

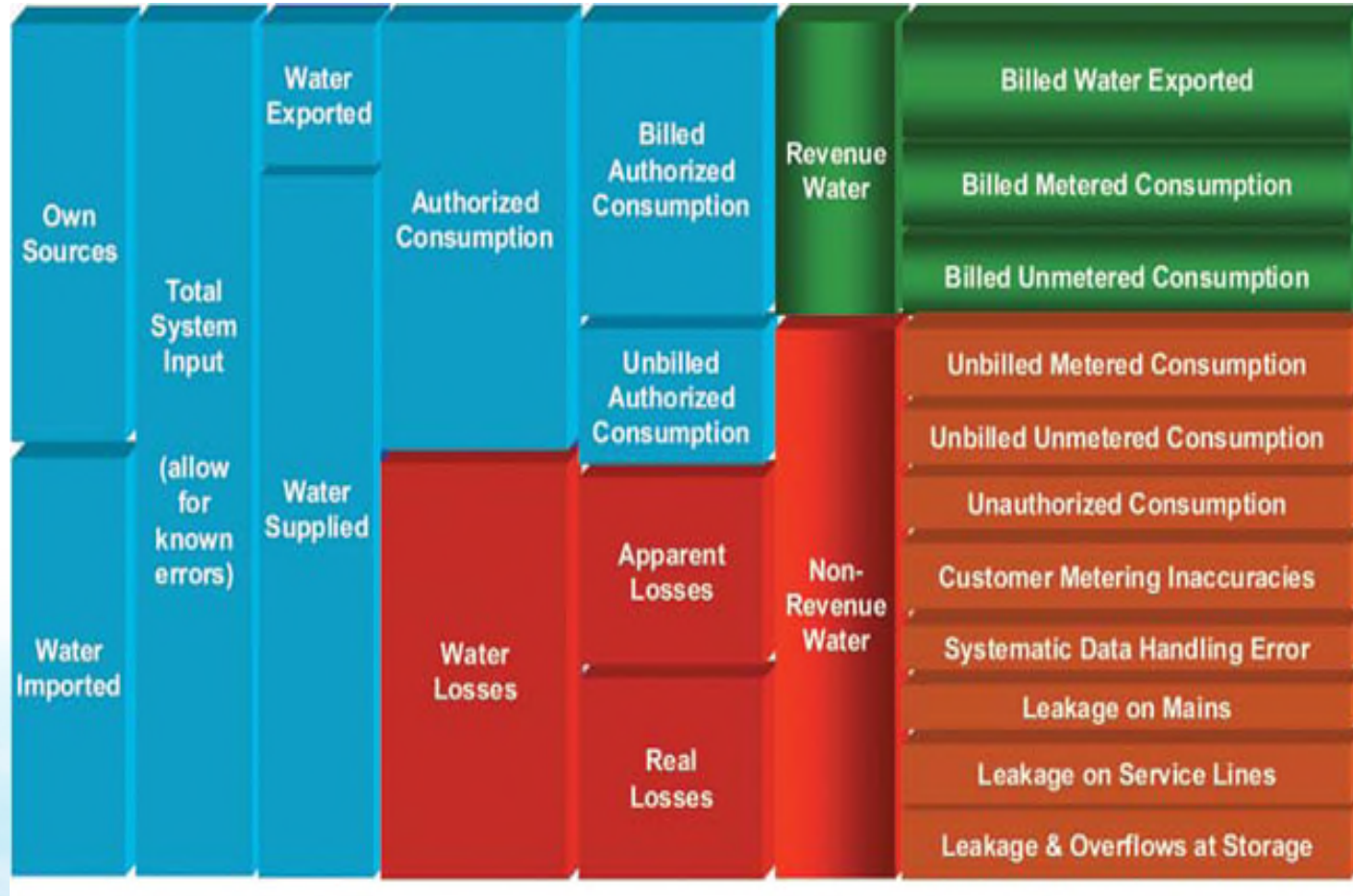
Water Loss Control: Definitions & Methodologies



What does water loss control even mean?



Water Balance Format



Definitions:



Non-Revenue Water

What is non-revenue water?



Non-Revenue Water



💧 Water you are NOT making money on.

💧 US - \$200 Billion

💧 Average loss – 16%



What is Real Loss?



“Physical Water Loss”

- Leakage in the distribution water mains.
- Leakage from services mains.
- Leakage in transmission mains.
- Leakage in storage tanks.



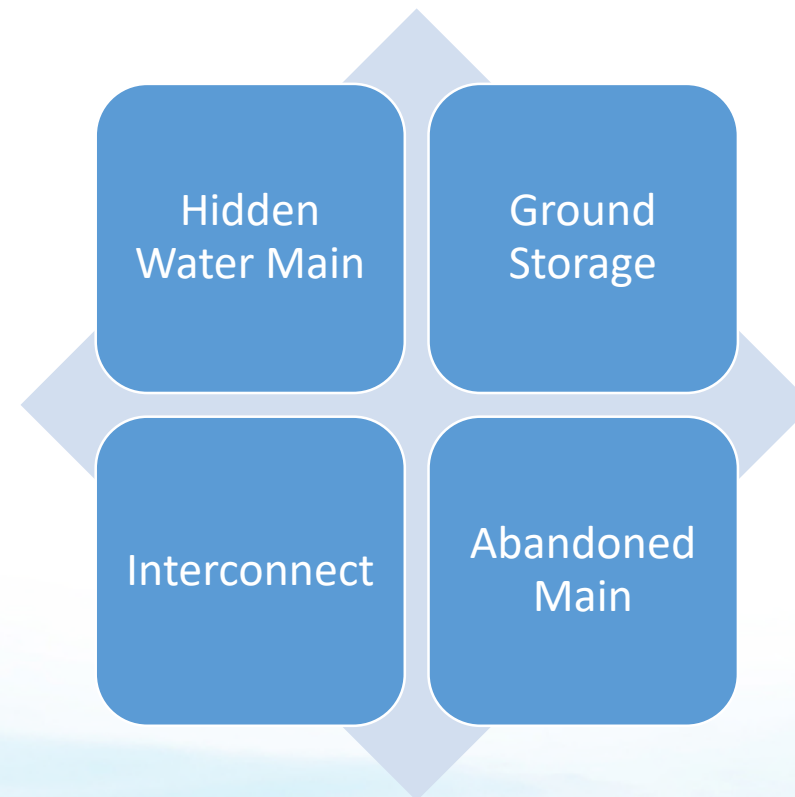
Real Loss

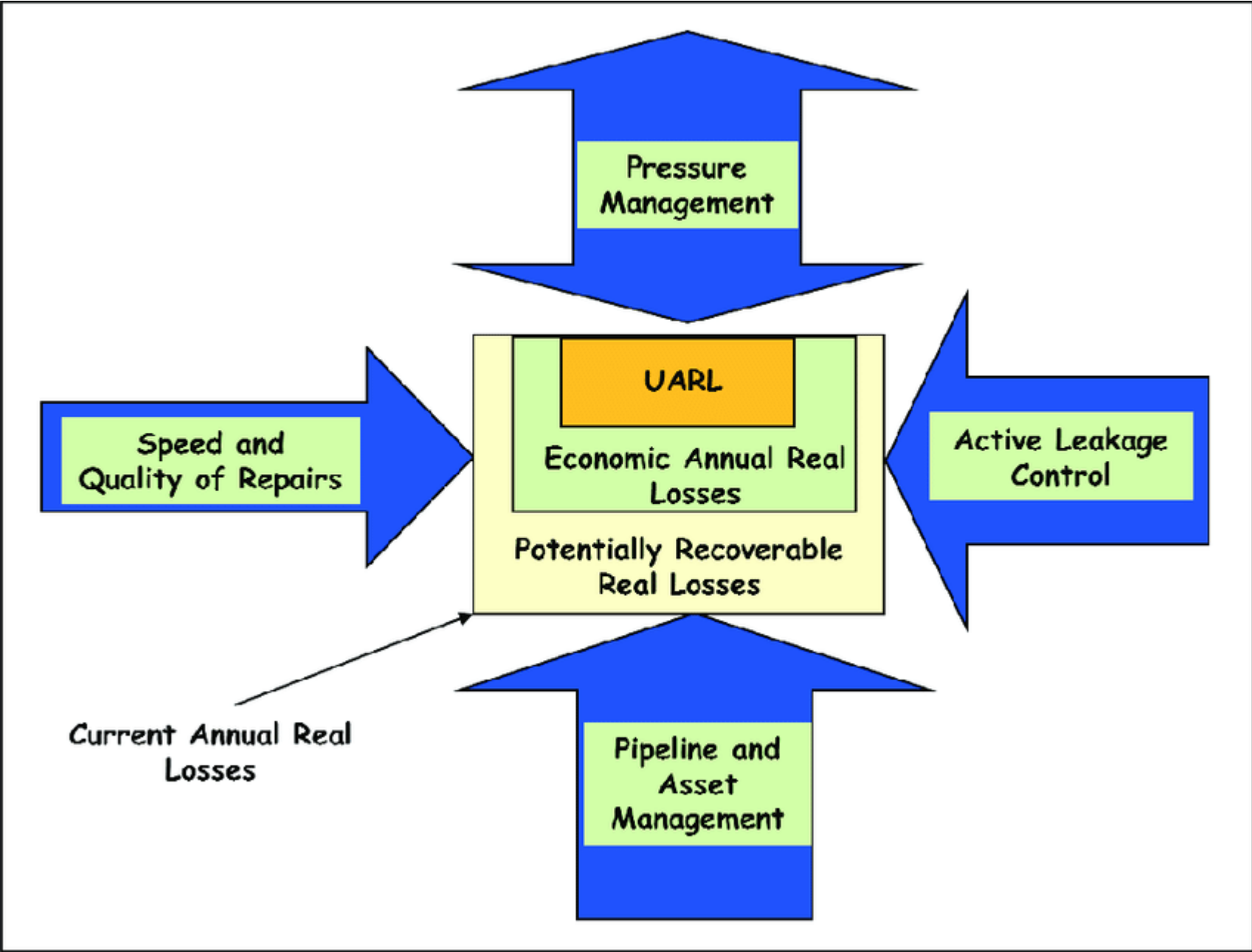


Real Loss



Real Loss (Story Time)

