

Reducing NRW with AI-Powered Technologies



House Keeping Rules

- **Mute Your Mic** – Please keep your microphone muted unless speaking to minimize background noise.
- **Q&A Session** – There will be a dedicated Q&A session at the end of the webinar. Feel free to submit questions via the Q&A feature.
- **Stay Engaged** – Polls, reactions, and the chat are great ways to participate.
- **Recording & Replay** – This webinar is being recorded. Recording & slides will be shared afterward.
- **Tech Support** – If you experience any issues, message our tech support team in the chat.

Enable translated captions





Kate Stanton-Davies

Co-founder and Director of
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**8 years of experience in
NRW reduction software
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**Business development &
expansion leader**



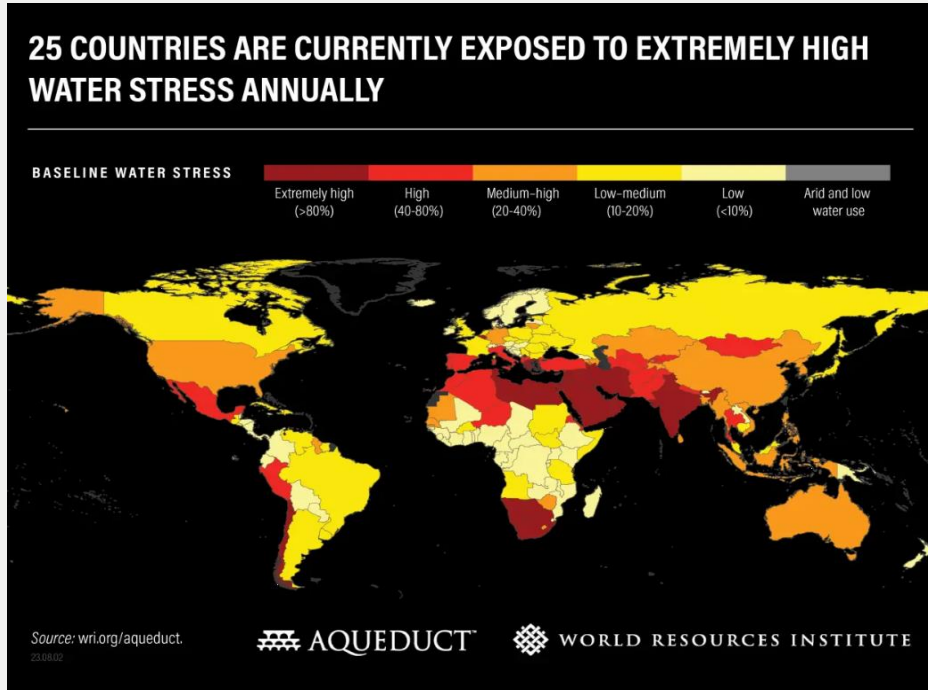
Agenda

- Introduction
- Understanding NRW Fundamentals
- Building an NRW Strategy for 2025
- Leveraging Technology for NRW Reduction
- Case Studies
- Q&A Session
- Closing & Call-to-Action

Introduction

- Importance of NRW Reduction
 - Significant loss for water utilities in operational costs and environmental sustainability
 - Critical for meeting community needs and preserving resources
- Impact of NRW Reduction
 - Affects utility performance, customer satisfaction, and community trust
 - Enhances service delivery and operational efficiency
- Webinar Goals
 - Understand core components of NRW and real losses developments over the last 30 years
 - Explore strategies to reduce NRW using AI-powered technologies
 - Implement sustainable and actionable strategies with Flowless' solutions

The challenges of global water stress



- Growing populations
- Climate change
- Increasing demand – agriculture, industry, manufacturing, energy production, datacenters, AI
- Ageing infrastructure
- Lack of capital investment

