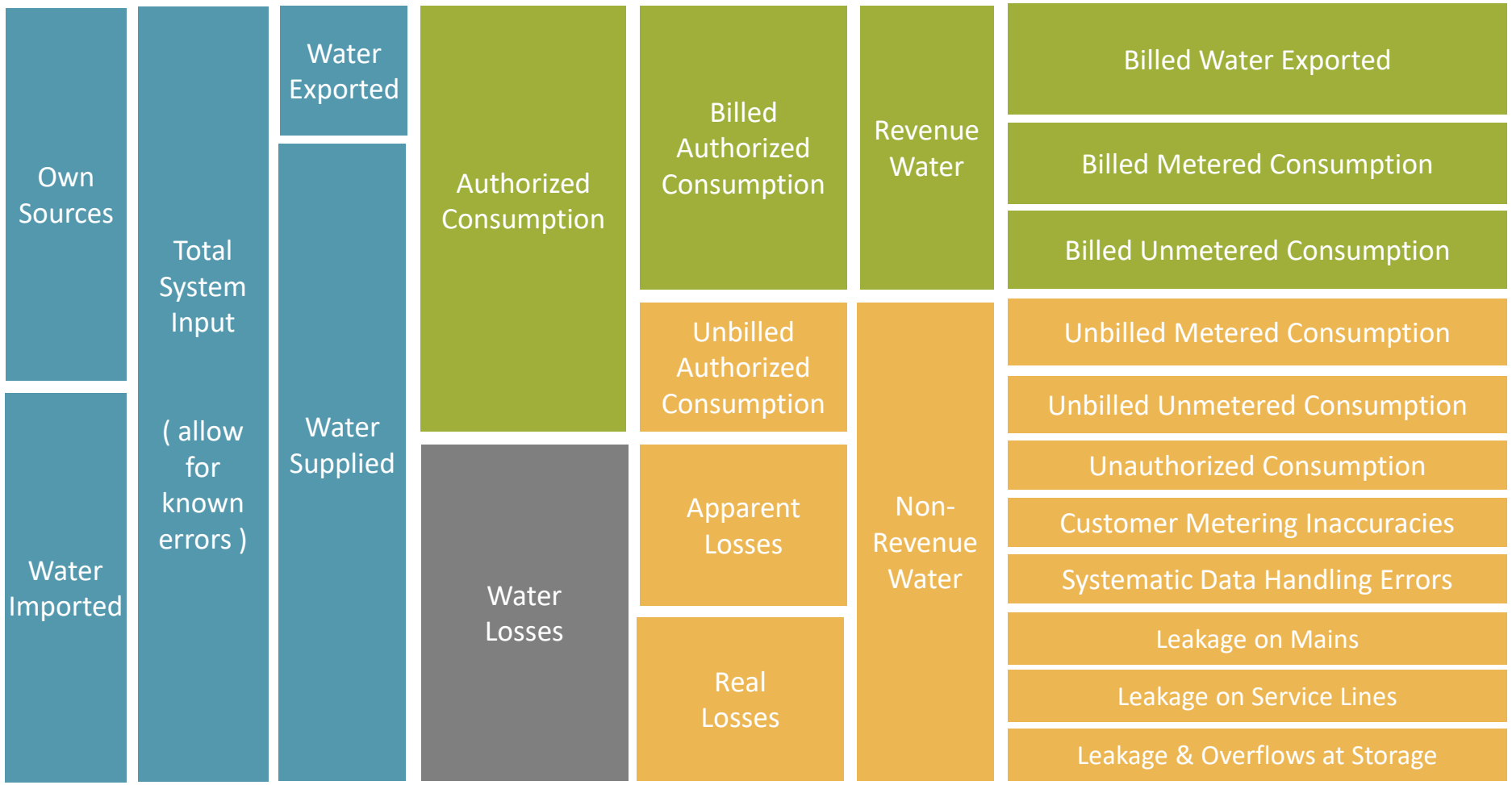

If a Water Loss Audit
is self-reported in the
forest, is it valid?

Every water system experiences water loss.

Establishing a baseline of validated water audit data is the anchor of a successful water loss strategy.

The AWWA methodology provides a path to building and progressing your water loss program.

THE IWA/AWWA WATER BALANCE



The Big Picture

Annual Water Balance

Annual M36 water audit

Apparent & Real Loss volumes

Level 1 validation

baseline

Loss Profiling & Uncertainty

Advanced Validation
- Level 2 Analytics
- Level 3 Field Study
- Margins of Error

Apparent Loss Profile
- Theft
- Meter Inaccuracy
- Data Handling

Real Loss Profile
- Reported Leakage
- Unreported Leakage
- Background Leakage

technical analysis

Cost-Benefit & Targets

Costs of losses
- by subcomponent
- in aggregate
- wholesale & retail

Costs of intervention strategies

Program design

System-specific

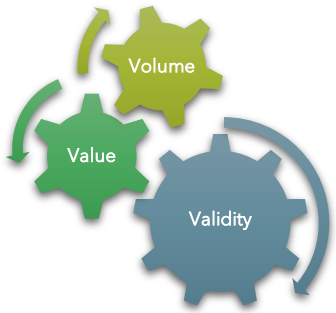
economic analysis

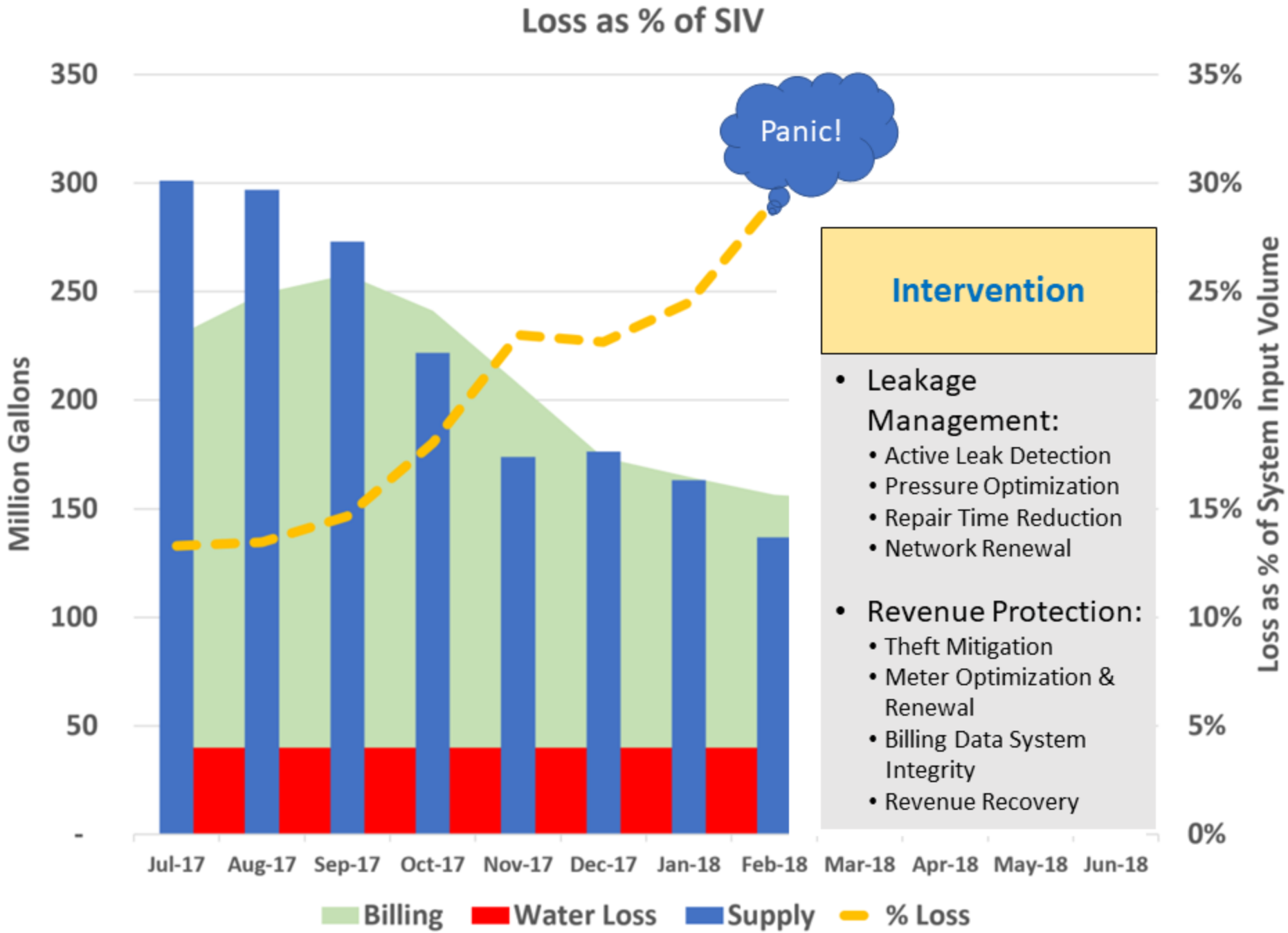
Intervention

Leakage Management:
- Active Leak Detection
- Pressure Optimization
- Repair Time Reduction
- Network Renewal

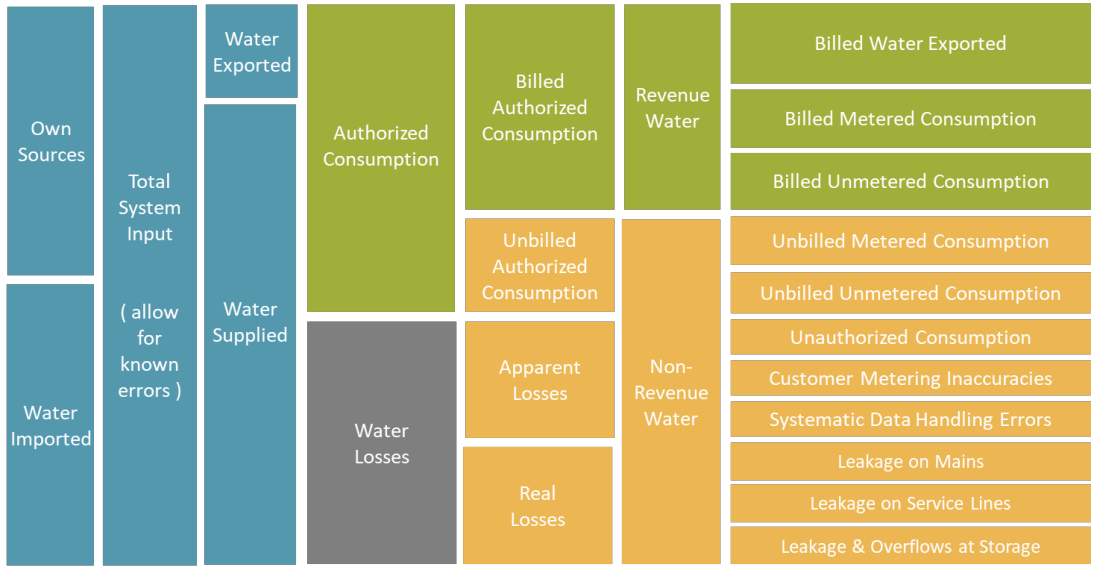
Revenue Protection:
- Theft Mitigation
- Meter Optimization & Renewal
- Billing Data System Integrity
- Revenue Recovery

cost-effectiveness




Loss as % of SIV
350
300
250
200
150
100
50
-
Million Gallons
35%
30%
25%
20%
15%
10%
5%
0%
Loss as % of System Input Volume
Panic!
Intervention
• Leakage Management:
• Active Leak Detection
• Pressure Optimization
• Repair Time Reduction
• Network Renewal
• Revenue Protection:
• Theft Mitigation
• Meter Optimization & Renewal
• Billing Data System Integrity
• Revenue Recovery
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Apr-18
May-18
Jun-18
Billing
Water Loss
Supply
% Loss