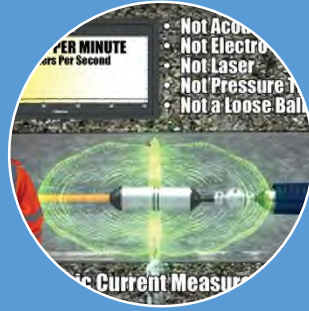




Methodologies: Real Loss



Non-Invasive
Leak
Detection



Invasive Leak
Detection



Reservoir &
Tower
Inspections



Pressure
Management



Non-Invasive Leak Detection

Leak Detection Dog



Non-Invasive Leak Detection



Satellite

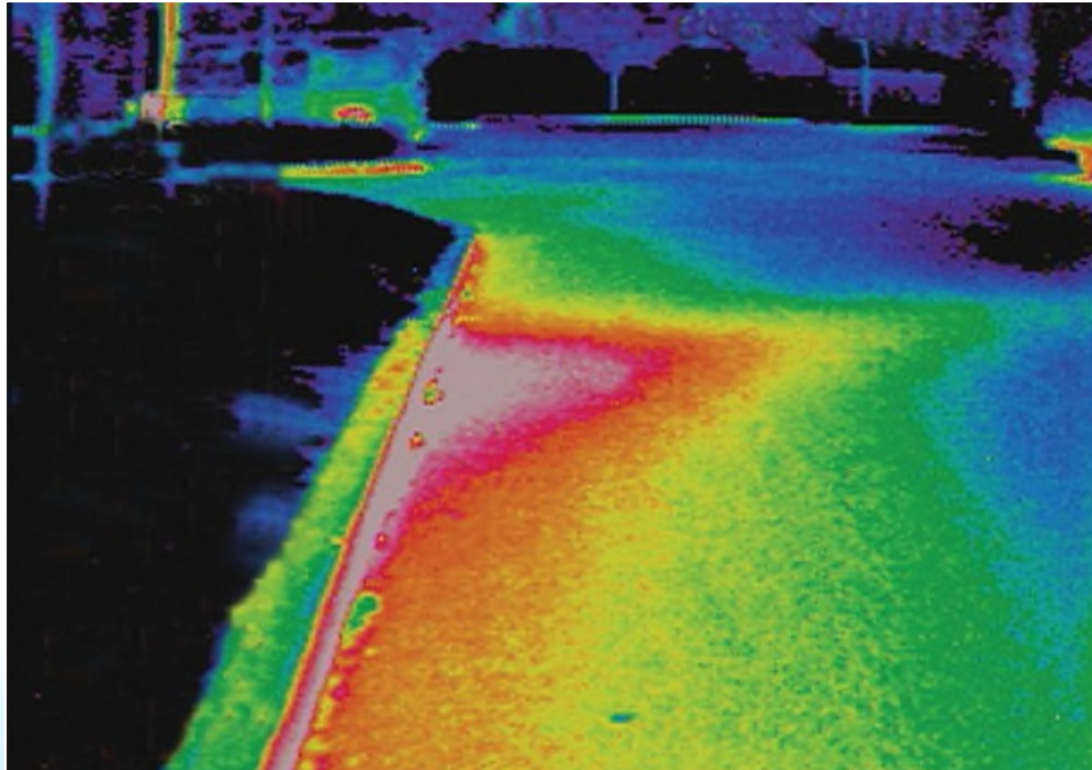


Non-Invasive Leak Detection

Smart
Meters



Non-Invasive Leak Detection



Thermal



Non-Invasive Leak Detection



Remote Leak
Detection



Non-Invasive Leak Detection

Traditional Acoustic Leak Detection



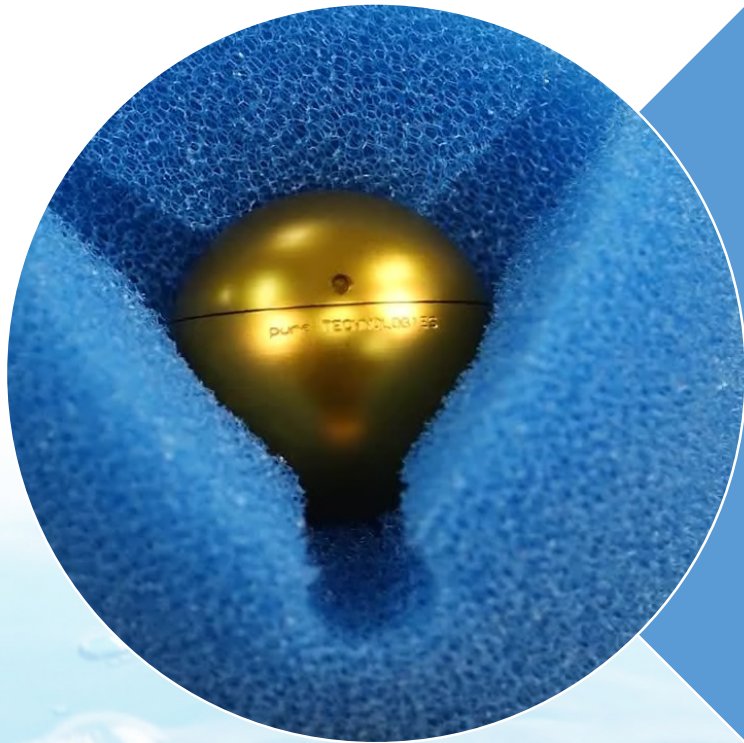
Non-Invasive Leak Detection



Reservoir Draw Down



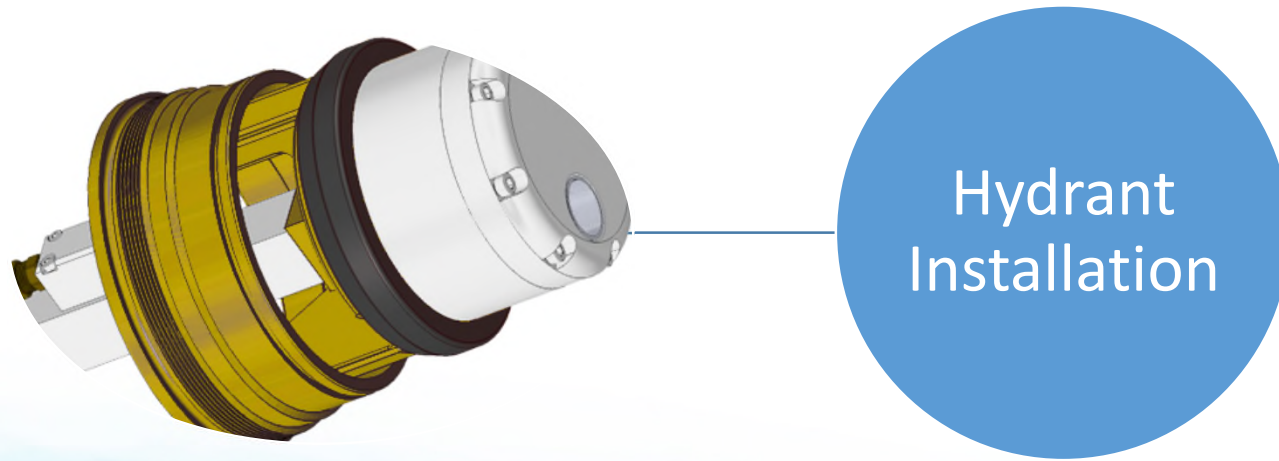
Invasive Leak Detection



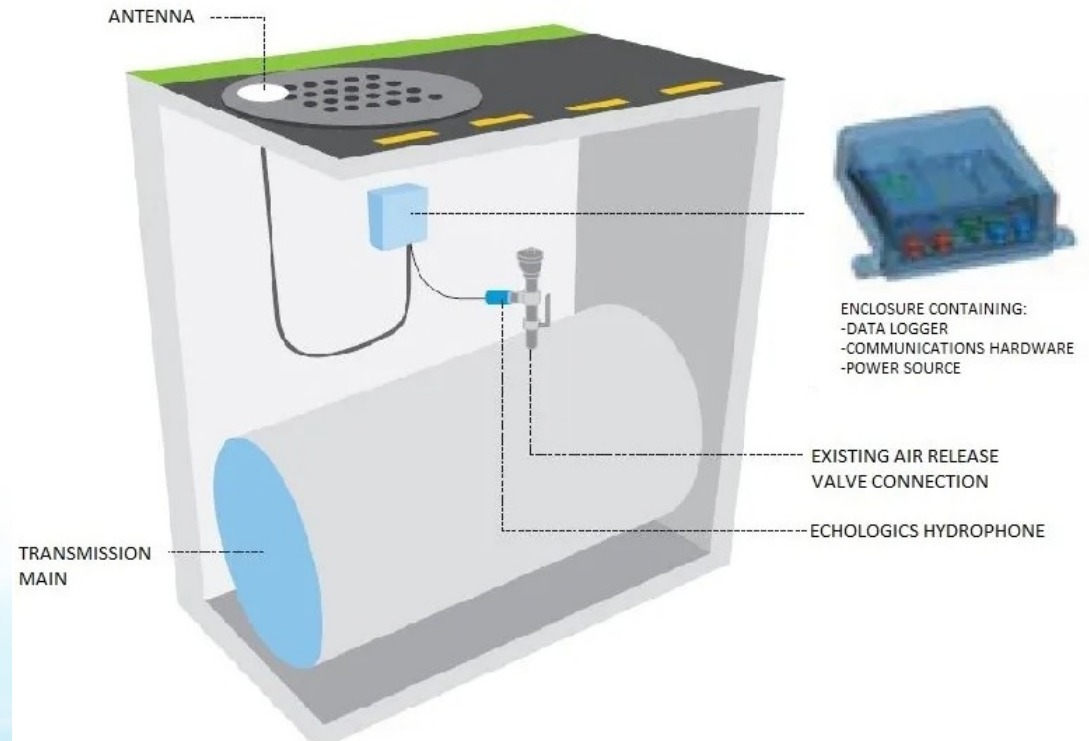
Smart Ball



Invasive Leak Detection



Invasive Leak Detection



Acoustic for Large Transmission



Invasive Leak Detection



- Not Acoustic
- Not Electro-Magnetic
- Not Laser
- Not Pressure Transient
- Not a Loose Ball or Sphere

Tethered



Invasive Leak Detection



Tracer Gas



Real Loss: Pressure Management

- 💧 Cellular Based
- 💧 Standard State Pressure
- 💧 Transient Pressure
- 💧 Alerts
- 💧 Pro / Con



What is Apparent Loss?