Linking NRW reduction to lower carbon emissions

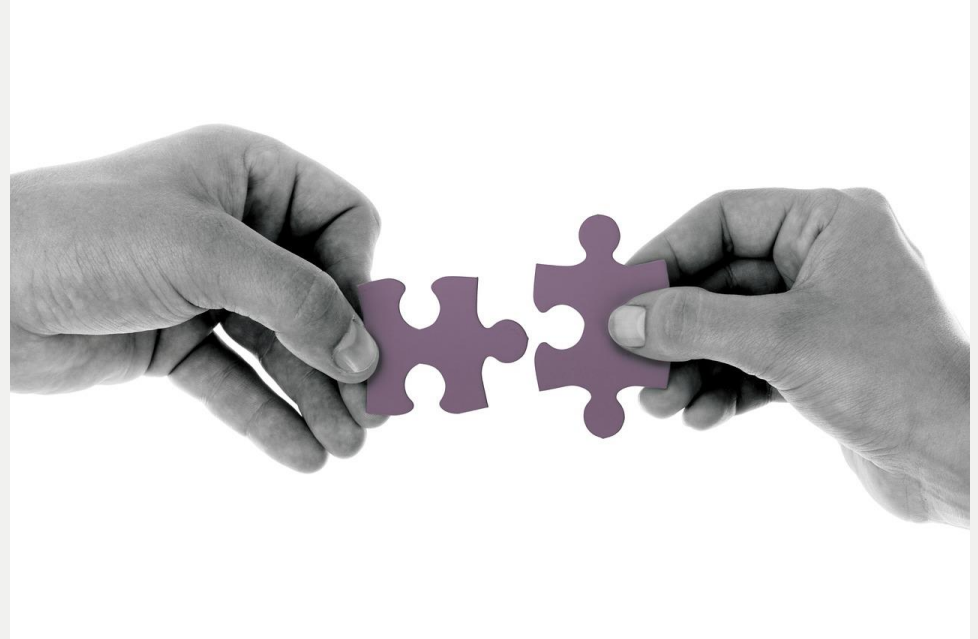


- Energy is used to extract, treat, pump and distribute each unit of water.
- Every unit of water lost to leakage results in carbon emissions that would otherwise be avoided if such leakage were reduced.
- Must be balanced against carbon expended in activities to reduce NRW
- IWA Leakage Emissions Initiative, including carbon water balances – [Home | LEI Group](#)

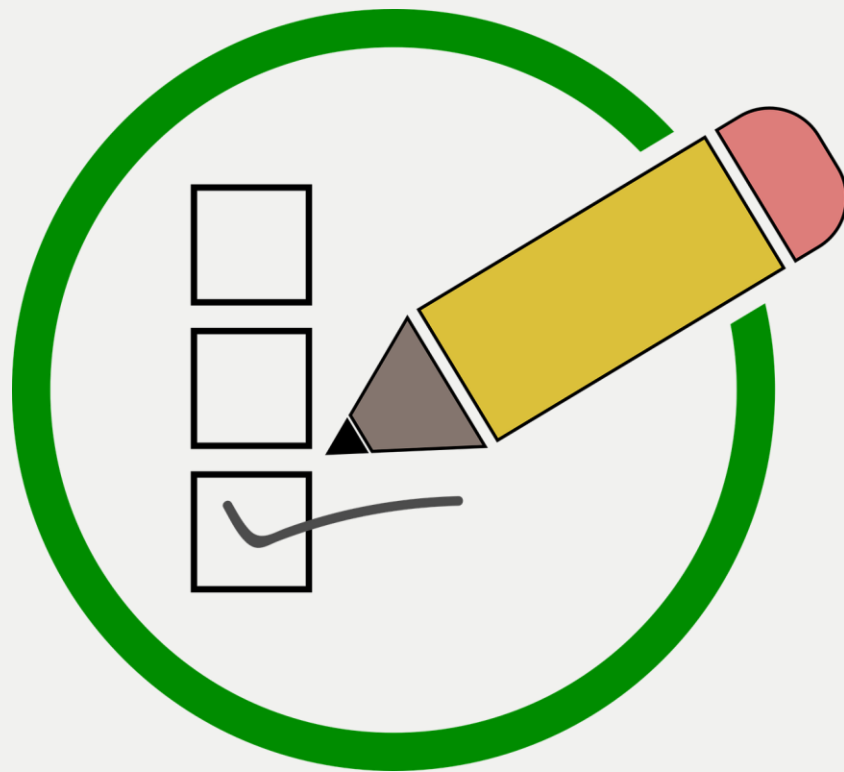
Time to get back to the basics

Let's review some fundamentals before we look at setting strategy and exploring solutions