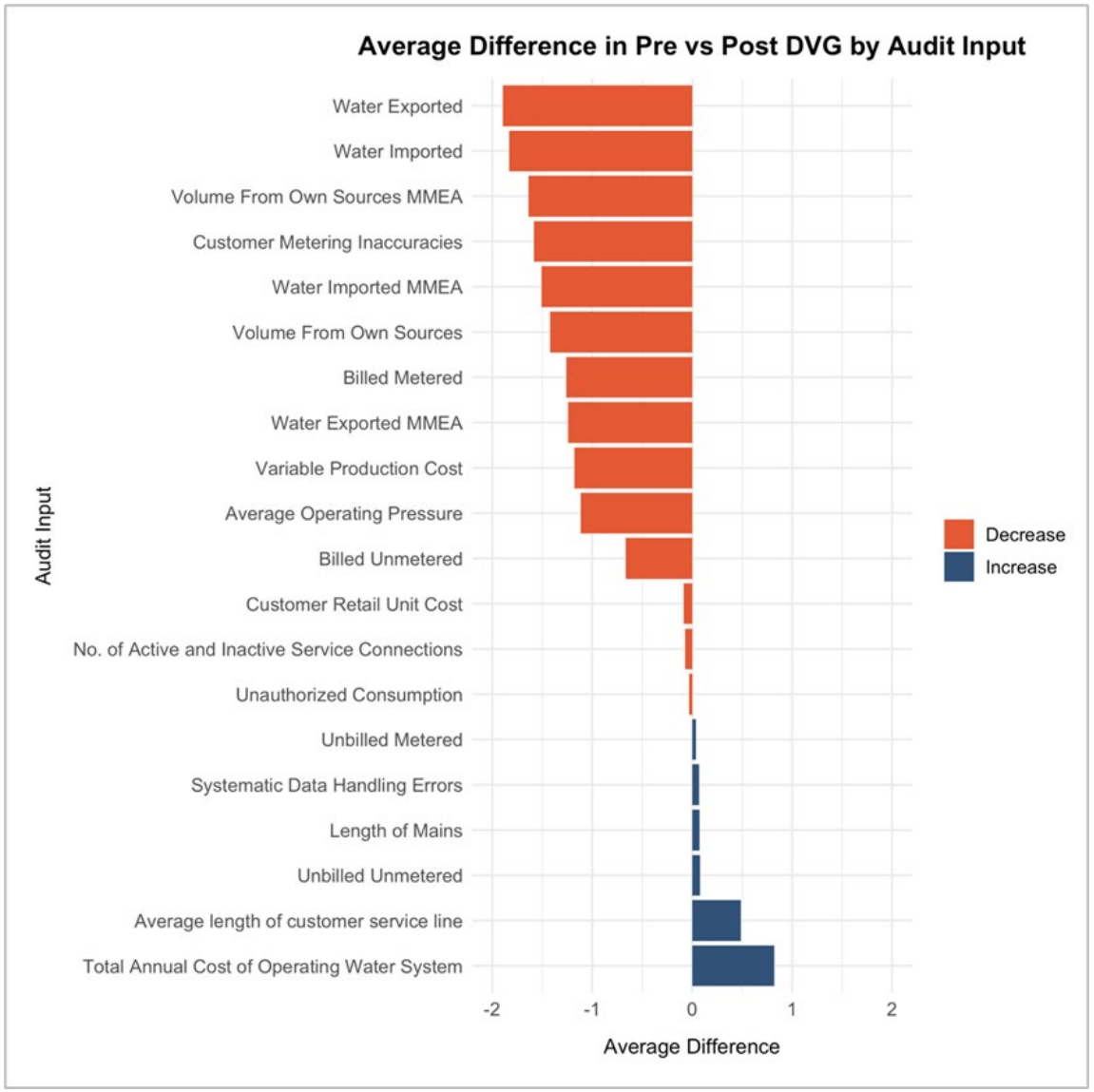
DATA QUALITY MATTERS



inaccuracy & uncertainty in inputs → inaccuracy & uncertainty in results

Sources of error:

- Instruments
- Databases
- People
- Missing information



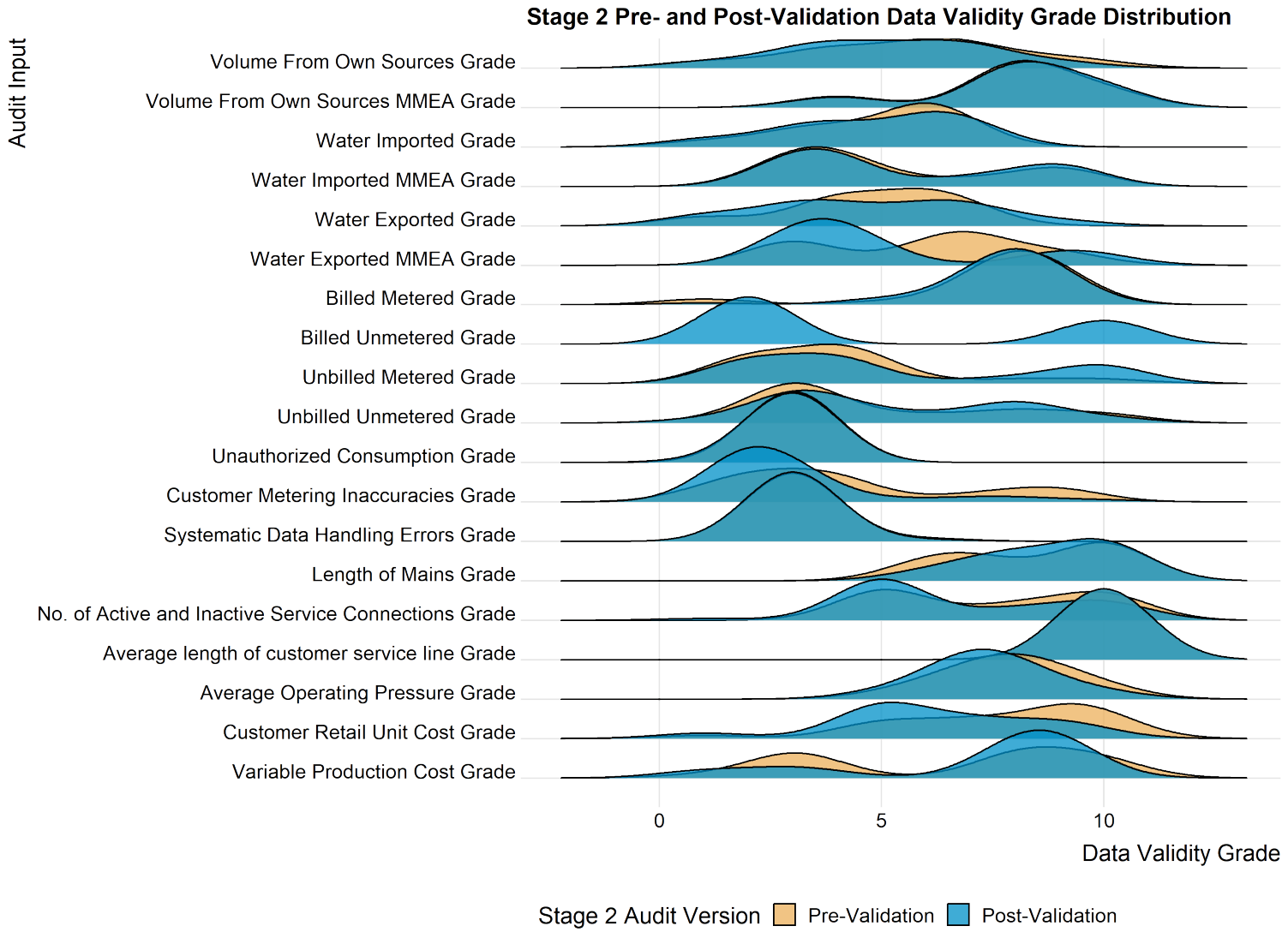
CHANGES TO DATA VALIDITY GRADES

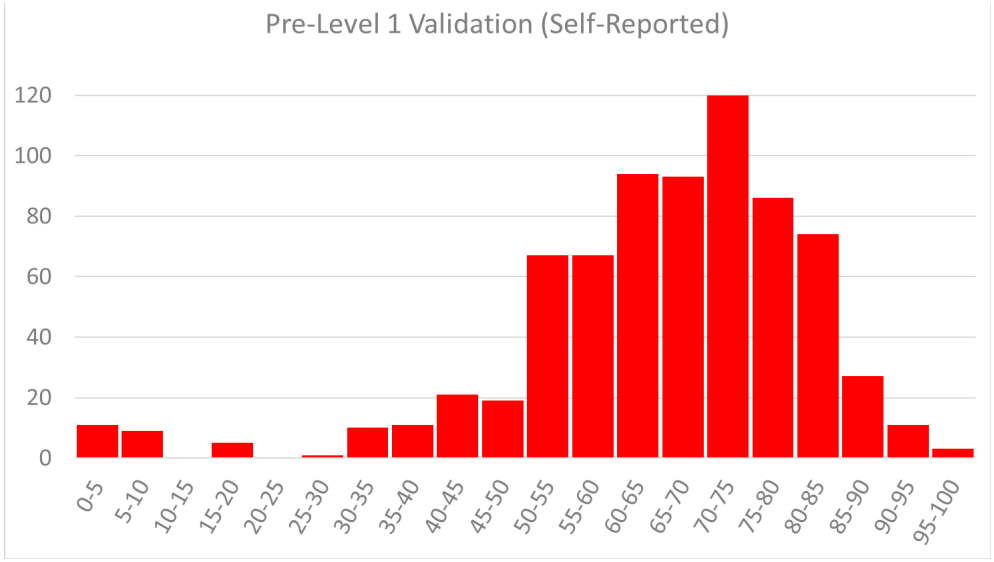
Source: WRF 5057

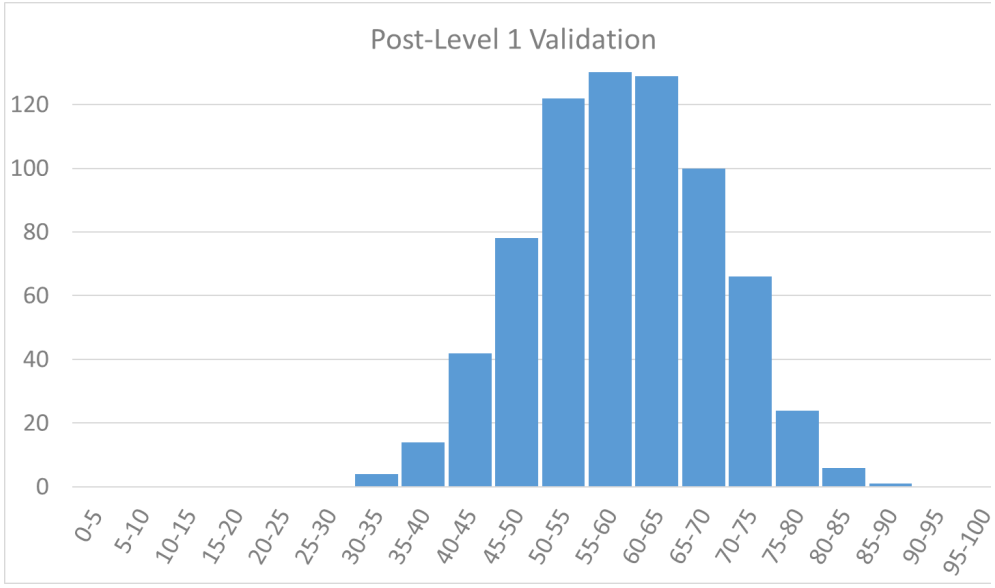
STATE OF FLORIDA

FLORIDA WATER LOSS PROGRAM

Saving Water – Reducing Costs – Being Proactive





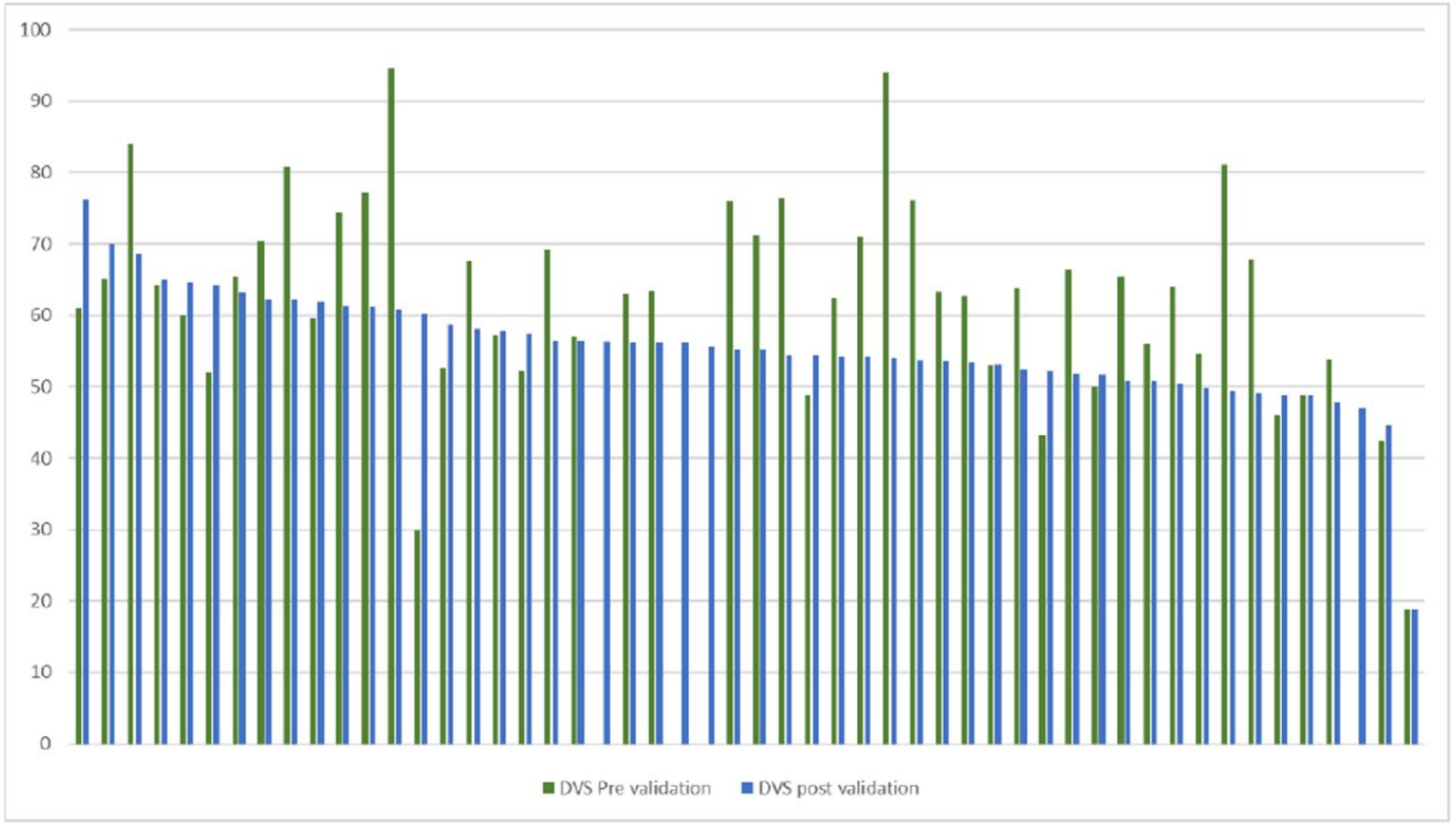


DATA VALIDITY DISTRIBUTION

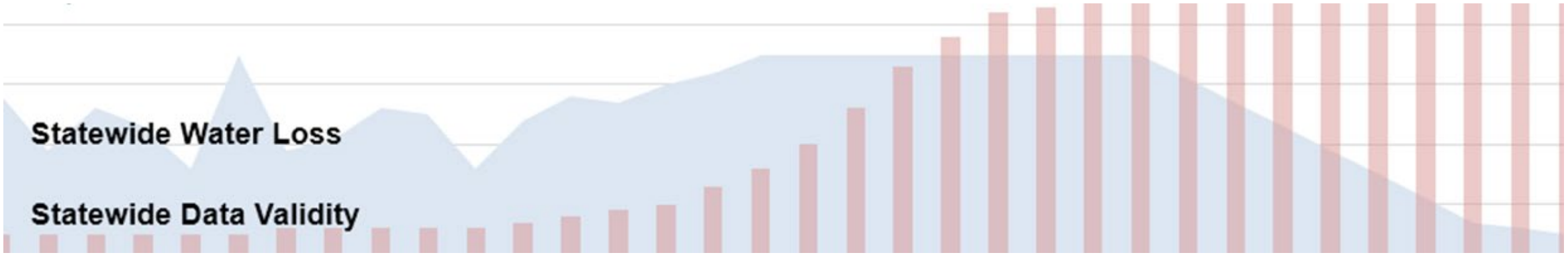
Source: WRF 5057

STATE OF COLORADO

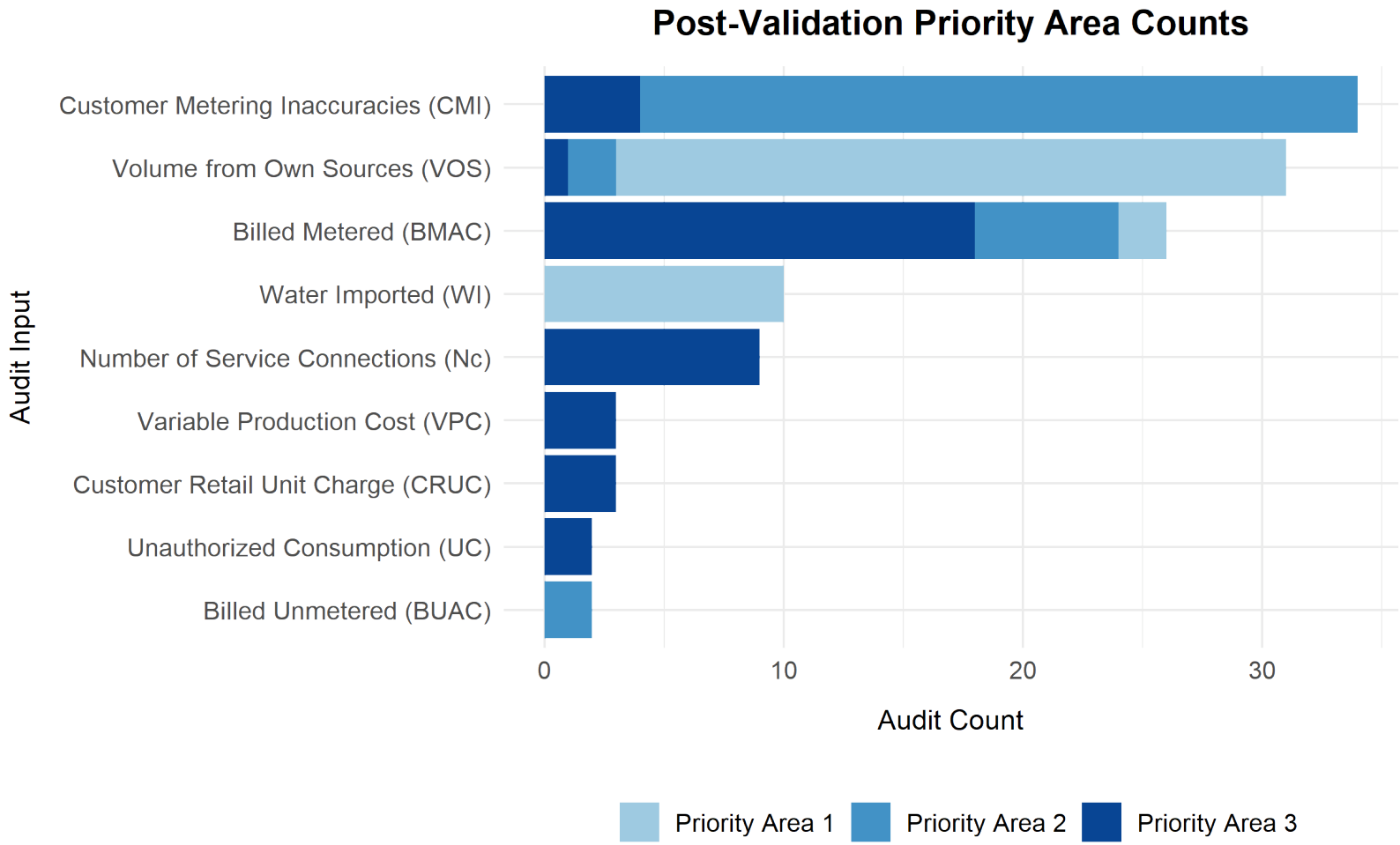
Colorado Water Loss Initiative



WATER LOSS REDUCTION STARTS WITH DATA VALIDATION



ASSESSING NEEDS OF UTILITIES



COMPARISON: V5 VS V6

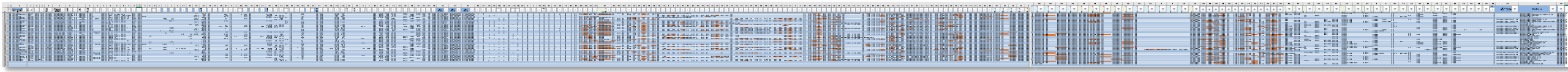
	v5	v6
Admin	17	26
Water Audit Input	25	22
Performance Indicator / Output	24	29
Data Grading	20	153
Total Data items from Water Audit	86	230

Compiler v5

New Compiler v6

Data Grading

Limiting Criteria



THE VALUE OF THE COLORADO WATER LOSS INITIATIVE: LEVEL 1 VALIDATION

Supply Meter Testing

Utility A

- real losses of 44.9 gal/conn/day and an **ILI of 2.93**
- flowmeter to be **under-registering by 1.7%**, thereby increasing the real losses to 45.9 gal/conn/day and **ILI of 2.99**
- Continue to investigate potential real loss intervention strategies

Utility B

- real losses of 44.6 gal/con/day and an **ILI of 2.51**
- flowmeter to be **over-registering by 5.6%,** thereby decreasing the real losses to 21.6 gal/conn/day and **ILI of 1.22**
- aligns with their water loss targets and means that no intervention strategy is currently required

WRF 5057 Level 1 Water Audit Validation Guidance Manual, Second Edition

Accurate water audits allow effective water loss control strategies to be planned. Therefore, it's essential that the quality of data that supports a water audit is examined and understood. By studying the quality of the water audit data, a water audit validator will explore and document uncertainty and minimize inaccuracy.

THE VALUE OF THE COLORADO WATER LOSS INITIATIVE: LEVEL 1 VALIDATION

Billing Data Analysis

Utility A

The Billed Metered Authorized Consumption volumes used in the 2022 Water Audit was 650.200 MG. The total volume included in the account level export was 765.875 MG, nearly 18% in excess of the audit volume. The first two lines in the example anomalies below account for nearly 85 MG of volumes. Even assuming these volumes are in error, this does not account for the full discrepancy.

Account #	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Grand Total
10-800013-13									84,712,100	0	0	0	0	0	0	1,900	84,714,000
10-800023-07									9,999,900	0	0	0	0	0	0	0	9,999,900
01-102270-01	74,000	82,000	76,000	102,000	56,000	1,000	11,000	463,000	681,000	907,000	747,000	396,000	1,000	7,000	189,000	275,000	4,068,000
01-100574-01	18,000	17,000	15,000	11,000	11,000	16,000	15,000	50,000	498,000	63,000	80,000	38,000	20,000	18,000	14,000	13,000	897,000
01-100572-01	14,000	17,000	11,000	13,000	31,000	20,000	24,000	712,000									842,000
10-300382-01	20,000	17,000	9,000	11,000	15,000	19,000	25,000	126,000	429,000	10,000	0	0	0	4,000	5,000	2,000	692,000
10-800024-05	64,200	42,000	22,300	0	0	55,000	0	116,000	0	160,200	0	0	0	0	0	0	459,700
01-101089-01	3,000	3,000	7,000	4,000	2,000	2,000	5,000	3,000	3,000	2,000	3,000	0	0	0	228,000	0	265,000

Utility B

Different multipliers applied to same size meters. A review of multipliers is recommended.

	(blank)	1	10	100	1000
(blank)	1				
1 1/2" meter			1	1,295	
1" meter		2	1,919	1	
2" meter		3	2	541	
3" meter		89	15	15	
3/4" meter		2	31,738		
4" meter		28	7	20	
5/8" x 3/4"			7	1	
6" meter		5			7
8" meter		4		1	2

WRF 5057 Level 1 Water Audit Validation Guidance Manual, Second Edition

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UTILITY FEEDBACK ON WATER AUDIT VALIDATION

By having the auditor provide a detailed breakdown of what the vision is of the project and for that section of the software and how it fits in the whole scheme of the project. It opens the eyes to those divisions to see how their input plays a role in the utility/project.

encouraged communications among the billing, meter, regional, and water production departments as we all try to piece together how each area's involvement contributes to the overall balance of water accounting

This process has led to increased visibility and focus in our comparison of water produced versus water sold. Some of our tracking mechanisms have been tweaked as the result

It provides more detailed information so money is spent in the right areas for cost savings

The AWWA methodology and Water Validation was more detailed and gave a better understanding on our system

THE BIG PICTURE

Annual Water Balance

Annual M36 water audit

Apparent & Real Loss volumes

Level 1 validation

baseline

Loss Profiling & Uncertainty

Advanced Validation
- Level 2 Analytics
- Level 3 Field Study
- Margins of Error

Apparent Loss Profile
- Theft
- Meter Inaccuracy
- Data Handling

Real Loss Profile
- Reported Leakage
- Unreported Leakage
- Background Leakage

technical analysis

Cost-Benefit & Targets

Costs of losses
- by subcomponent
- in aggregate
- wholesale & retail

Costs of intervention strategies

Program design

System-specific

economic analysis

Intervention

Leakage Management:
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- Repair Time Reduction
- Network Renewal

Revenue Protection:
- Theft Mitigation
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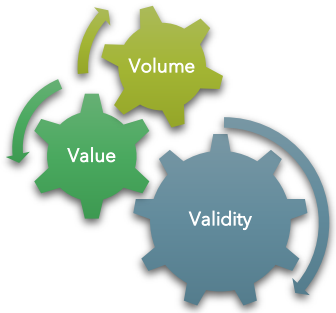
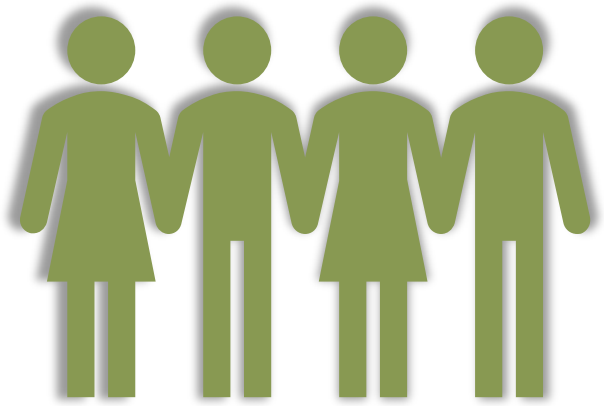
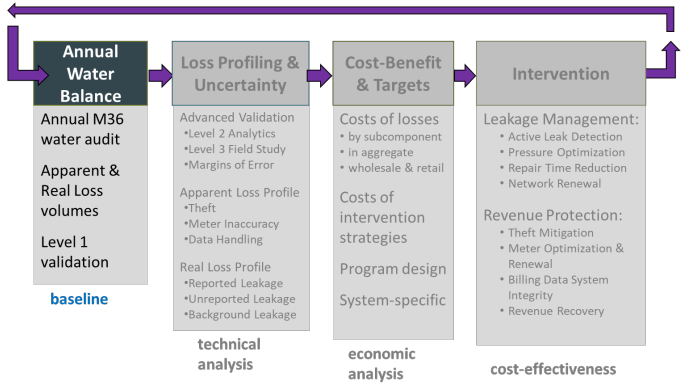
cost-effectiveness





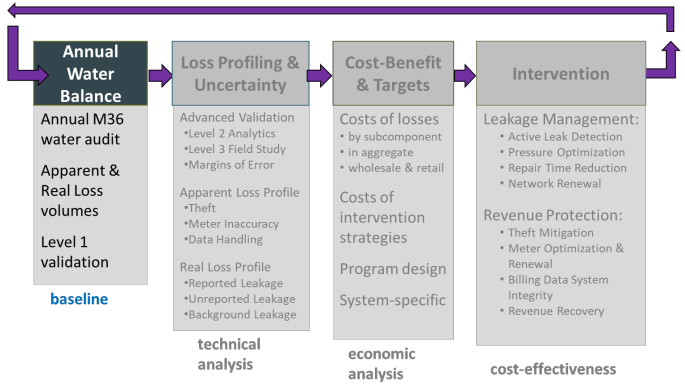
Establish Your Team

- Supply Metering
- Customer Metering
- Billing/Finance
- Management



Gather Data & Compile Water Audit

- Data Request Sheet/Supporting Documentation
- Water Audit: Inputs & Data Validity Grades