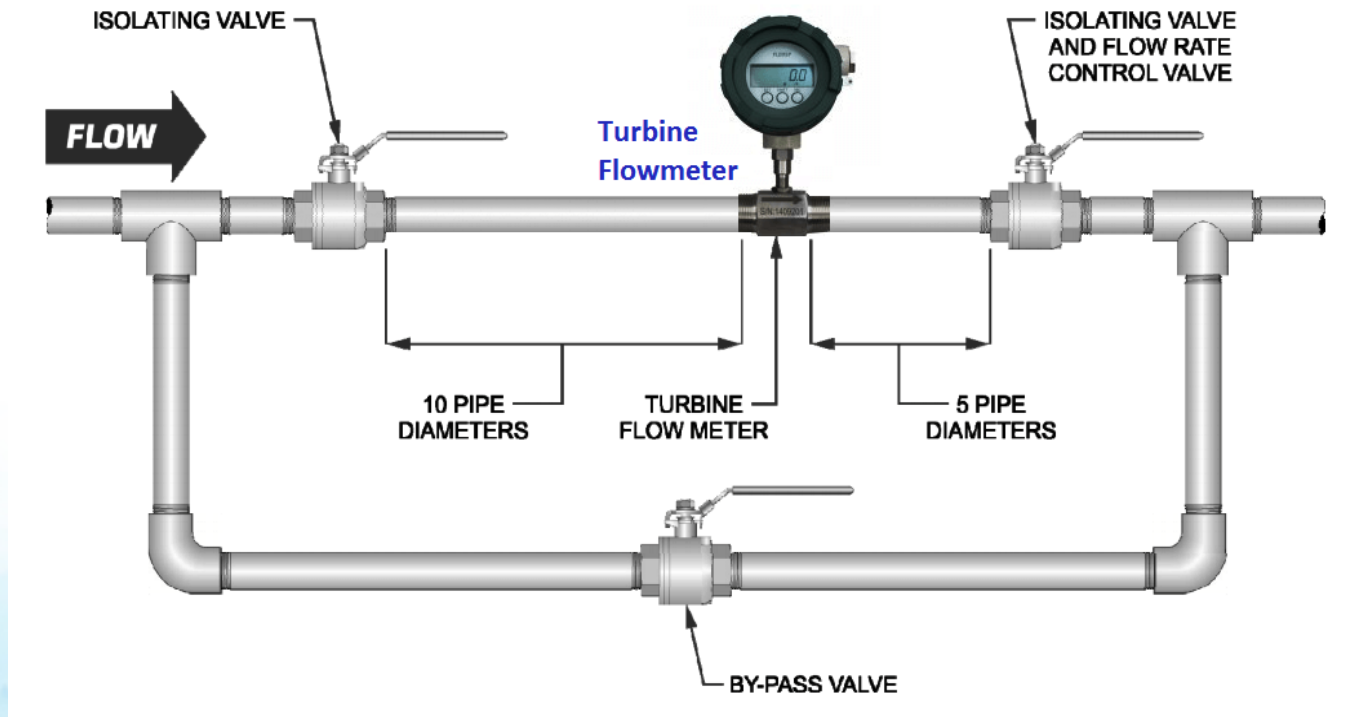
Apparent Loss

Unauthorized Consumption

- Bypass installed by customer
- Unauthorized fire hydrant use
- Connections to bordering systems
- Meter Vandalism
- Contractor FH use



Apparent Loss: Unauthorized Consumption



By-Pass connection by customer.



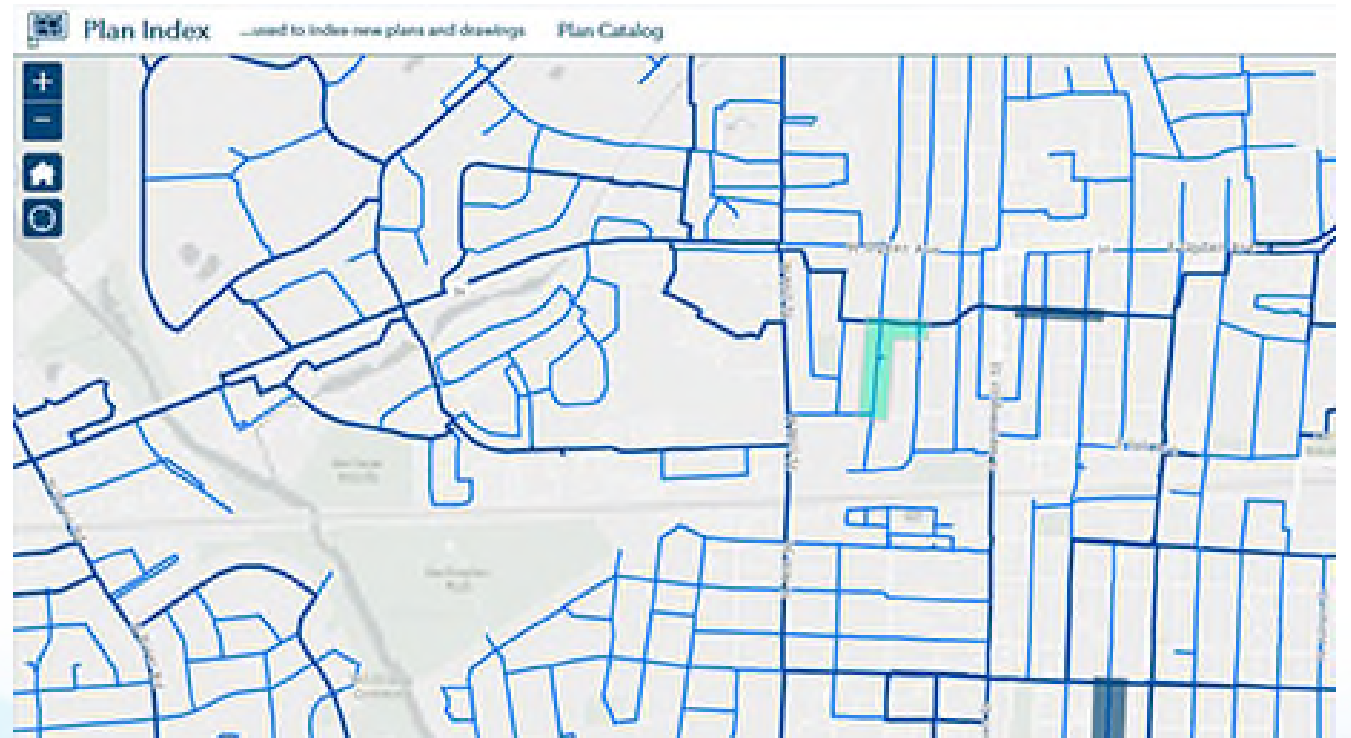
Apparent Loss: Unauthorized Consumption

💧 Fire Hydrant Use



Apparent Loss: Unauthorized Consumption

 Interconnect Valve



Apparent Loss: Unauthorized Consumption



Meter Vandalism



Apparent Loss: Unauthorized Consumption



 Contractor



Apparent Loss

Customer Metering Inaccuracies

- Meter Installation
- Open/Leaking Bypass Valve
- Under / Oversized Water Meter
- Improper Type of Meter
- Buried / Lost Meters

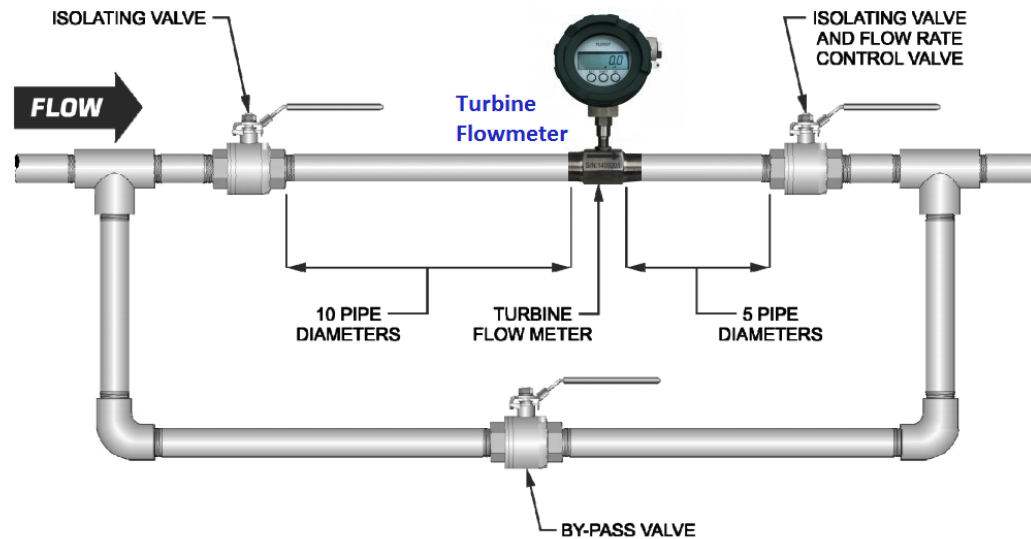


Apparent Loss: Customer Metering Inaccuracies

💧 Meter Installation— Zero Reading



Apparent Loss: Open bypass



🌊 Open bypass



Apparent Loss: Undersized / Oversized

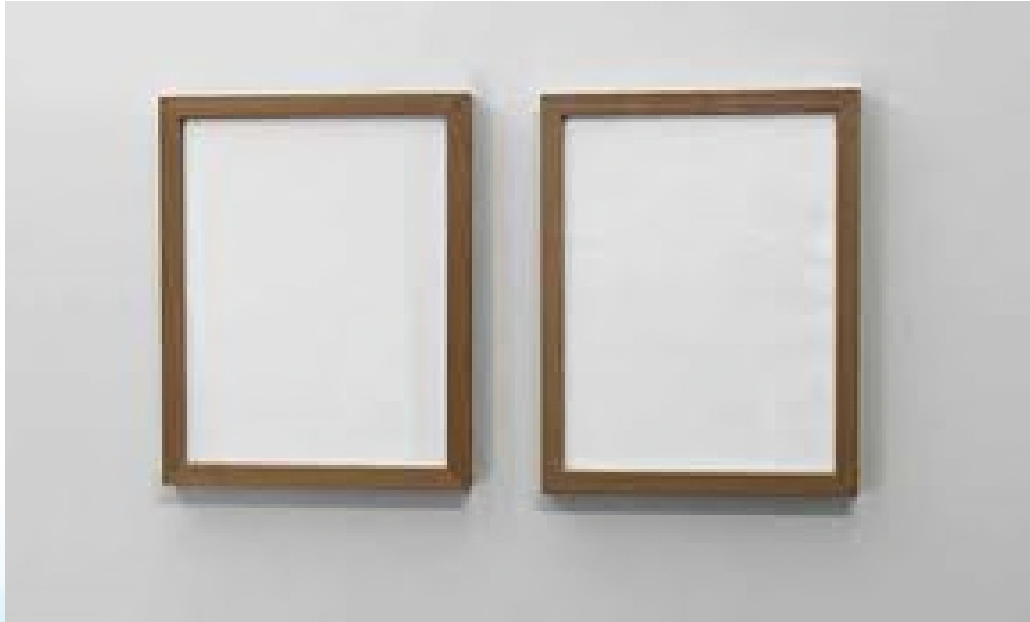


Apparent Loss: Improper Meter

💧 Incorrect type of meter.