Focus on Real Losses



Poll 1

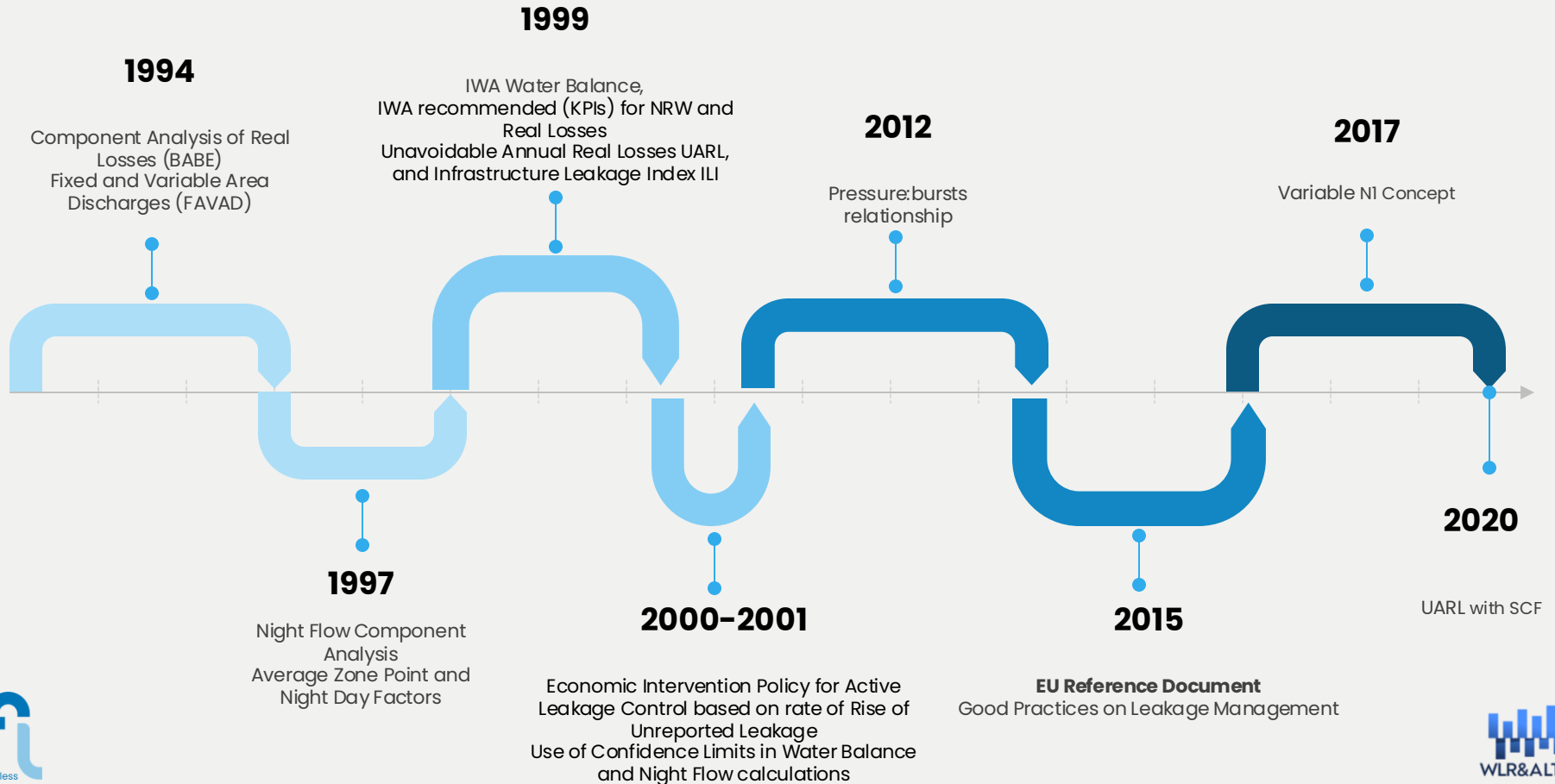


Understanding NRW Fundamentals

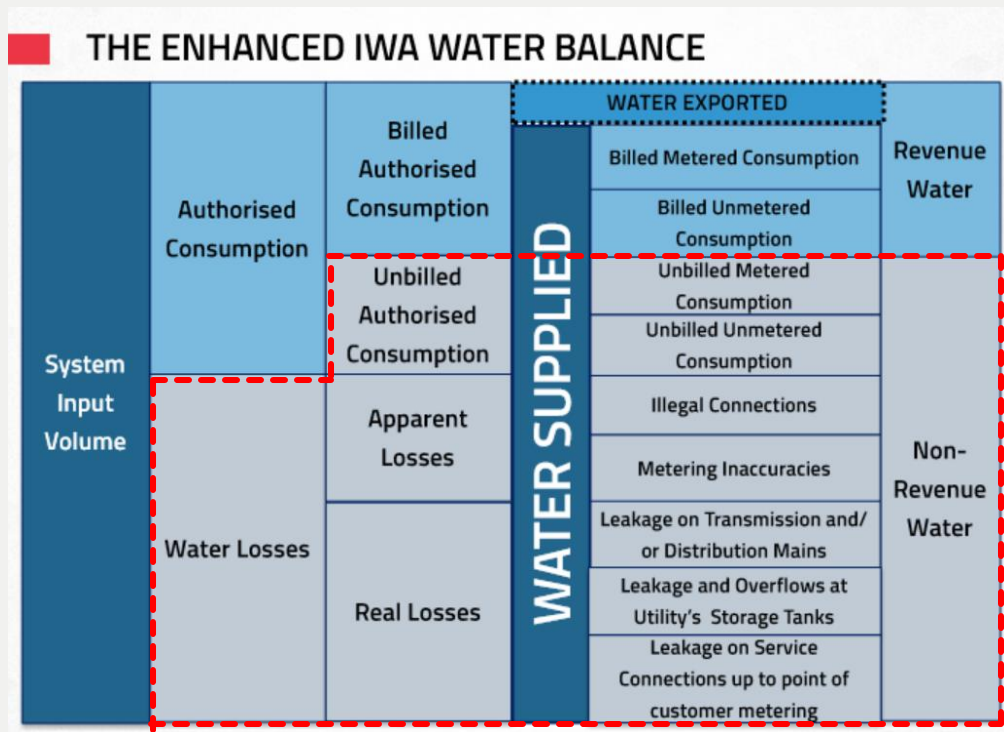
“You can’t connect the dots looking forward; you can only connect them looking backwards.” – *Steve Jobs*