SUPPORTING DOCUMENTATION

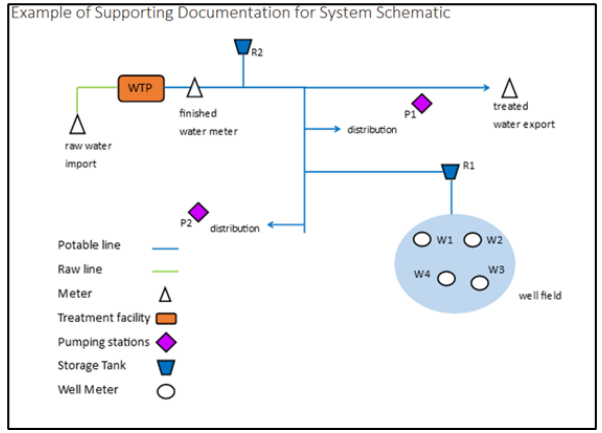
REQUIRED	SUPPLEMENTAL
❑ Volume from Own Sources *broken down by month and meter*	❑ Customer Meter Inaccuracy derivation
❑ Water Imported *broken down by month and meter*	❑ Average Operating Pressure derivation
❑ Water Exported *broken down by month and meter*	❑ Customer Retail Unit Cost derivation
❑ Supply Meter Test Records *for all supply meters, if conducted*	❑ Variable Production Cost derivation
❑ Volume of Metered Consumption *broken down by month and use type/code*	❑ System Schematic *showing locations of Supply and Export Meters*

Required Supporting Documents are critical for Level 1 Validation

WATER SUPPLIED DATA

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 Test Records *for all supply meters, if conducted*	❑ Variable Production Cost derivation
❑ Volume of Metered Consumption *broken down by month and use type/code*	❑ System Schematic *showing locations of Supply and Export Meters*

Example of Supporting Documentation for System Schematic



Example of Supporting Documentation for all Water Supplied Volumes

Volume from Own Sources

UNITS = Gal

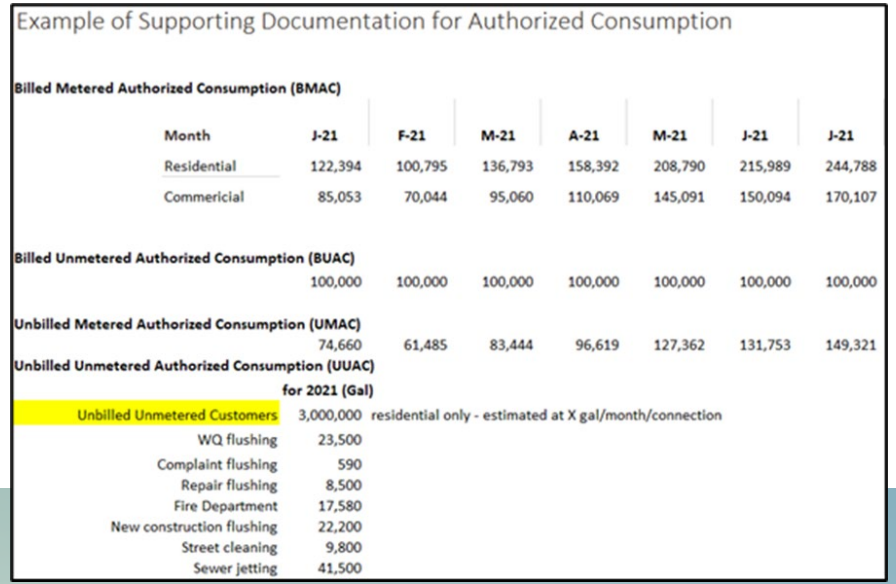
Month	Meter 1	Meter 2	Meter 3	Monthly Distribution Totals
November 2020	*254,860*	*132,650*	*45,606*	*433,115.67*
December 2020	*355,890*	*111,780*	*30,586*	*498,255.80*
January 2021	339,870	111,056	27,764	478,690.00
February 2021	279,900	91,456	22,864	394,220.00
March 2021	379,860	124,096	31,024	534,980.00
April 2021	439,840	143,720	35,930	619,490.00
May 2021	579,780	189,448	47,362	816,590.00
June 2021	599,780	195,984	48,996	844,760.00
July 2021	679,750	222,112	55,528	957,390.00
August 2021	719,730	235,176	58,794	1,013,700.00
September 2021	599,780	195,984	48,996	844,760.00
October 2021	479,820	156,784	39,196	675,800.00
November 2021	399,850	130,656	32,664	563,170.00
December 2021	359,870	117,592	29,398	506,860.00
January 2022	*345,770*	*106,330*	*34,010*	*486,110.00*
February 2022	*340,020*	*101,220*	*34,670*	*475,910.00*
VOS Total	5,857,830	1,914,064.00	478,516	8,250,410.00

Notes:

No water exported

AUTHORIZED CONSUMPTION DATA

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 Test Records *for all supply meters, if conducted*	❑ Variable Production Cost derivation
❑ Volume of Metered Consumption *broken down by month and use type/code*	❑ System Schematic *showing locations of Supply and Export Meters*



Example of Supporting Documentation for Authorized Consumption

Billed Metered Authorized Consumption (BMAC)

Month	J-21	F-21	M-21	A-21	M-21	J-21	J-21
Residential	122,394	100,795	136,793	158,392	208,790	215,989	244,788
Commericial	85,053	70,044	95,060	110,069	145,091	150,094	170,107

Billed Unmetered Authorized Consumption (BUAC)

	100,000	100,000	100,000	100,000	100,000	100,000	100,000

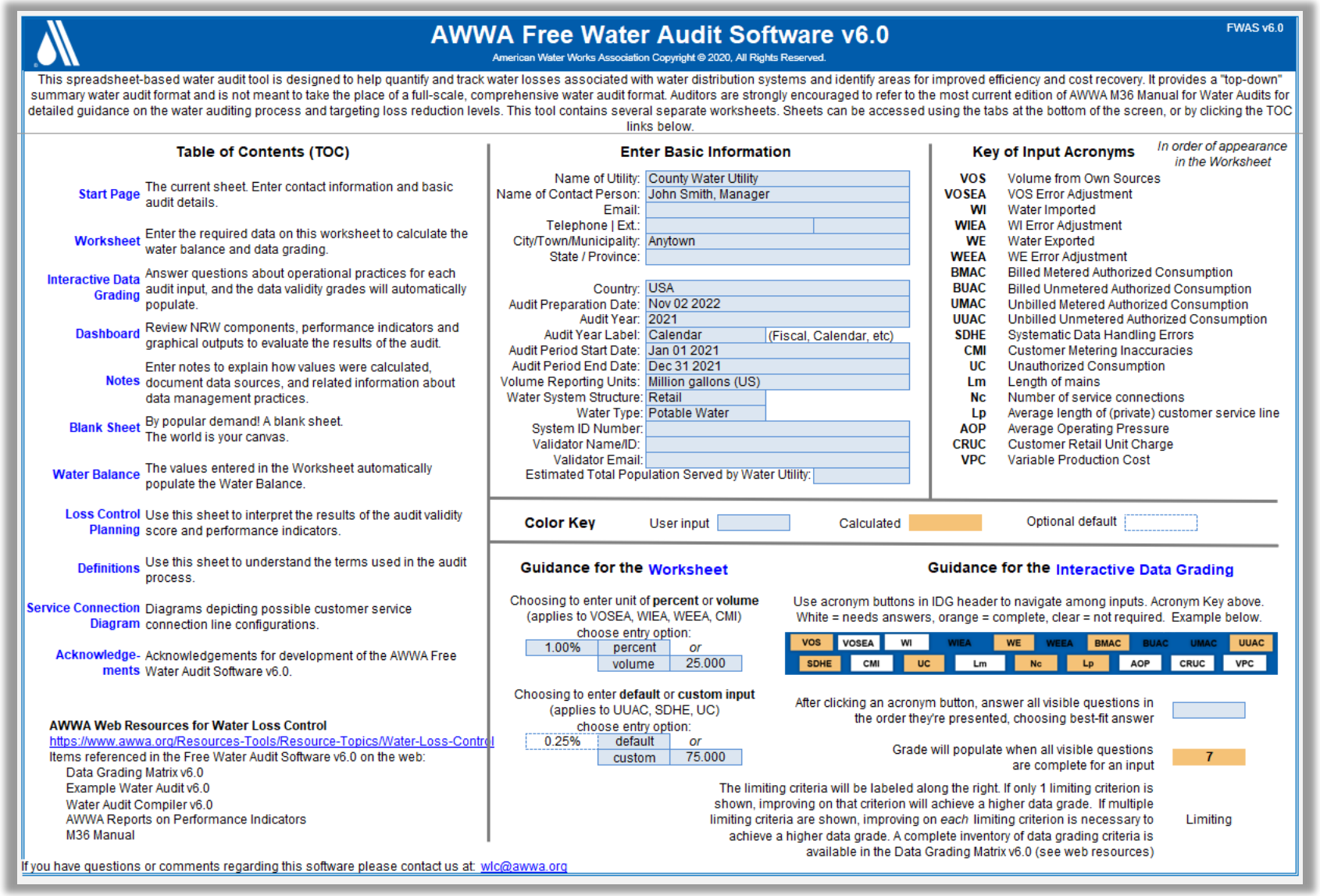
Unbilled Metered Authorized Consumption (UMAC)

	74,660	61,485	83,444	96,619	127,362	131,753	149,321

Unbilled Unmetered Authorized Consumption (UUAC)

	for 2021 (Gal)	
Unbilled Unmetered Customers	3,000,000	residential only - estimated at X gal/month/connection
WQ flushing	23,500	
Complaint flushing	590	
Repair flushing	8,500	
Fire Department	17,580	
New construction flushing	22,200	
Street cleaning	9,800	
Sewer jetting	41,500	

AWWA FREE WATER AUDIT SOFTWARE – INSTRUCTIONS WORKSHEET



AWWA Free Water Audit Software v6.0

FWAS v6.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format and is not meant to take the place of a full-scale, comprehensive water audit format. Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

Table of Contents (TOC)

Start Page	The current sheet. Enter contact information and basic audit details.
Worksheet	Enter the required data on this worksheet to calculate the water balance and data grading.
Interactive Data Grading	Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.
Dashboard	Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.
Notes	Enter notes to explain how values were calculated, document data sources, and related information about data management practices.
Blank Sheet	By popular demand! A blank sheet. The world is your canvas.
Water Balance	The values entered in the Worksheet automatically populate the Water Balance.
Loss Control Planning	Use this sheet to interpret the results of the audit validity score and performance indicators.
Definitions	Use this sheet to understand the terms used in the audit process.
Service Connection Diagram	Diagrams depicting possible customer service connection line configurations.
Acknowledge-ments	Acknowledgements for development of the AWWA Free Water Audit Software v6.0.

AWWA Web Resources for Water Loss Control

https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

Enter Basic Information

Name of Utility:	County Water Utility
Name of Contact Person:	John Smith, Manager
Email:	
Telephone | Ext.:	
City/Town/Municipality:	Anytown
State / Province:	
Country:	USA
Audit Preparation Date:	Nov 02 2022
Audit Year:	2021
Audit Year Label:	Calendar (Fiscal, Calendar, etc)
Audit Period Start Date:	Jan 01 2021
Audit Period End Date:	Dec 31 2021
Volume Reporting Units:	Million gallons (US)
Water System Structure:	Retail
Water Type:	Potable Water
System ID Number:	
Validator Name/ID:	
Validator Email:	
Estimated Total Population Served by Water Utility:	

Key of Input Acronyms

In order of appearance in the Worksheet

VOS	Volume from Own Sources
VOSEA	VOS Error Adjustment
WI	Water Imported
WIEA	WI Error Adjustment
WE	Water Exported
WEEA	WE Error Adjustment
BMAC	Billed Metered Authorized Consumption
BUAC	Billed Unmetered Authorized Consumption
UMAC	Unbilled Metered Authorized Consumption
UUAC	Unbilled Unmetered Authorized Consumption
SDHE	Systematic Data Handling Errors
CMI	Customer Metering Inaccuracies
UC	Unauthorized Consumption
Lm	Length of mains
Nc	Number of service connections
Lp	Average length of (private) customer service line
AOP	Average Operating Pressure
CRUC	Customer Retail Unit Charge
VPC	Variable Production Cost

Color Key User input | Calculated | Optional default

Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI) choose entry option:

1.00%	percent	*or*
	volume	25.000

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC) choose entry option:

0.25%	default	*or*
	custom	75.000

Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.