Apparent Loss: Lost Meters



💧 This is a thing



Apparent Loss



**COMMON DATA
ENTRY ERRORS**



Apparent Loss: Data Entry Errors

Systematic Data Handling Errors – Data Handling / Transfer Errors

- 💧 Manual Adjusts to a meter read
- 💧 Long term “no read”
- 💧 Estimated Billing
- 💧 Data entry errors when changing out meters.
- 💧 Programming of AMR
- 💧 Meter is in place but not read
- 💧 Compound meter issue
- 💧 Customer incorrect contact info

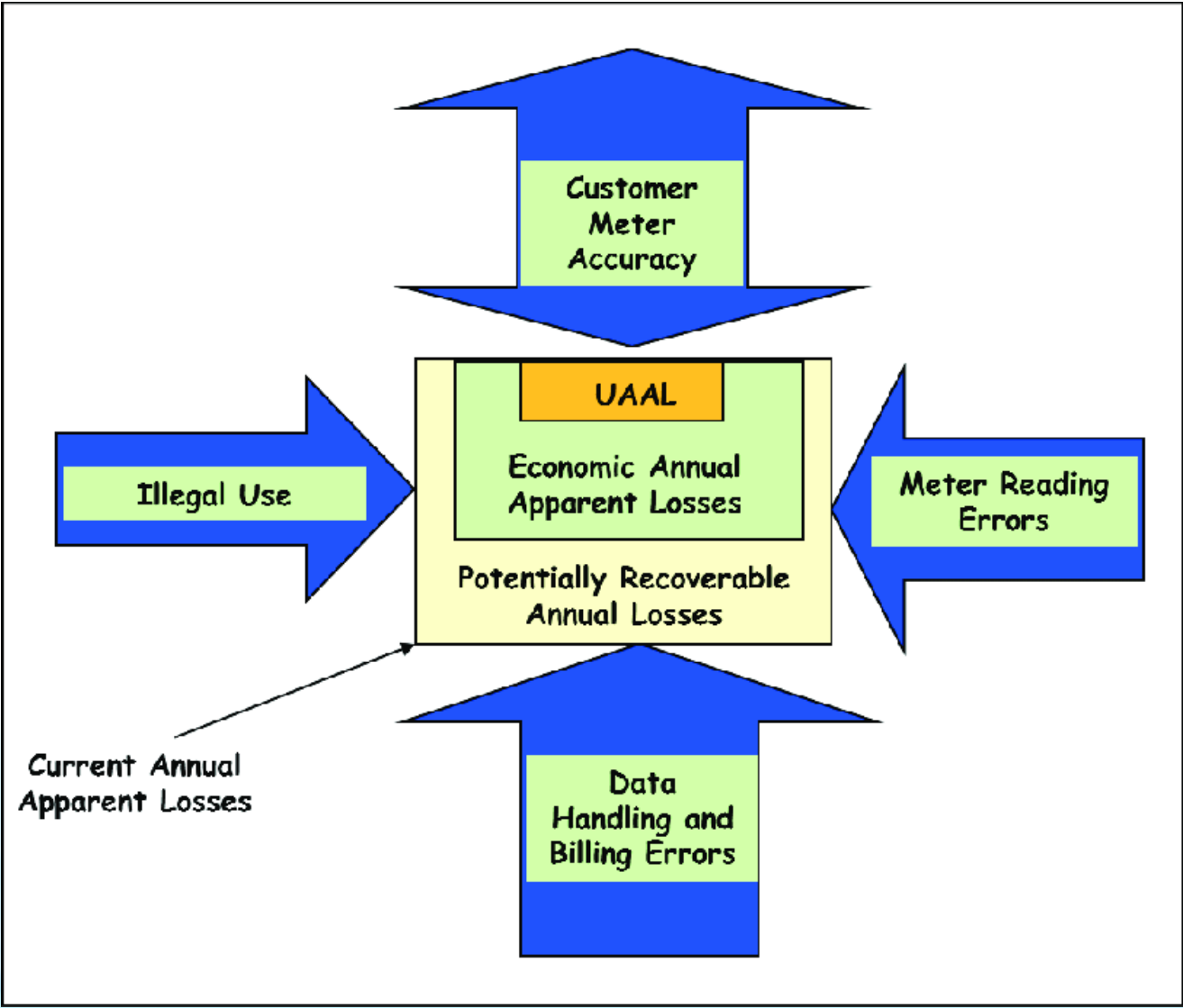


Apparent Loss: Data Entry Errors

Systematic Data Handling Errors – Data Analysis / Billing Errors

- 💧 Improper Multiplier
- 💧 Manually adjusting bills but not the usage
- 💧 Adjustments due to leakage
- 💧 Long term “no-reads” are NOT flagged
- 💧 Computer / Billing software issues
- 💧 Improper AMR programming
- 💧 Theft
- 💧 No Meter





Methodologies: Apparent Loss



Unauthorized
Consumption



Customer
Metering
Inaccuracies



Data Handling
Errors



Unauthorized Consumption



Bypass Meter



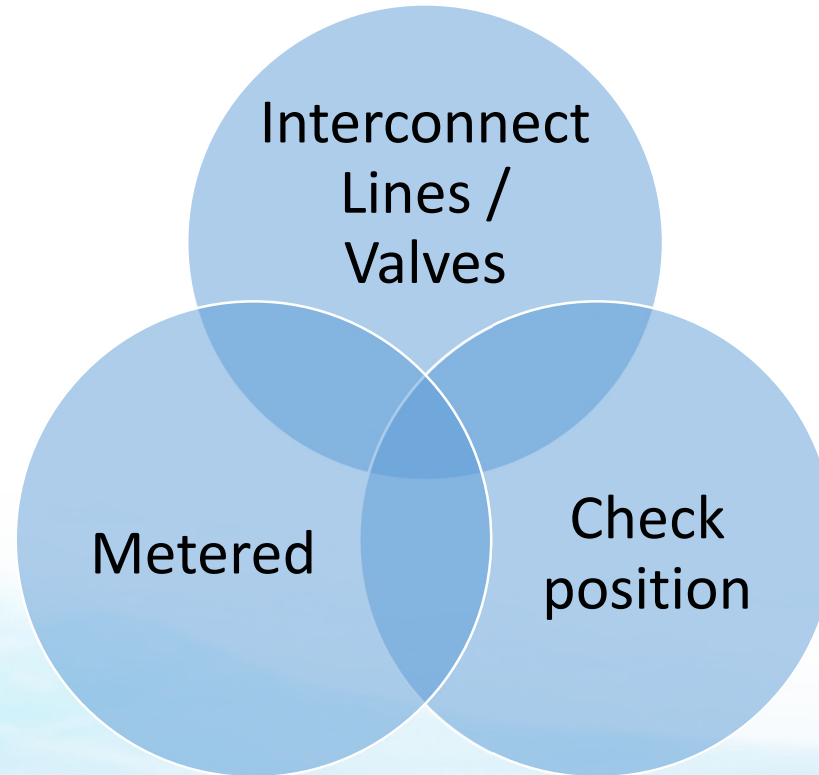
Bypass Valve
Locking



Unauthorized Consumption



Unauthorized Consumption



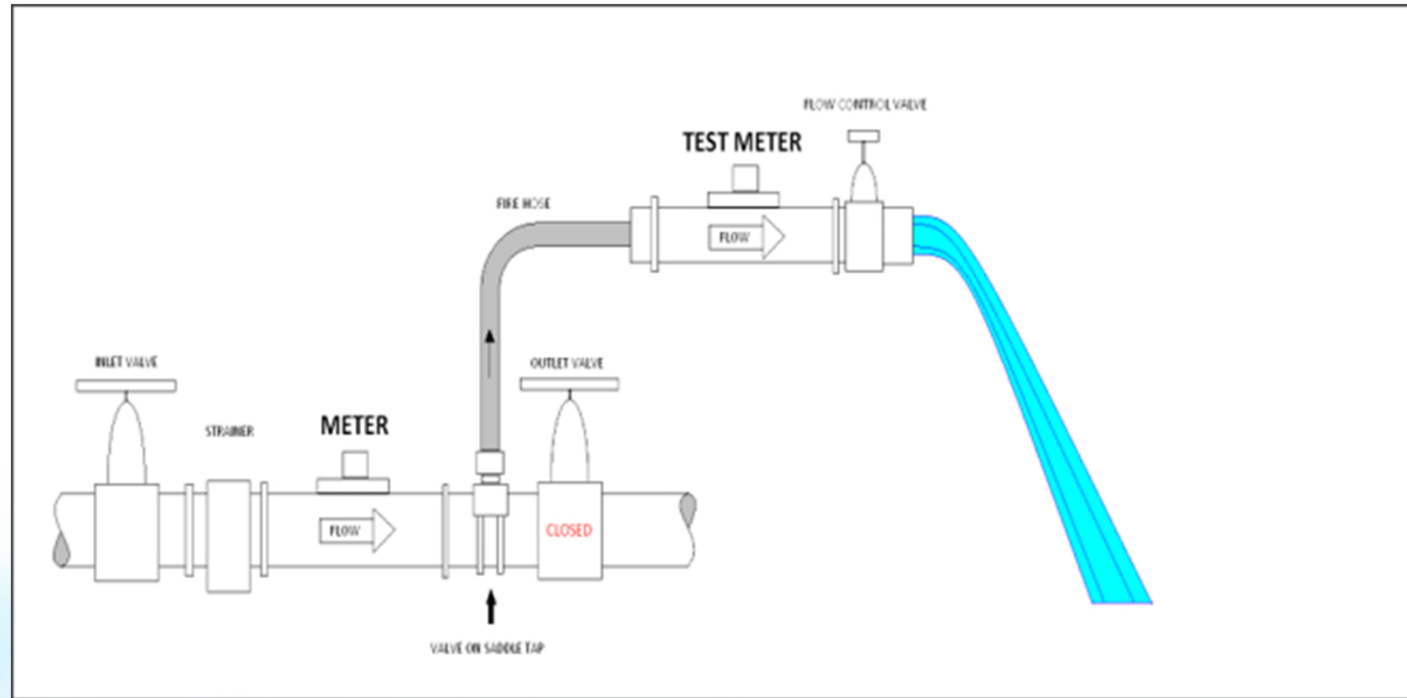
Unauthorized Consumption



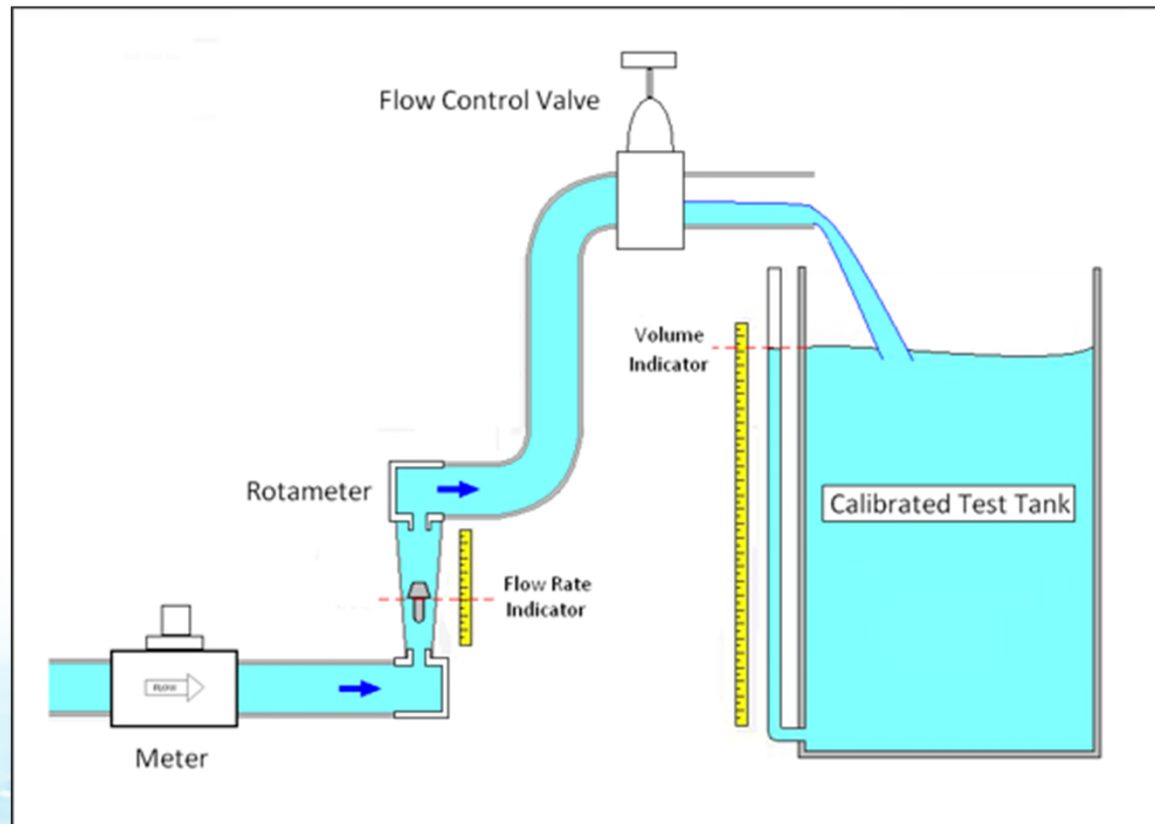
Water
Fill
Stations



Customer Metering Inaccuracies



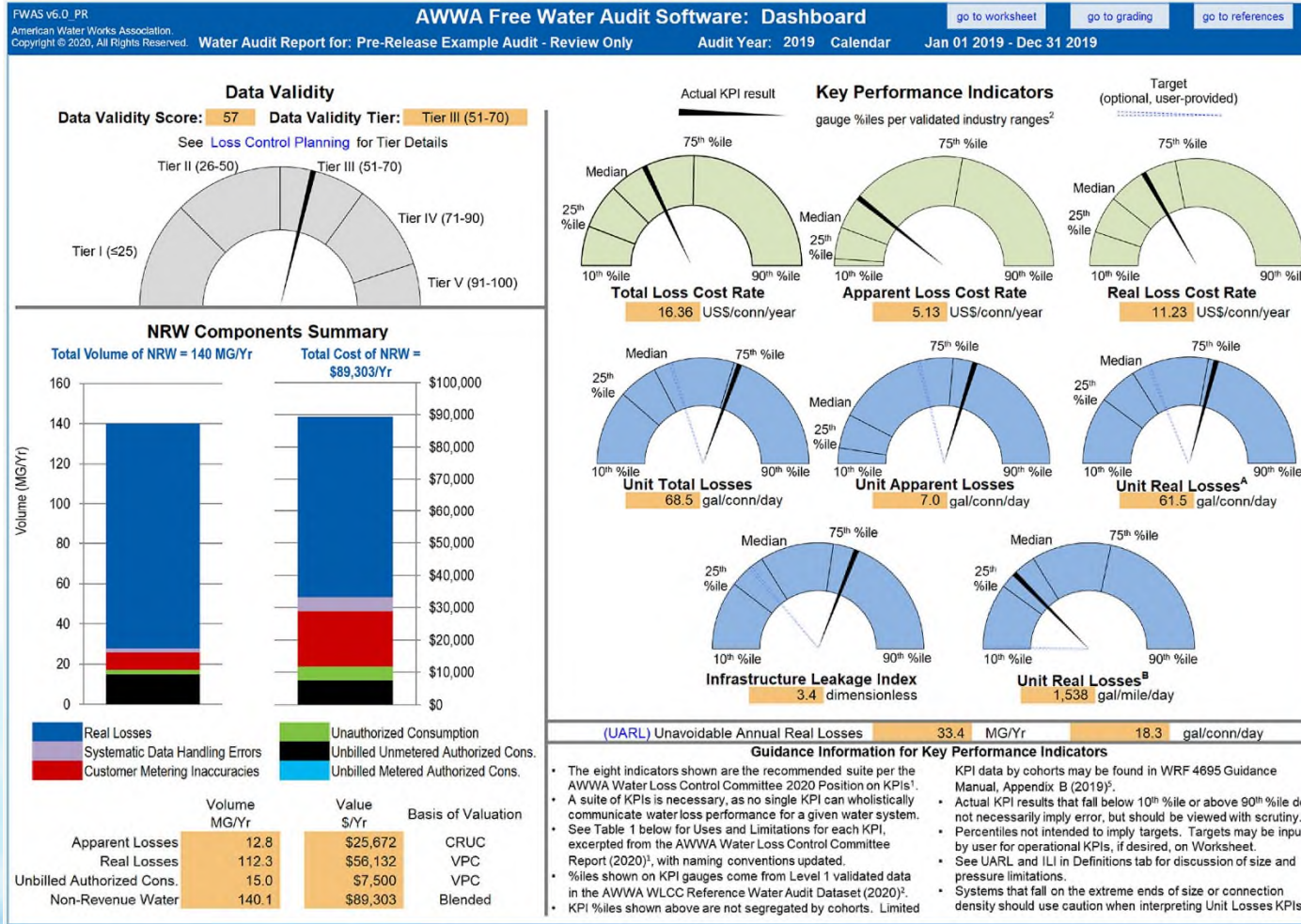
Customer Metering Inaccuracies



Customer Metering Inaccuracies



Data Handling Errors



conn—connection, CRUC—Customer Retail Unit Charge, FWAS—Free Water Audit Software, ILI—Infrastructure Leakage Index, KPI—key performance indicator, NRW—nonrevenue water, UARL—Unavoidable Annual Real Loss, VPC—Variable Production Cost, WLCC—Water Loss Control Committee, WRF—The Water Research Foundation