VOS	VOSEA	WI	WIEA	WE	WEEA	BMAC	BUAC	UMAC	UUAC
SDHE	CMI	UC	Lm	Nc	Lp	AOP	CRUC	VPC	

After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

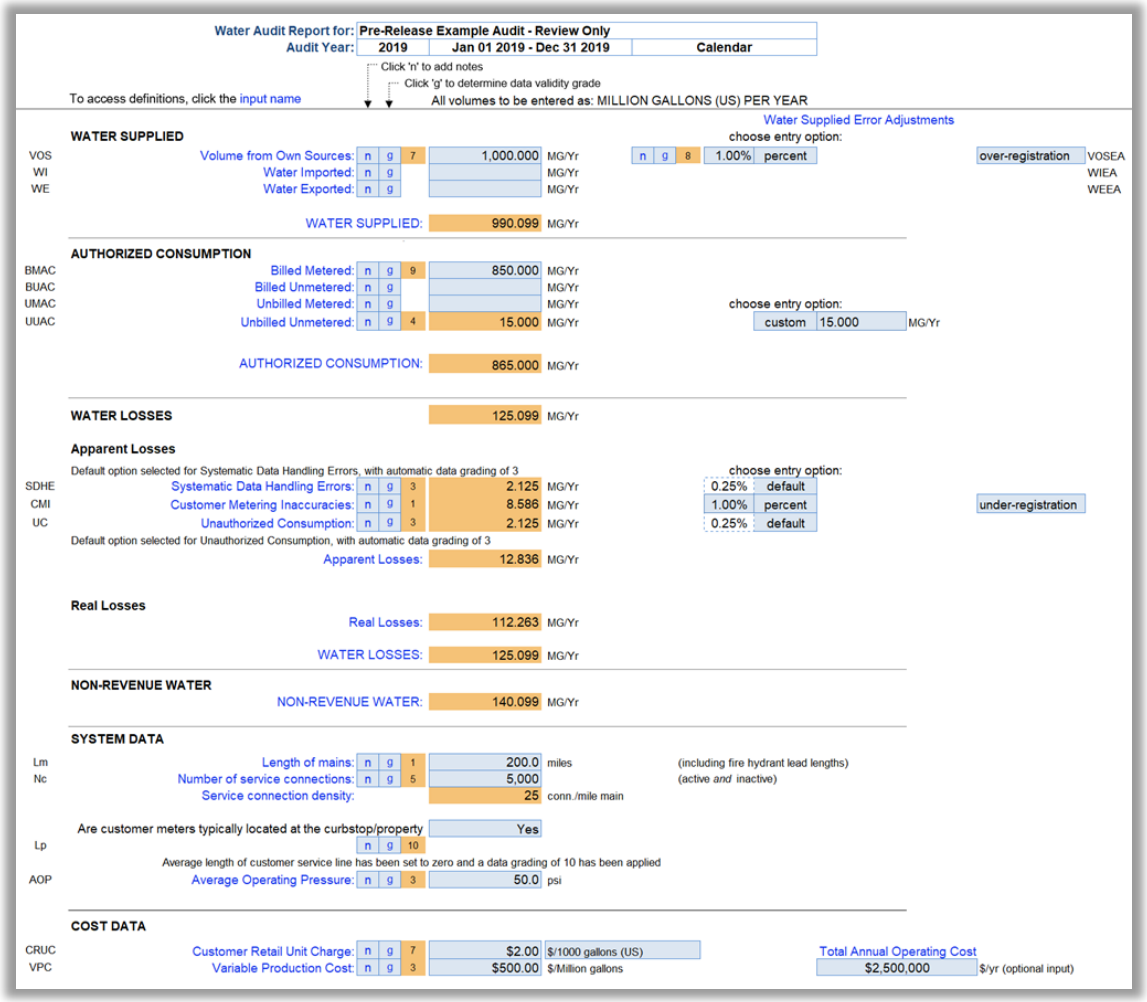
Grade will populate when all visible questions are complete for an input: 7

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources)

Limiting

If you have questions or comments regarding this software please contact us at: wlc@awwa.org

AWWA FREE WATER AUDIT SOFTWARE WORKSHEET



Water Audit Report for: Pre-Release Example Audit - Review Only
Audit Year: 2019 | Jan 01 2019 - Dec 31 2019 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To access definitions, click the input name

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

VOS	Volume from Own Sources:	n	g	7	1,000.000	MG/Yr	n g 8	1.00%	percent	over-registration VOSEA
WI	Water Imported:	n	g			MG/Yr				WIEA
WE	Water Exported:	n	g			MG/Yr				WEEA
	WATER SUPPLIED:				990.099	MG/Yr				

AUTHORIZED CONSUMPTION

BMAC	Billed Metered:	n	g	9	850.000	MG/Yr				
BUAC	Billed Unmetered:	n	g			MG/Yr				
UMAC	Unbilled Metered:	n	g			MG/Yr	choose entry option:			
UUAC	Unbilled Unmetered:	n	g	4	15.000	MG/Yr	custom	15.000	MG/Yr	
	AUTHORIZED CONSUMPTION:				865.000	MG/Yr				

WATER LOSSES 125.099 MG/Yr

Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	3	2.125	MG/Yr	0.25%	default		
CMI	Customer Metering Inaccuracies:	n	g	1	8.586	MG/Yr	1.00%	percent		under-registration
UC	Unauthorized Consumption:	n	g	3	2.125	MG/Yr	0.25%	default		

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 12.836 MG/Yr

Real Losses

Real Losses: 112.263 MG/Yr

WATER LOSSES: 125.099 MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 140.099 MG/Yr

SYSTEM DATA

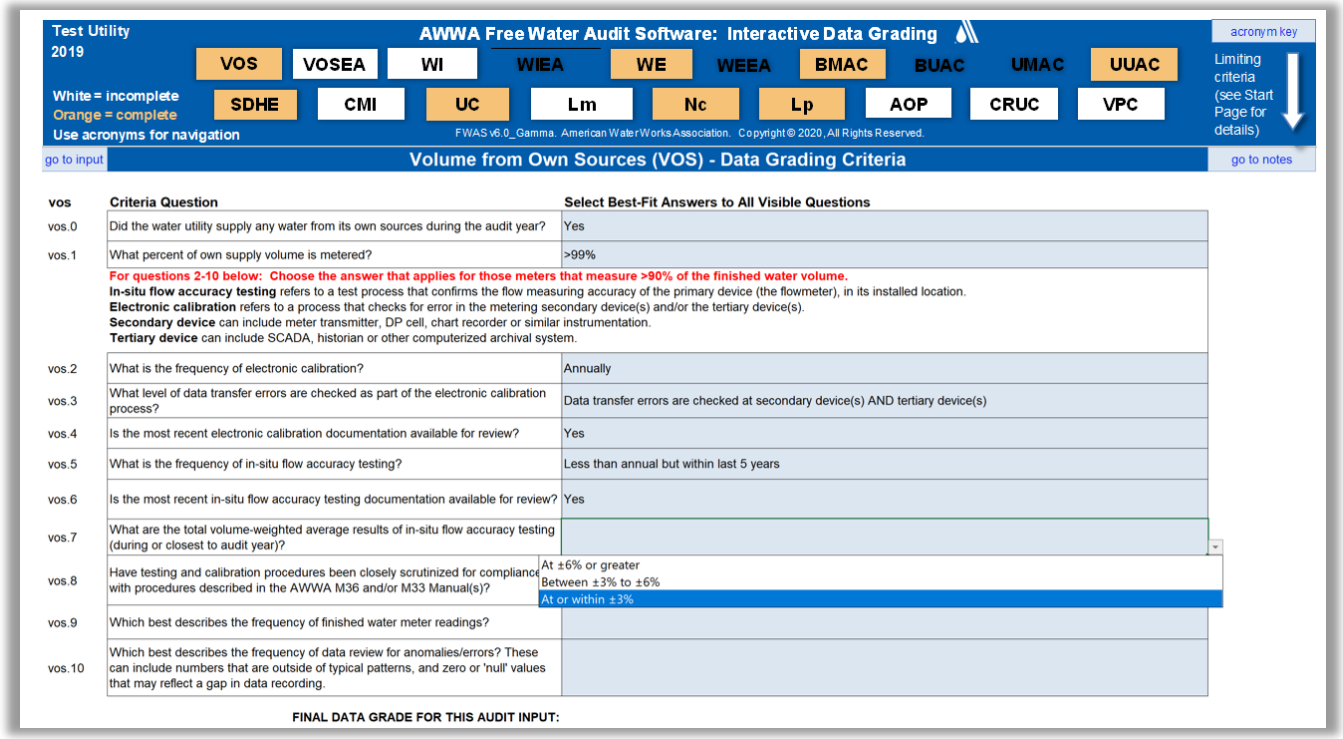
Lm	Length of mains:	n	g	1	200.0	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	5,000		(active *and* inactive)
	Service connection density:				25	conn./mile main	
	Are customer meters typically located at the curbstop/property				Yes		
Lp		n	g	10			
	Average length of customer service line has been set to zero and a data grading of 10 has been applied						
AOP	Average Operating Pressure:	n	g	3	50.0	psi	

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	7	$2.00	$/1000 gallons (US)	Total Annual Operating Cost	
VPC	Variable Production Cost:	n	g	3	$500.00	$/Million gallons	$2,500,000	$/yr (optional input)

AWWA FREE WATER AUDIT SOFTWARE - DATA GRADING

- Components are assigned a Grading from 1-10 based upon the validity of the source data and operational practices
- Interactive Data Grading Matrix worksheet gives criteria for grading components according to utility operations and practices
- Grading criteria is a *process-based* approach



Test Utility
2019

White = incomplete
Orange = complete
Use acronyms for navigation

AWWA Free Water Audit Software: Interactive Data Grading

acronym key

VOS | VOSEA | WI | WIEA | WE | WEEA | BMAC | BUAC | UMAC | UUAC
SDHE | CMI | UC | Lm | Nc | Lp | AOP | CRUC | VPC

Limiting criteria (see Start Page for details)

go to input

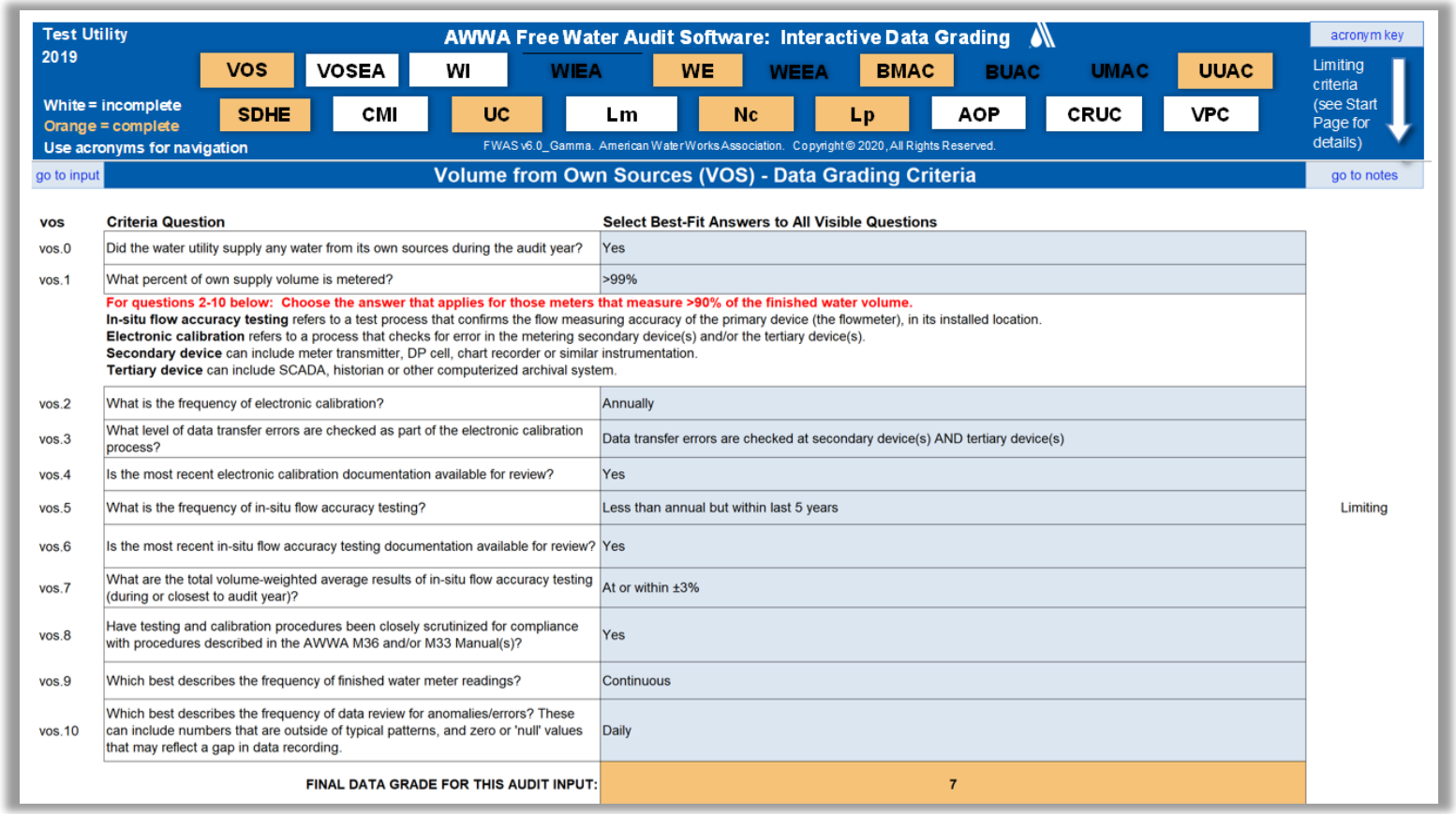
Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

vos	Criteria Question	Select Best-Fit Answers to All Visible Questions
vos.0	Did the water utility supply any water from its own sources during the audit year?	Yes
vos.1	What percent of own supply volume is metered?	>99%
	For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume. **In-situ flow accuracy testing** refers to a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location. **Electronic calibration** refers to a process that checks for error in the metering secondary device(s) and/or the tertiary device(s). **Secondary device** can include meter transmitter, DP cell, chart recorder or similar instrumentation. **Tertiary device** can include SCADA, historian or other computerized archival system.	
vos.2	What is the frequency of electronic calibration?	Annually
vos.3	What level of data transfer errors are checked as part of the electronic calibration process?	Data transfer errors are checked at secondary device(s) AND tertiary device(s)
vos.4	Is the most recent electronic calibration documentation available for review?	Yes
vos.5	What is the frequency of in-situ flow accuracy testing?	Less than annual but within last 5 years
vos.6	Is the most recent in-situ flow accuracy testing documentation available for review?	Yes
vos.7	What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)?	
vos.8	Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?	At ±6% or greater Between ±3% to ±6% At or within ±3%
vos.9	Which best describes the frequency of finished water meter readings?	
vos.10	Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	

FINAL DATA GRADE FOR THIS AUDIT INPUT:

AWWA FREE WATER AUDIT SOFTWARE - DATA GRADING



Test Utility
2019

White = incomplete
Orange = complete
Use acronyms for navigation

AWWA Free Water Audit Software: Interactive Data Grading

VOS | VOSEA | WI | WIEA | WE | WEEA | BMAC | BUAC | UMAC | UUAC
SDHE | CMI | UC | Lm | Nc | Lp | AOP | CRUC | VPC

acronym key

Limiting criteria (see Start Page for details)

FWAS v6.0_Gamma. American Water Works Association. Copyright © 2020, All Rights Reserved.

go to input

Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

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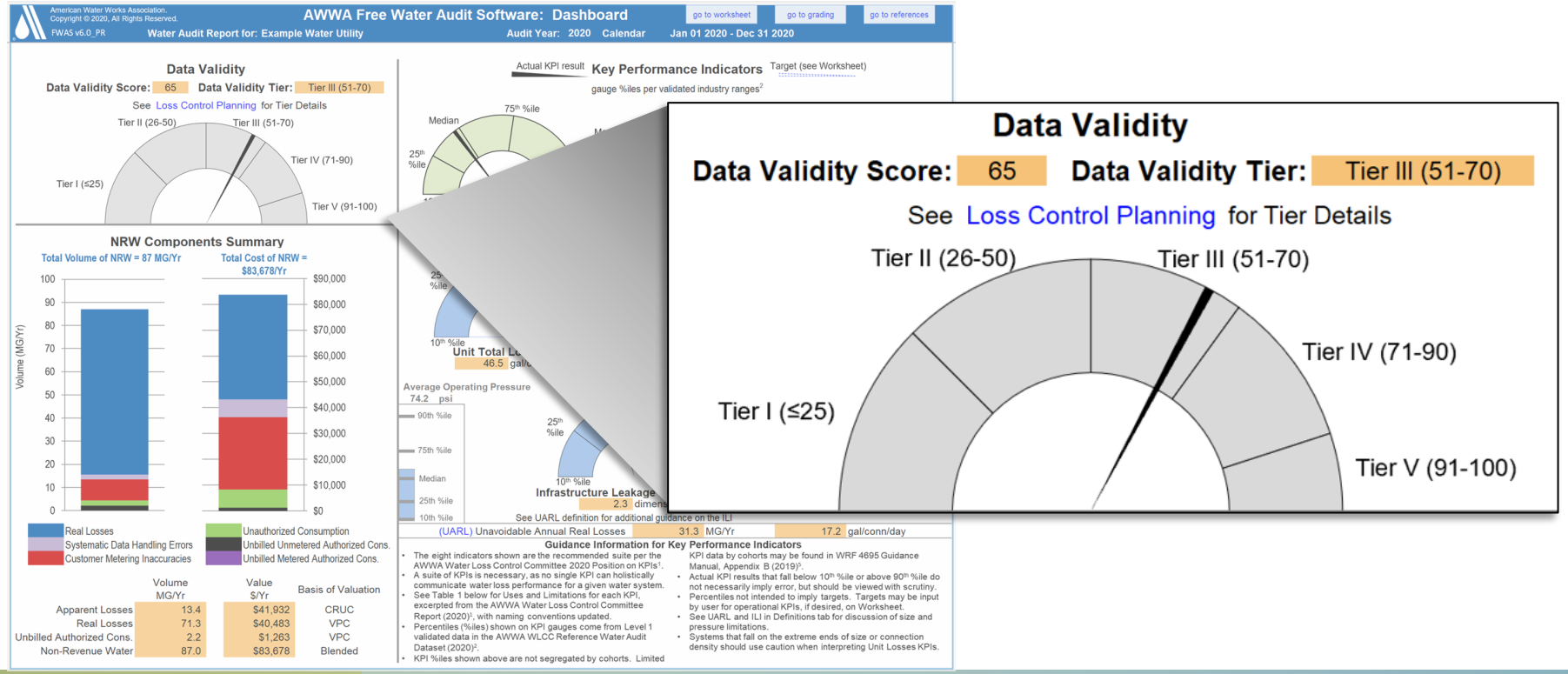
vos.2	What is the frequency of electronic calibration?	Annually	
vos.3	What level of data transfer errors are checked as part of the electronic calibration process?	Data transfer errors are checked at secondary device(s) AND tertiary device(s)	
vos.4	Is the most recent electronic calibration documentation available for review?	Yes	
vos.5	What is the frequency of in-situ flow accuracy testing?	Less than annual but within last 5 years	Limiting
vos.6	Is the most recent in-situ flow accuracy testing documentation available for review?	Yes	
vos.7	What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)?	At or within ±3%	
vos.8	Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)?	Yes	
vos.9	Which best describes the frequency of finished water meter readings?	Continuous	
vos.10	Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	Daily	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	7	

- Includes questions regarding practices, policies, and grading criteria selections
- Automated Data Grade selections
- Includes guidance for improvement to the next grade shown as ‘Limiting’ criteria

AWWA FREE WATER AUDIT SOFTWARE QUANTIFYING DATA VALIDITY

Data Validity Score (DVS)

- A composite calculation based upon the gradings of the individual water audit components
- Represents the overall validity, or trustworthiness, of the data and is an indirect assessment of the utility's processes to supply and deliver water



AWWA FREE WATER AUDIT SOFTWARE
WHAT DOES THE DVS MEAN FOR MY WATER UTILITY?

- *Water Loss Control Planning Guide*
- Gives guidance on interpretation of the Data Validity Tier (DVT)
- Represents a continuum of process-based assessments
- Higher validity = more reliable assessment of water loss standing and greater loss control opportunities

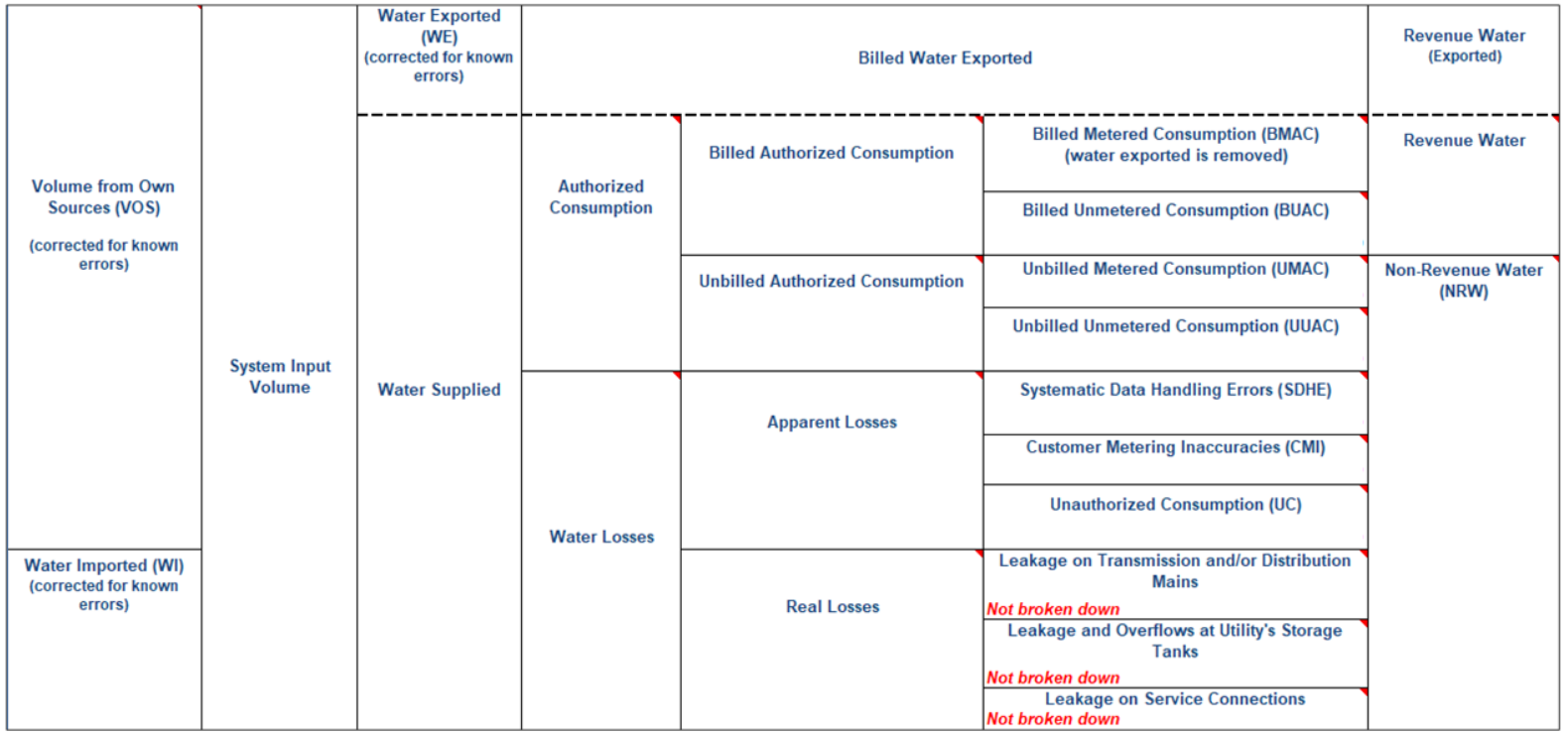
Water Loss Control Planning Guide

	Water Audit Data Validity Tier (Score Range)				
Functional Focus Area	**Tier I (1-25)**	**Tier II (26-50)**	**Tier III (51-70)**	**Tier IV (71-90)**	**Tier V (91-100)**
Audit Data Collection	Launch auditing and loss control team; address supply metering deficiencies	Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering	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 AMR/AMI 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 with PIs for performance comparisons for real losses	Performance Benchmarking with PIs is meaningful in comparing real loss standing	Identify Best Practices/ Best in class; PIs are very reliable as real loss performance indicators for best in class service

For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.

ACCURACY IN THE WATER BALANCE

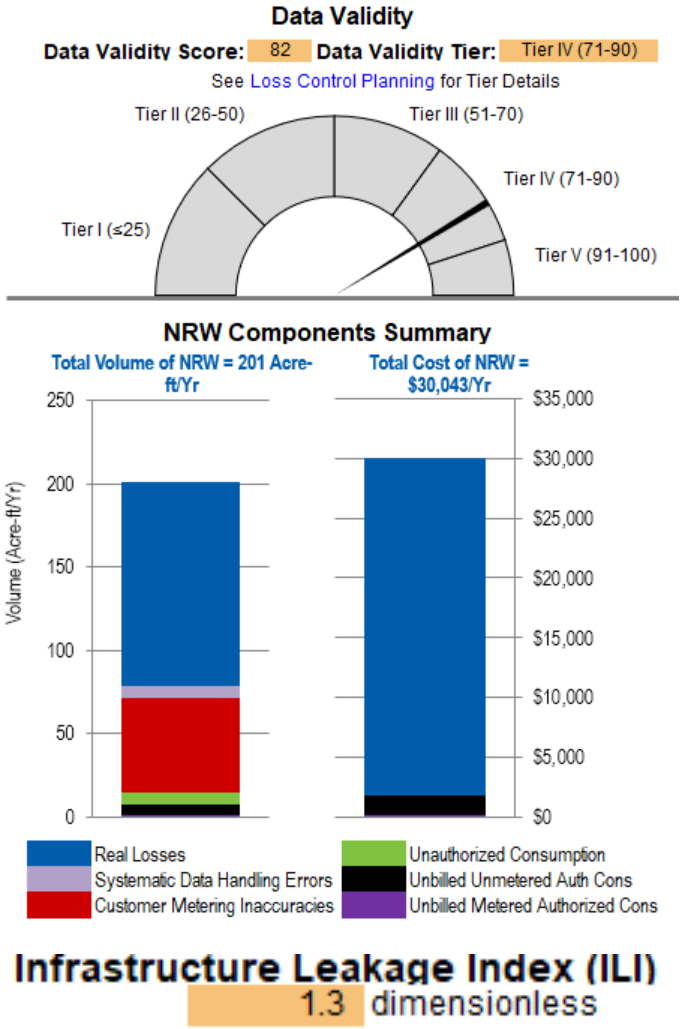
Where does error sneak in?



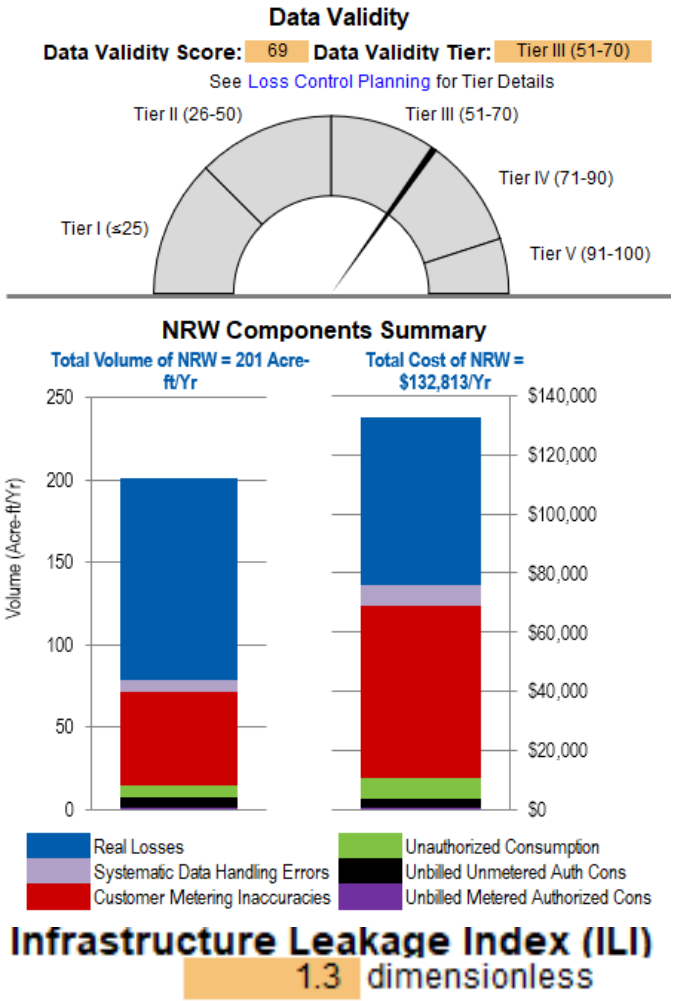
- Primary instrumentation
- Secondary data management, archival, and summary
- Interaction with data and methodology; estimation

Impacts of Data Validation for a Particular Water Utility – DVS Decreased!