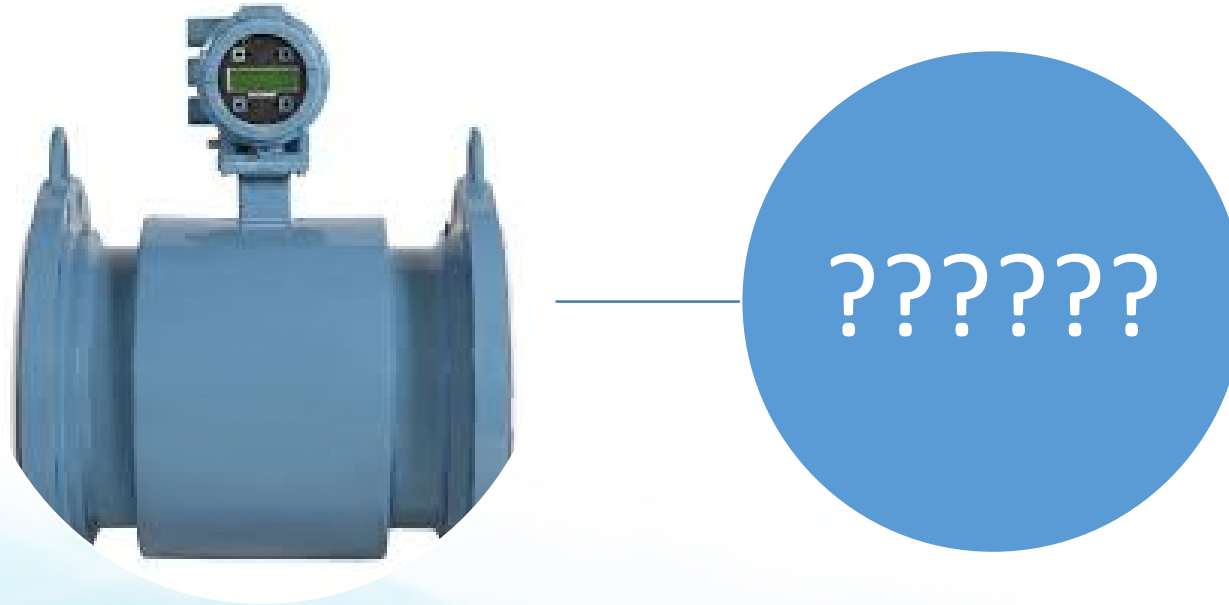
Data Handling Errors



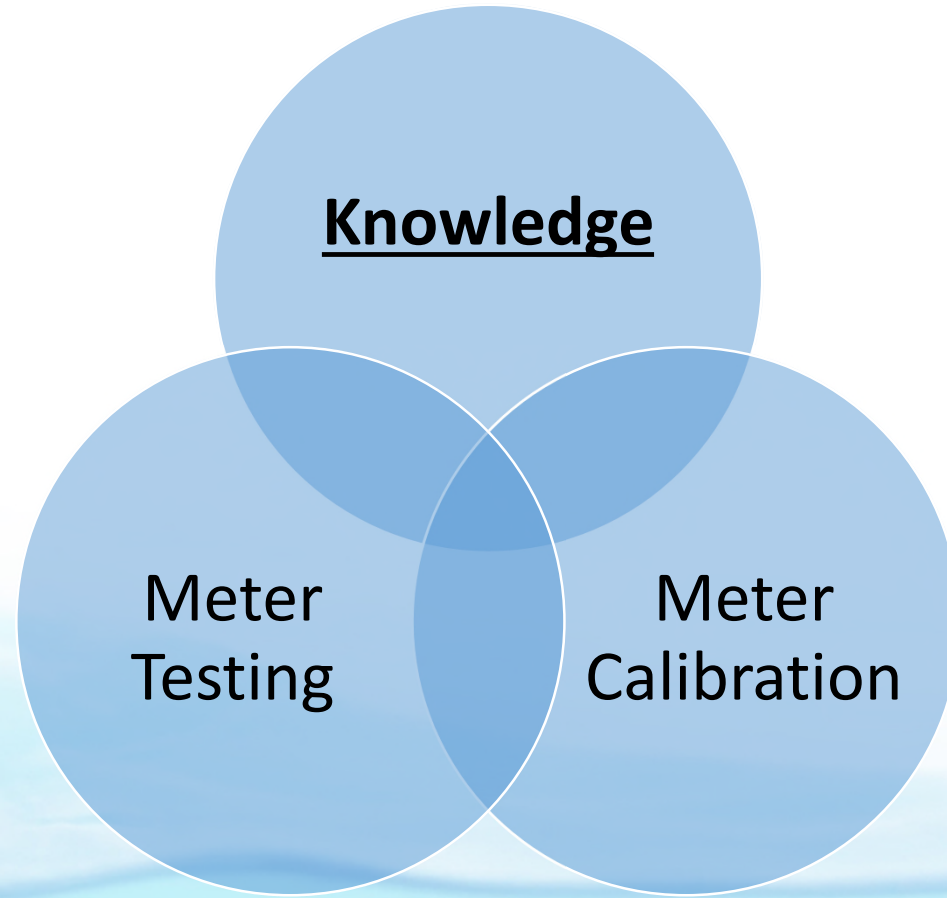
Data Handling Errors



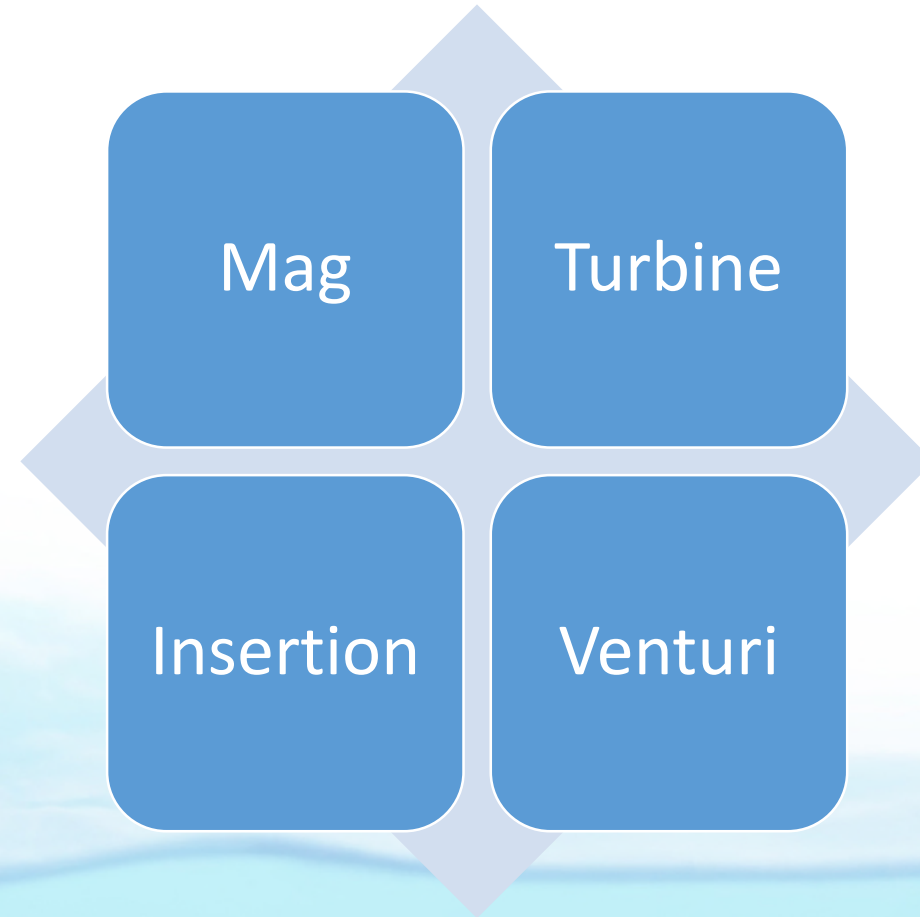
Master Meter: The Heart



Master Meters



Master Meters



Master Meters



Methodologies: Master Meters



Pitot Testing



Ultra Sonic Strap On



Pitot Testing

Test in place



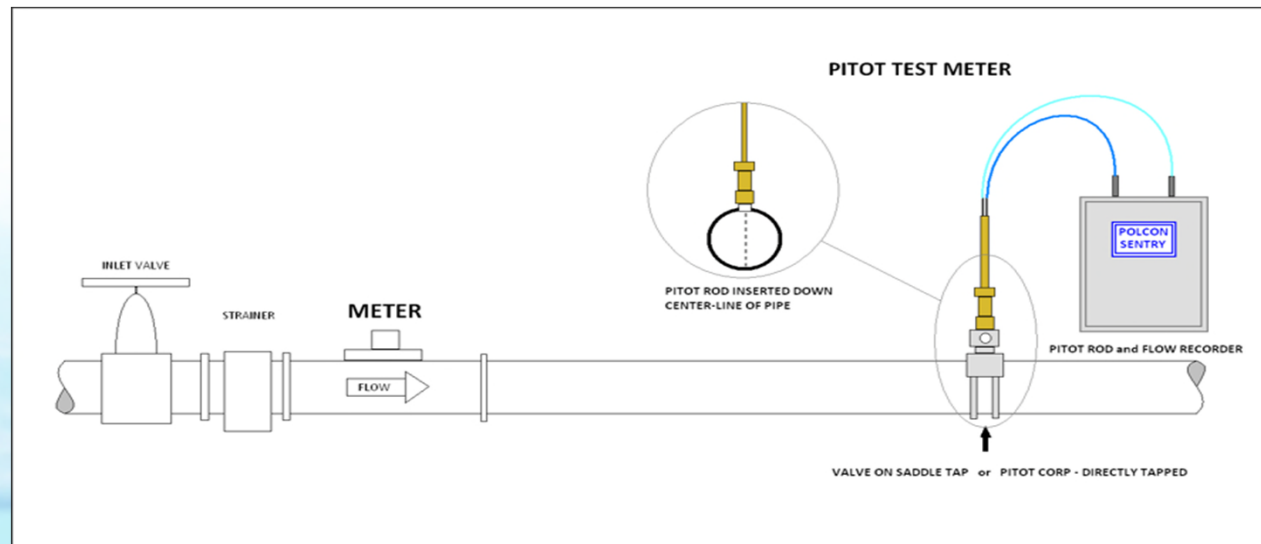
Repeatable



True size



(+/-) 2%



Flow Meter: Strap on – Doppler

Test in Place



Repeatable



Ease of use



(+/-) 5%



AWWA: Water Audit

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v8.0
American Water Works Association
Copyright © 2014. All Rights Reserved.

Water Audit Report for: **Anytown (001)**
Reporting Year: **2014** **10/2013 - 9/2014**

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (via ur 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades.

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

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below.

<----- Enter grading in column 'E' and 'J' ----->

WATER SUPPLIED

Volume from own sources:	<input type="text" value=""/>	MG/yr	Master Meter and Supply Error Adjustments	
Water imported:	<input type="text" value="2,750,000"/>	MG/yr	Pct:	<input type="text" value="-4.00%"/>
Water exported:	<input type="text" value=""/>	MG/yr	Value:	<input type="text" value=""/>
WATER SUPPLIED:	2,864,583	MG/yr	Enter negative % or value for under-registration Enter positive % or value for over-registration	

AUTHORIZED CONSUMPTION

Billed metered:	<input type="text" value="2,400,000"/>	MG/yr	Click here: <input type="button" value="H"/> for help using option buttons below
Billed unmetered:	<input type="text" value="20,000"/>	MG/yr	
Unbilled metered:	<input type="text" value="35,807"/>	MG/yr	
Unbilled unmetered:	<input type="text" value=""/>	MG/yr	
Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed			
AUTHORIZED CONSUMPTION:	2,455,807	MG/yr	

WATER LOSSES (Water Supplied - Authorized Consumption) **408,776** MG/yr

Apparent Losses

Unauthorized consumption:	<input type="text" value="7,161"/>	MG/yr	Pct:	<input type="text" value="0.25%"/>
Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed			Value:	<input type="text" value=""/>
Customer metering inaccuracies:	<input type="text" value="182,151"/>	MG/yr	Pct:	<input type="text" value="7.00%"/>
Systematic data handling errors:	<input type="text" value="6,000"/>	MG/yr	Value:	<input type="text" value=""/>
Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed				
Apparent Losses:	195,312	MG/yr		

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **213,464** MG/yr

WATER LOSSES: **408,776** MG/yr

NON-REVENUE WATER

NON-REVENUE WATER: **464,583** MG/yr

Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	<input type="text" value="260.1"/>	mile
Number of active AND inactive service connections:	<input type="text" value="19,345"/>	
Service connection density:	<input type="text" value="74"/>	conn./mile-main
Are customer meters typically located at the curbside or property line?	<input type="text" value="No"/>	
Average length of customer service line:	<input type="text" value="59.0"/>	ft (length of service line, beyond the property boundary, that is the responsibility of the utility)
Average operating pressure:	<input type="text" value="55.0"/>	psi

COST DATA

Total annual cost of operating water system:	<input type="text" value="\$9,000,000"/>	\$/Year
Customer retail unit cost (applied to Apparent Losses):	<input type="text" value="\$5.00"/>	\$/1000 gallons (US)
Variable production cost (applied to Real Losses):	<input type="text" value="\$135.00"/>	\$/Million gallon <input type="checkbox"/> Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 86 out of 100 *****

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



Water Audit

AWWA Free Water Audit Software: Determining Water Loss Standing		WAS American Water Works Association, Copyright © 2014, All Rights Reserved			
Water Audit Report for: Anytown (007)					
Reporting Year: 2014 10/2013 - 9/2014					
Data Validity Score: 86					
Water Loss Control Planning Guide					
Water Audit Data Validity Level / Score					
Functional Focus Area	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
For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.					



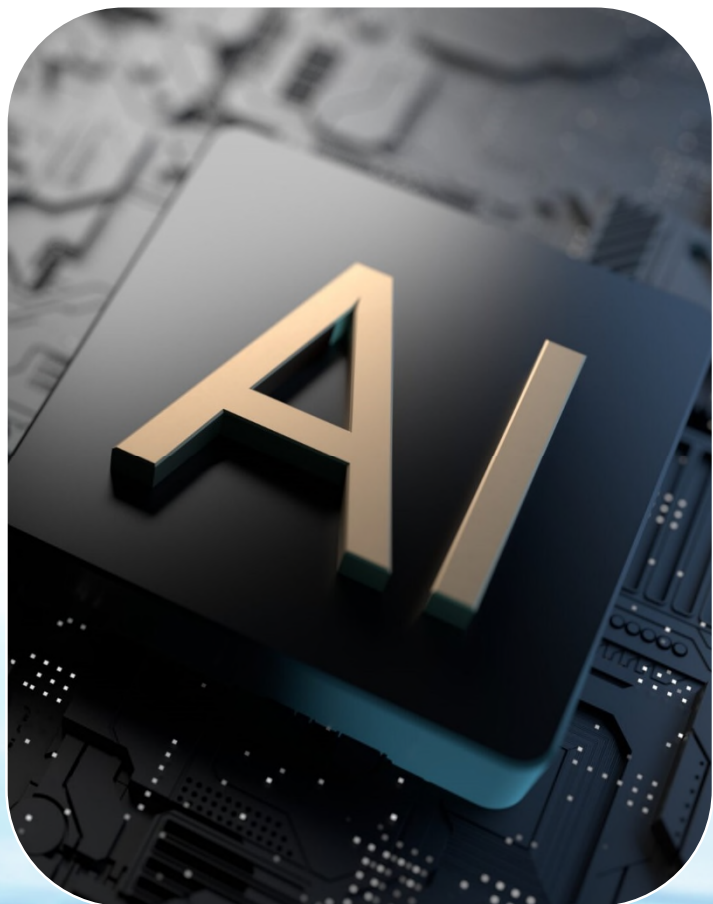
The Future

Machine
Learning

Artificial
Intelligence



Artificial Intelligence



Mimics



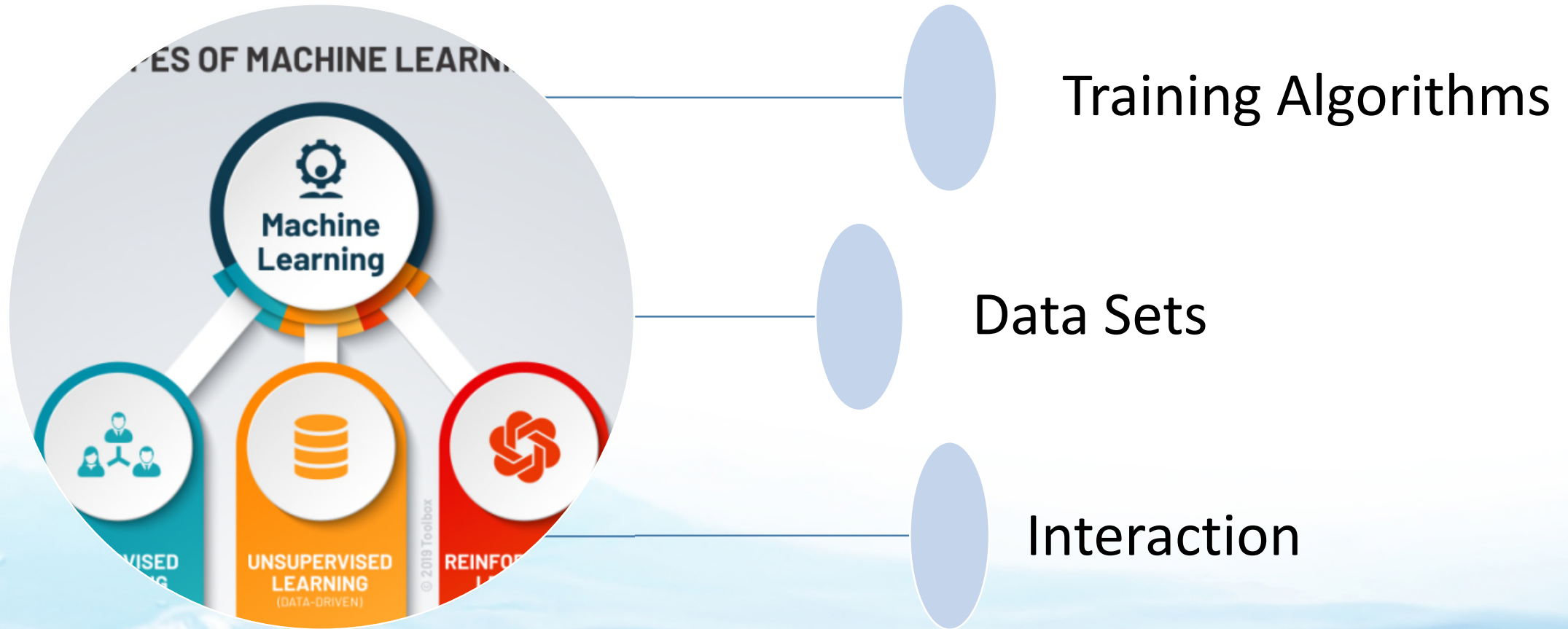
Tasks



Learns

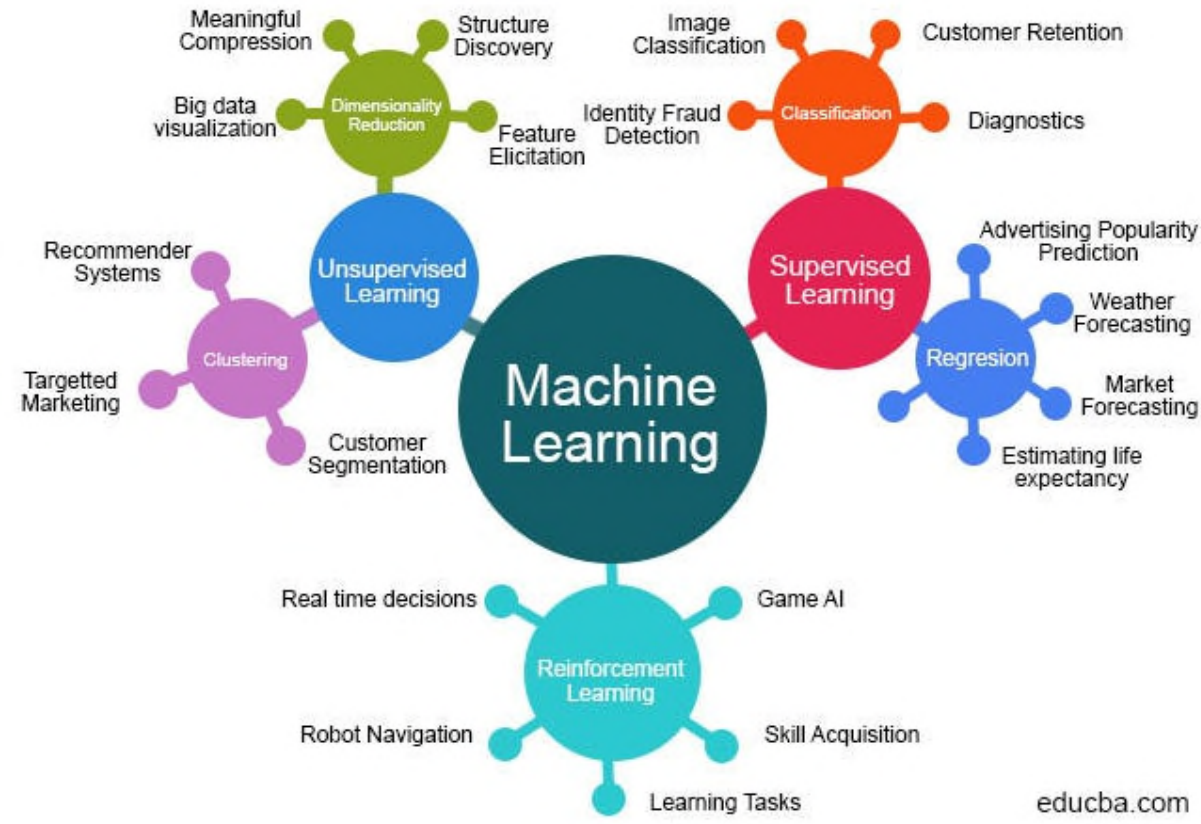


Machine Learning: Subfield



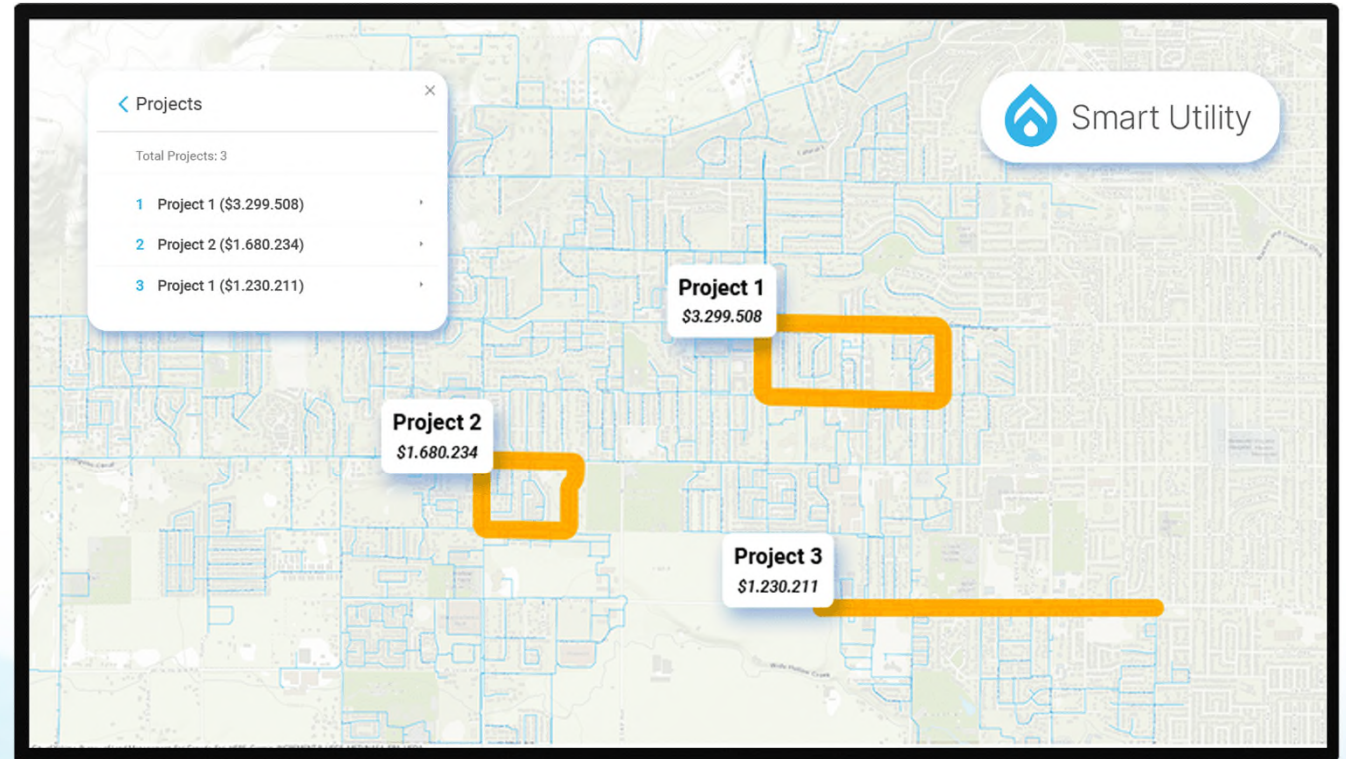
Machine Learning

Machine Learning Algorithms



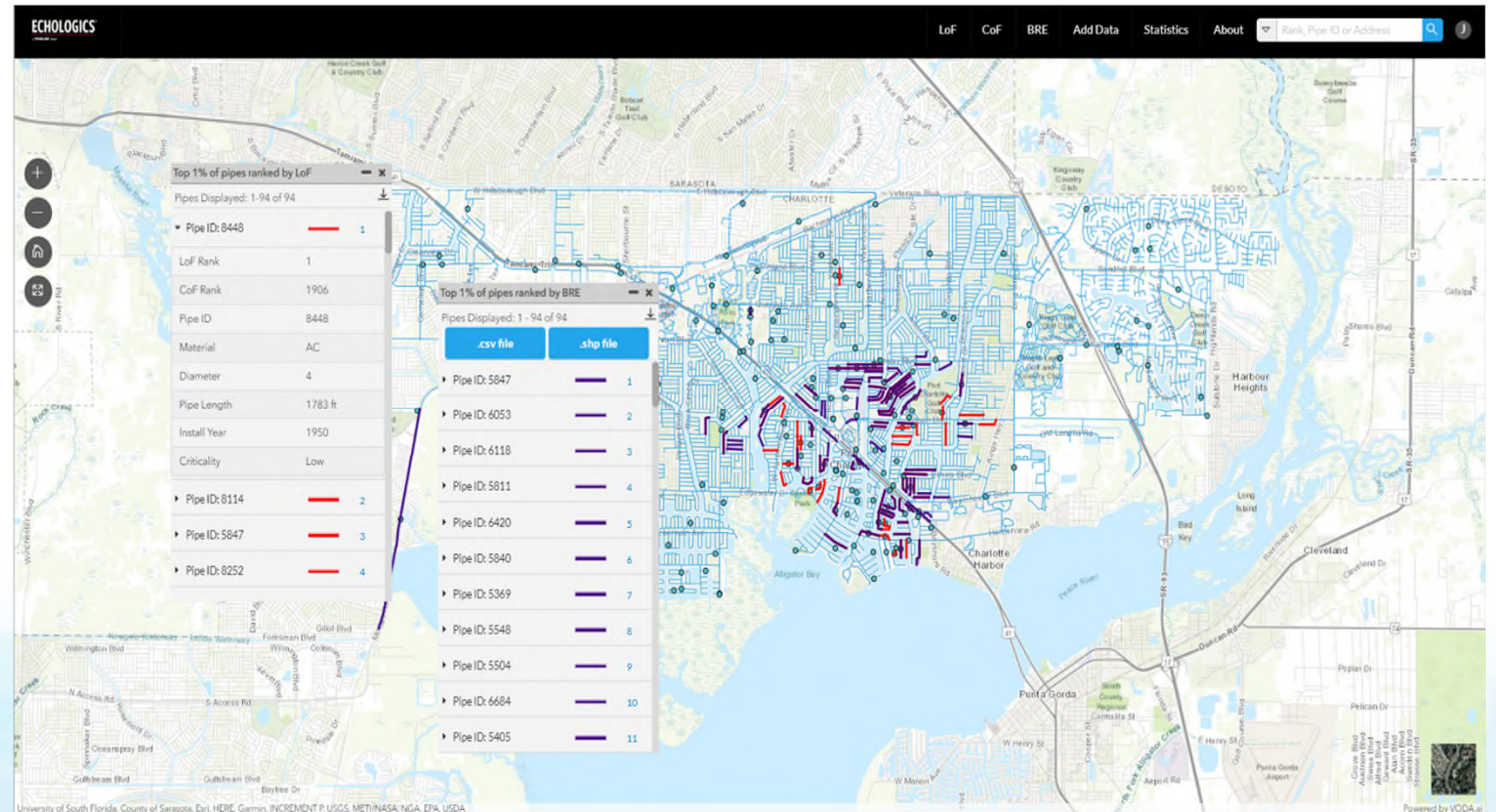
Methodologies: A.I.

- 💧 Predict Emergency Events
- 💧 Sophisticated Decisioning Intel
- 💧 Optimize Energy
- 💧 Overconsumption



Methodologies: A.I.

- 💧 Prediction Analytics
- 💧 Risk Modeling
- 💧 Condition Assessment
- 💧 Planner



Condition Assessment



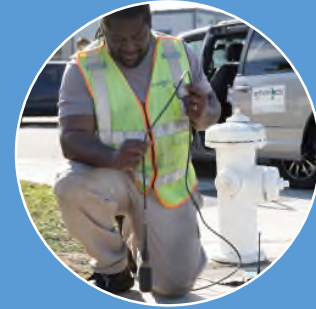
Condition Assessment: Methodologies



Artificial
Intelligence



Invasive



Non-Invasive

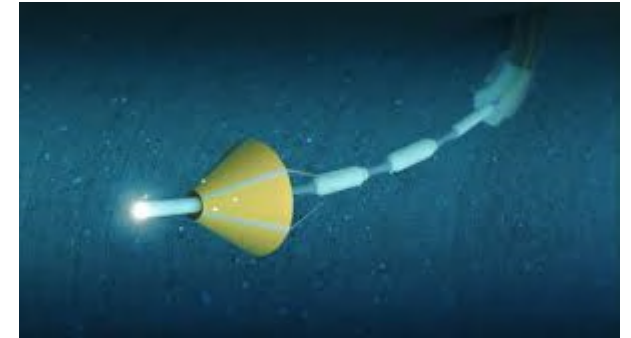


Condition Assessment: Invasive

Free Floating



Tethered

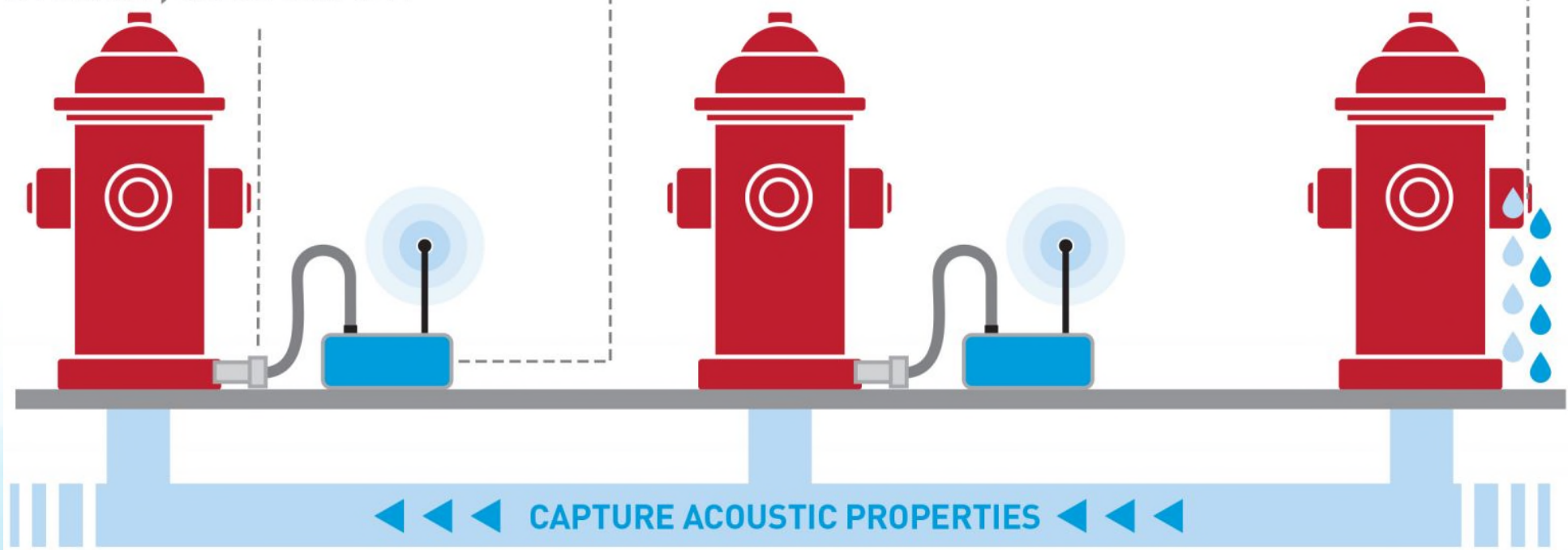


Condition Assessment: Non-Invasive

SENSOR CONNECTED TO
HYDRANT, VALVE OR PIPE

RF TRANSMITTER

NOISE SOURCE



Return on Investment



Product Marketing & Growth | Glossary

Return On Investment (ROI)

Return on Investment is a key business metric that measures the profitability of investments or marketing activities by weighing the size of the upfront cost against the net profits it produced.



Methodology: R.O.I.

Return on investment formula

$$\text{ROI} = \frac{\text{Net investment gain}}{\text{Cost of investment}} \times 100$$

INSIDER



Conclusion

Did we fulfill our learning objectives today?

- Understanding the difference definitions & methodologies for your water distribution system.
- What management practices can I implement to reduce real & apparent loss in my distribution system.



Thank you!!

Randy Lusk

M.E. Simpson Co., Inc.

V.P. of Innovation & Solutions

RandyL@mesimpson.com