Pre-Level 1 Validation



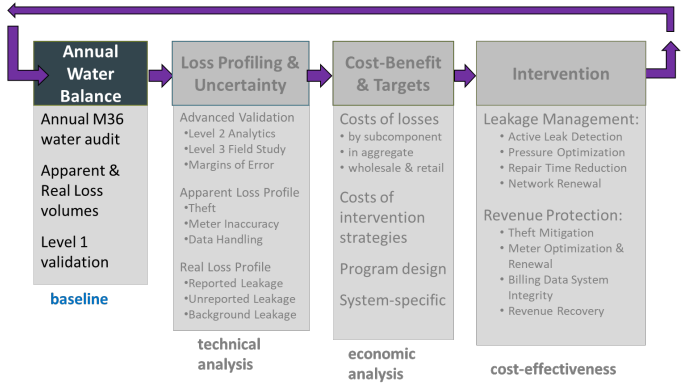
Post-Level 1 Validation



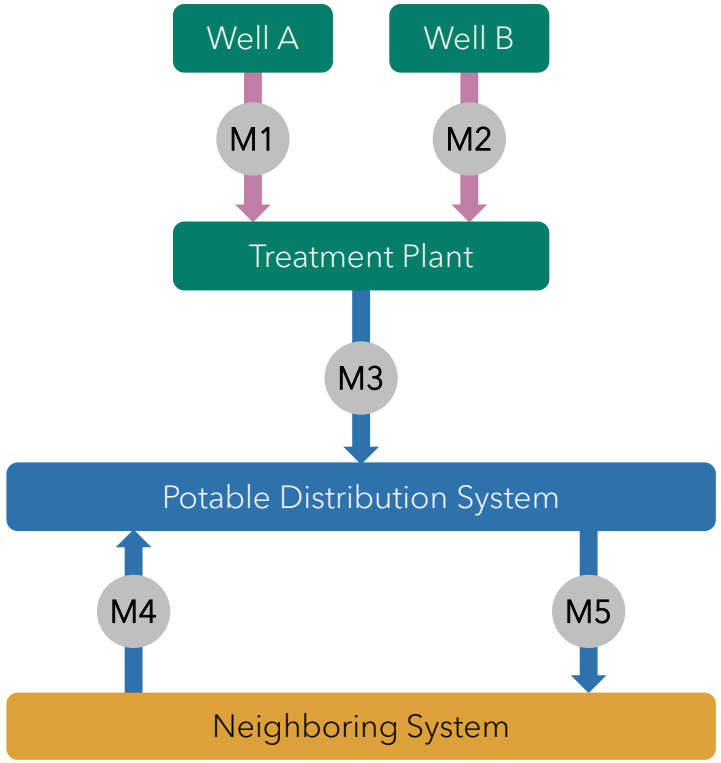
Graphics are from FWAS Dashboard worksheet

Level 1 Validation Session

- One-on-One validation session with your water audit validator



WATER AUDIT BOUNDARY



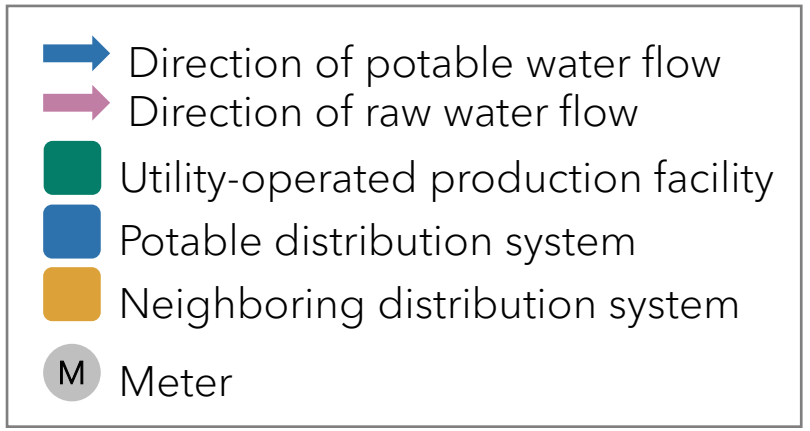
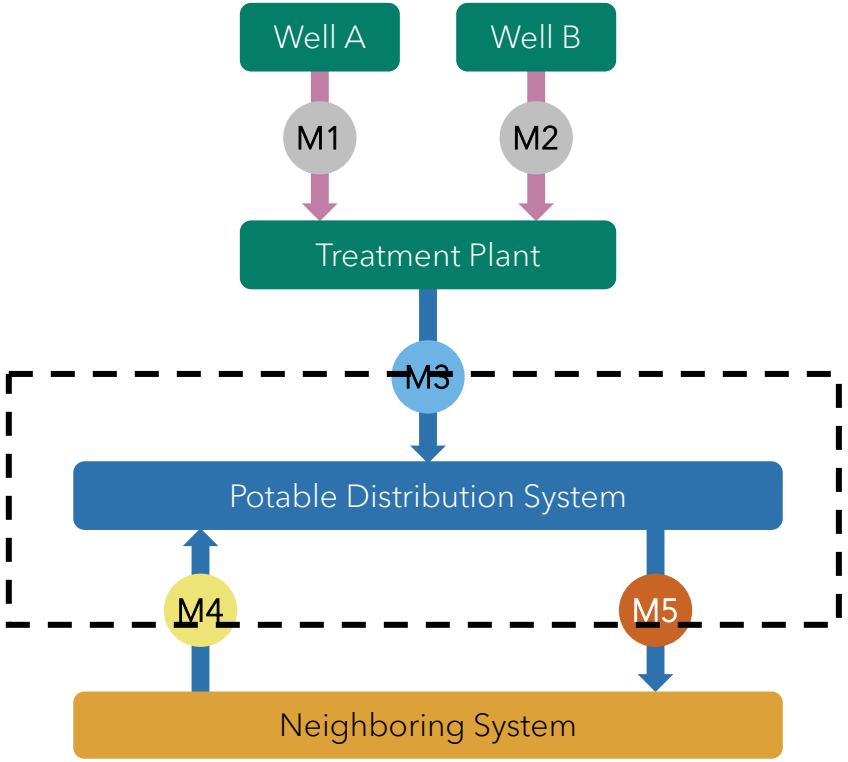


Image: WRF 5057

WATER AUDIT BOUNDARY



Direction of potable water flow

Direction of raw water flow

Utility-operated production facility

Potable distribution system

Neighboring distribution system

*Meters that form **example** water audit boundary*

Meter **used** to determine volume from own sources (VOS)

Meter **used** to determine water imported (WI)

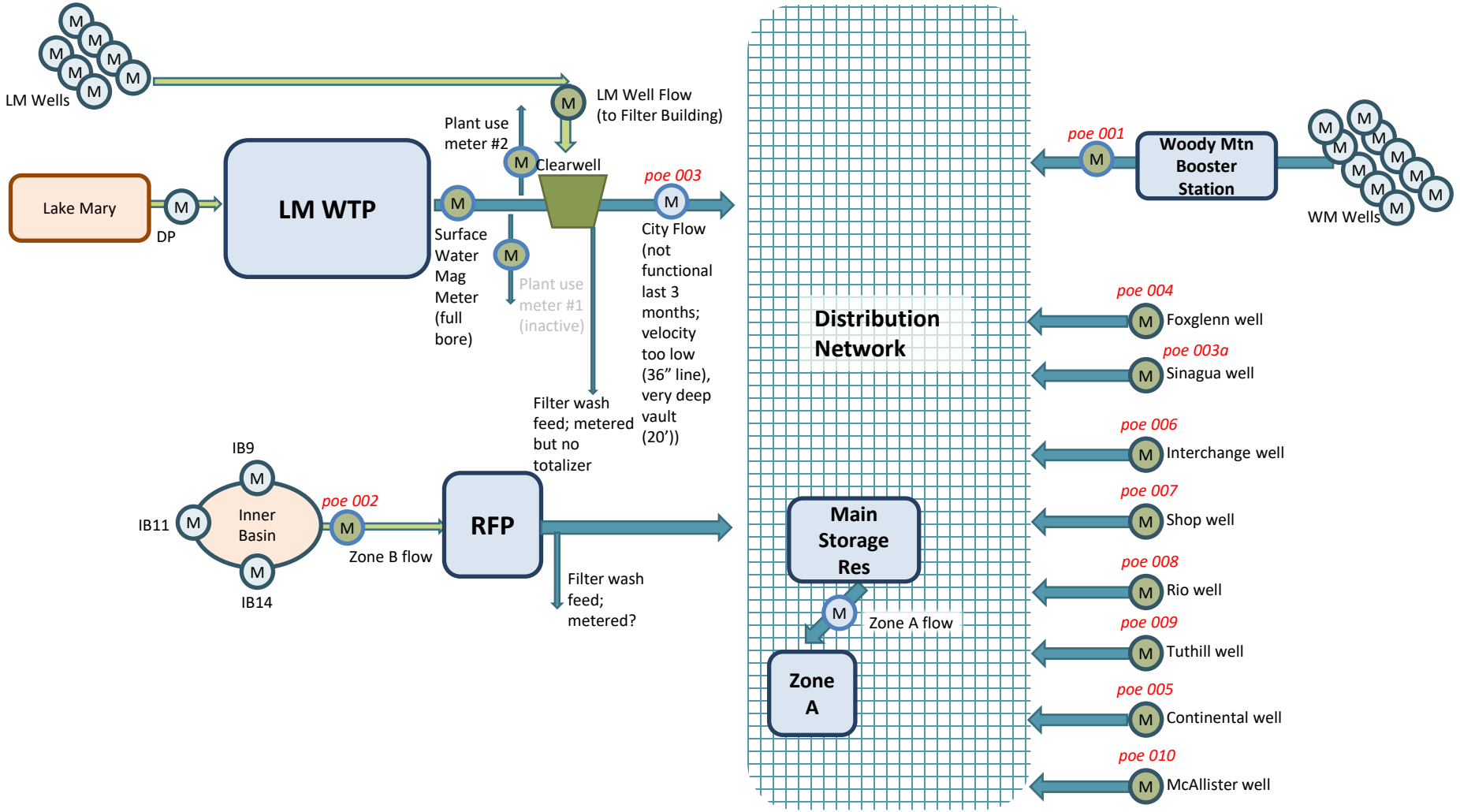
Meter **used** to determine water exported (WE)

*Meters that are not part of **example** water audit boundary*

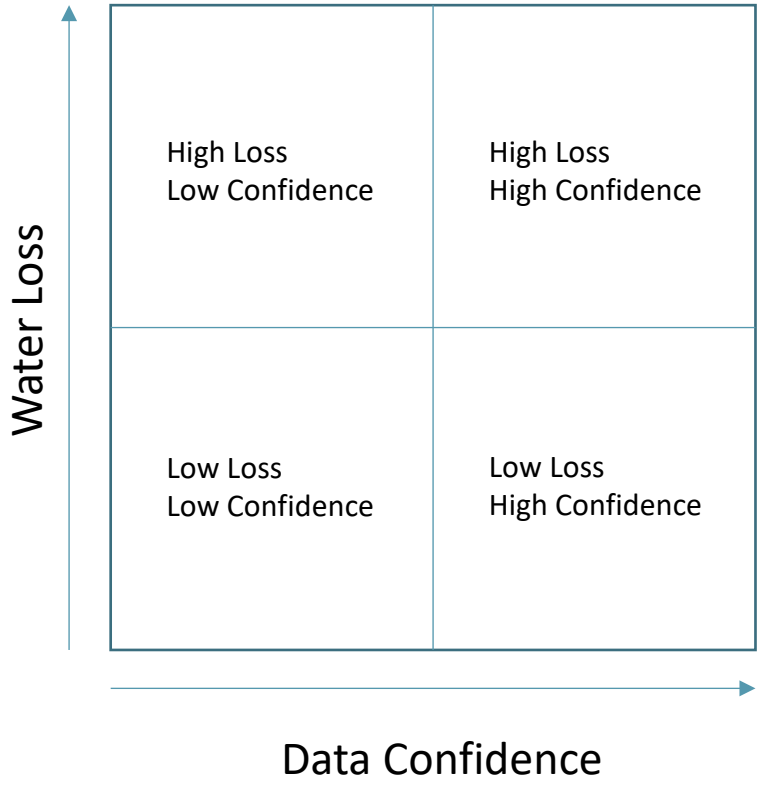
Meter **not used** to determine VOS, WI, or WE

Image: WRF 5057

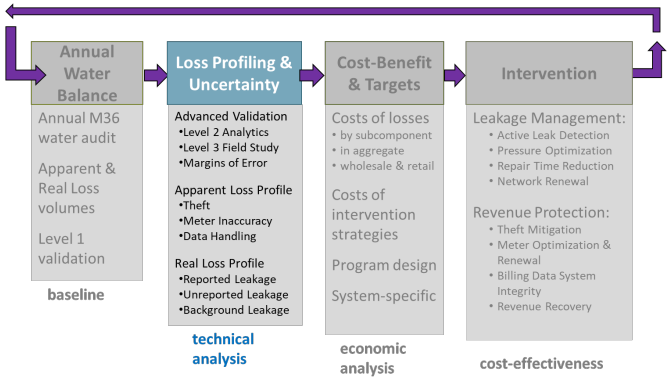
WATER AUDIT BOUNDARY - EXAMPLE



DETERMINE NEXT APPROPRIATE STEPS



- **Production Meter Testing**
- **Detailed Billing Data Analysis**
- **Large Customer Meter Testing**
- **Leak Detection**
- **Real Loss Component Analysis**



Technical Assistance	Data Requirements	Infrastructure	Team Effort
Water Audit Compilation	Operational data to fill out AWWA FWAS v6	No specific requirements	Time to gather data and answer the team's questions during the data review process.
Estimation of Unmetered Authorized Consumption	Operational data of unmetered water consumptions	No specific requirements	Time to gather data and answer the team's questions during the data review process.
Level 1 Validation	Completed AWWA FWAS for last year and additional required supporting documentation	No specific requirements	Time to gather the data and fill out FWAS plus the 2-hour validation meeting.
Supply Meter Testing	Supply meter type, brand/make information, flow history data, and piping configuration	Upstream & downstream distance of straight pipe or nearby tank	Time to gather data and up to 1 day of support during field testing
Billing Data Analysis	Raw data export from meter reading/billing system in electronic data format (.xls, .csv, or similar) that includes meter info, customer info, meter reads, read dates, billed volumes. Additional detail to be provided.	Metered customers	Time to prepare the data export
Customer Meter Testing: Test Design or Results Analysis	Meter summary statistics including size, type, age, and throughput. Results of all customer meter tests performed. Additional detail to be provided.	Metered customers	Time to prepare the data export or aggregate meter test results.
Real Loss Component Analysis	Completed water audit, detailed leak repair data, leak detection results (if applicable), infrastructure summary data including hydrants, valves, service lines, mains, and storage capacity	No specific requirements	Time to gather data
Leak Detection Survey	Water infrastructure maps or GIS files	Preferable if customer meters are at curb stop and accessible.	Time to gather data. For field work, effort will vary depending on utility preference. Field team usually works independently.

WATER LOSS AUDIT VALIDATION IN NORTH AMERICA

THE Water Research FOUNDATION

2015: Water Audits in the United States: A Review of Water Losses and Data Validity

Unrealistic results of self-reported water audits creates the need for water audit validation.

2017: Level 1 Water Audit Validation Guidance Manual

Manual develops standardization of water audit validation

2021: Level 1 Water Audit Validation Guidance Manual, Second Edition

Manual updated to align with newer version of the AWWA Water Audit

WATER LOSS AUDIT VALIDATION

Definition:

process of examining water audit inputs to improve the water audit's accuracy and document the uncertainty associated with water audit data

Purpose:

Water audit validation aims to:

- Identify and correct errors
- Evaluate and communicate uncertainty

Level 1 – interview & summary records

Level 2 – deep data review

Level 3 – new data from the field

WHAT DOES LEVEL 1 WATER AUDIT VALIDATION DO?

- The Level 1 water audit validation aims to:

- Confirm the accurate application of water audit methodology and terminology to the utility-specific situation
- Identify/adjust any evident inaccuracies
- Validation of practices and policy criteria, and understanding the answers in full context of the utility operations

- In meeting these goals, the Level 1 validation process results in:

- Data validity grades that reflect utility practices
- Identification of macro-level inaccuracies
- Recommendations for advanced validation activities

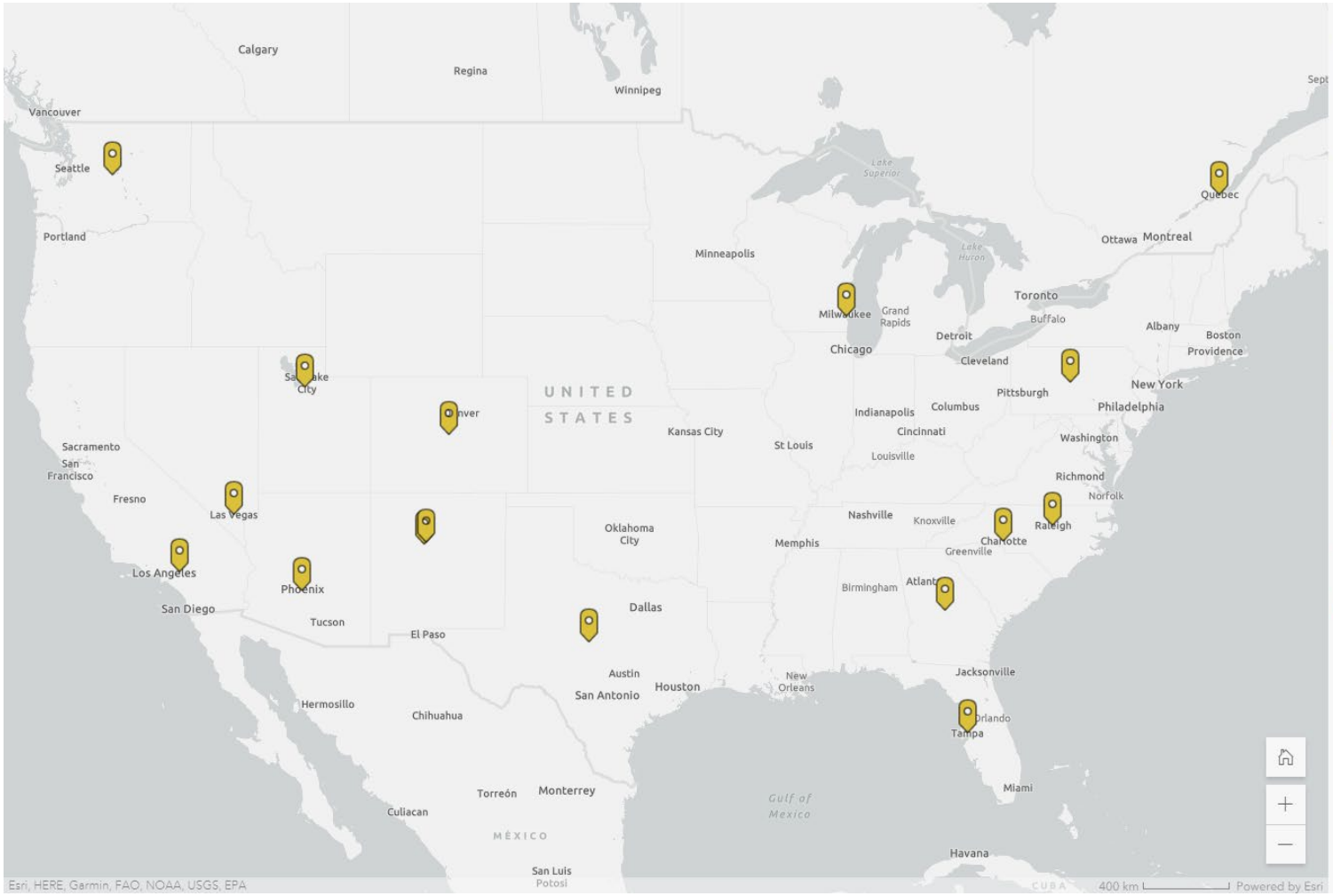
WHAT DOES LEVEL 1 WATER AUDIT VALIDATION *NOT* DO?

- Level 1 water audit validation is the least rigorous level of validation. The effort and time required to complete Level 1 validation are relatively small. Water audit validation does not:

- Correct inaccuracies in raw data that may affect summary data and audit inputs
- Investigate data processing and handling to identify and correct inaccuracies
- Study instrument accuracy through field tests to improve the certainty of the water audit
- Corroborate the volume of Real Losses with bottom-up or field investigations of leakage

BROADER COUNTRY WIDE TRAINING INITIATIVE

Pilot Studies | Statewide Programs | Certification Programs



Georgia Water Loss Program

Wisconsin M36 Water Loss Auditing

New Mexico Water Loss Control Training Program

California Water Loss Technical Assistance…

Utah Water System Efficiency and Water Loss…

Washington Water Loss Pilot Program

Florida Water Loss Pilot Technical Assistance…

North Carolina Water Loss Program

The Catawba-Wateree Water Loss Program

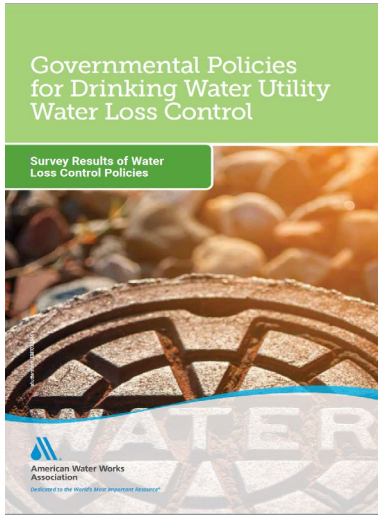
Arizona Water Loss Pilot Program

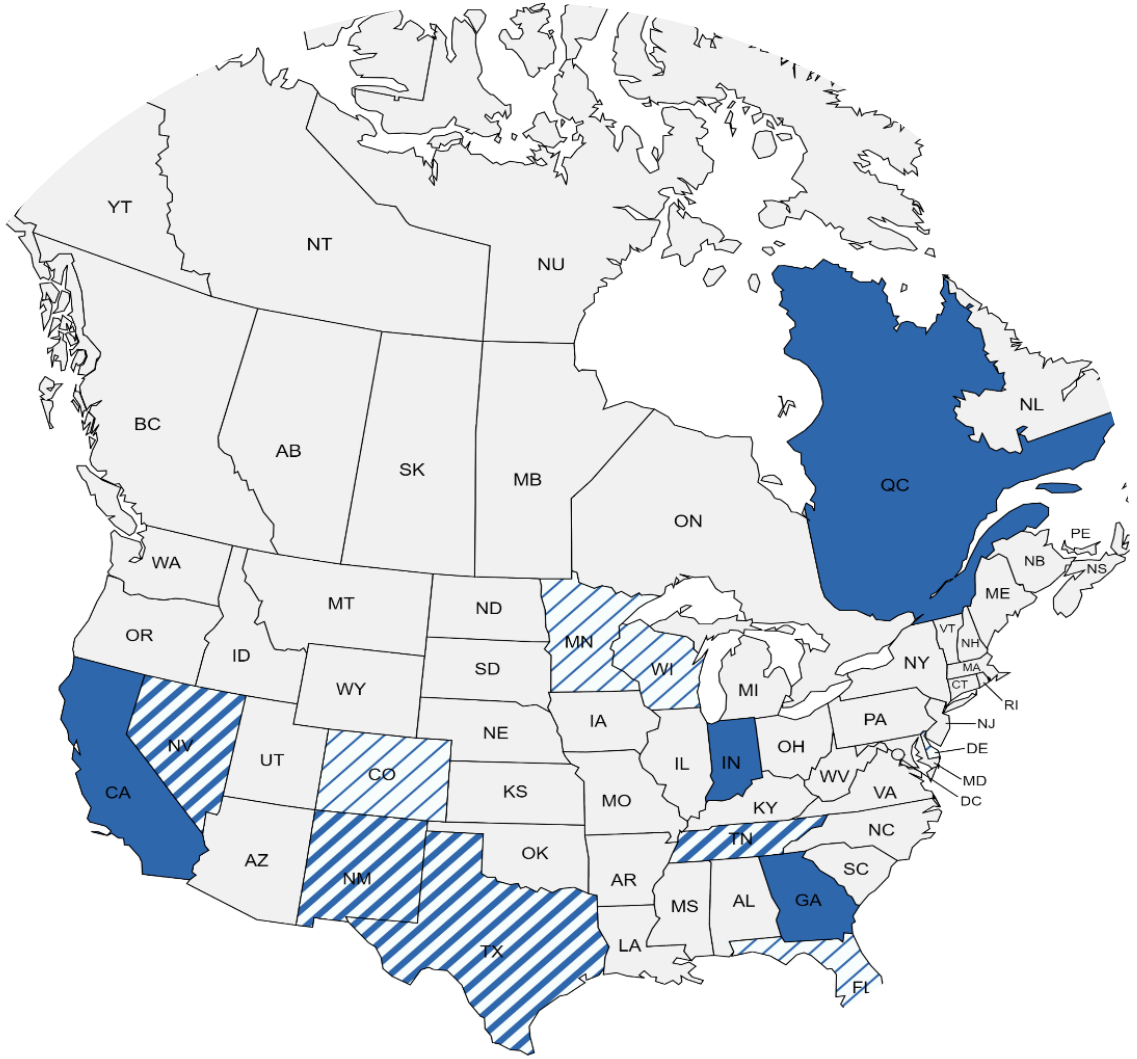
Colorado Water Loss Initiative

Quebec's Water Efficiency Strategy

https://arcg.is/1nrHTv0

NORTH AMERICAN REGULATORY STATUS (2021)





Water Audit Validator Certification Programs:

- State of California
- State of Georgia
- State of Indiana
- State of Colorado*
- State of Texas*

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)

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, DRBC*)

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)

LEAKAGE EMISSIONS INITIATIVE

Andrew McCarthy
andrew.mccarthy@cavanaughsolutions.com

QUESTIONS?

Drew Blackwell
drew.blackwell@cavanaughsolutions.com

Relevant Roles:
Secretary, AWWA Water Loss Control Committee
Board Member, Alliance for Water Efficiency
Co-author, *WRF 5057 Level 1 Water Audit Validation Guidance Manual*
Director of Water Efficiency, Cavanaugh

Andrew McCarthy
andrew.mccarthy@cavanaughsolutions.com

Relevant Roles:
Member, IWA Water Loss Specialists Group
Member, American Biogas Council
Co-author, *AWWA Committee Report: Leakage Emissions Initiative*
Business Development Manager, Cavanaugh