“Study the past if you would define the future.” – *Confucius*

NRW Milestones from the last 30 years



Let's start with a Water Balance

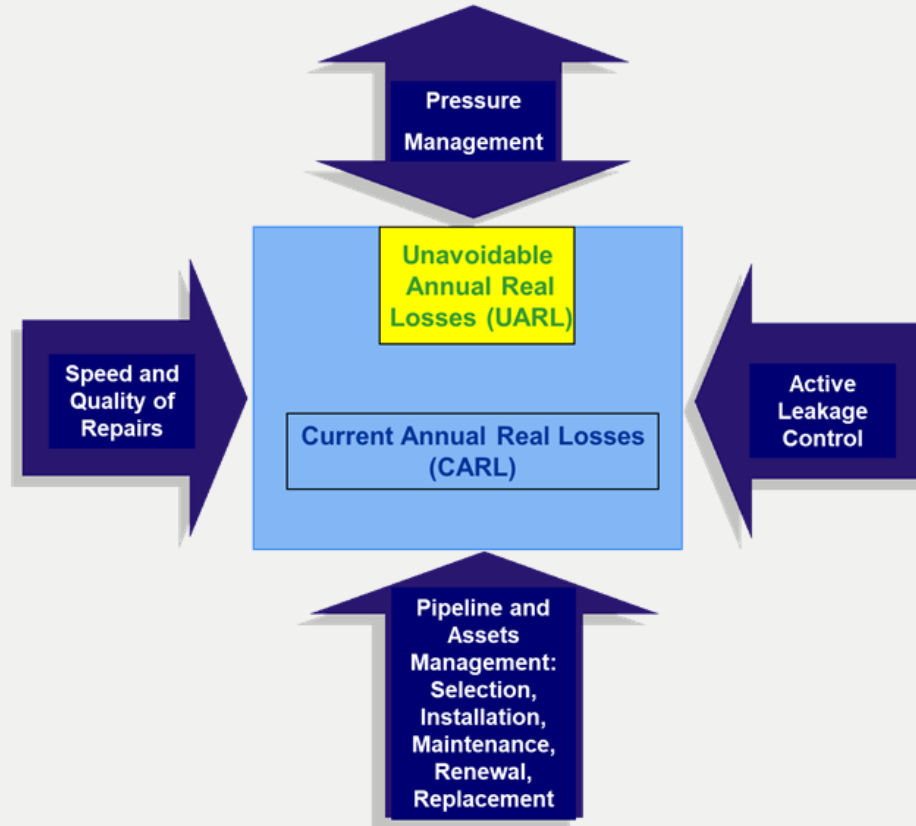


Non-Revenue Water

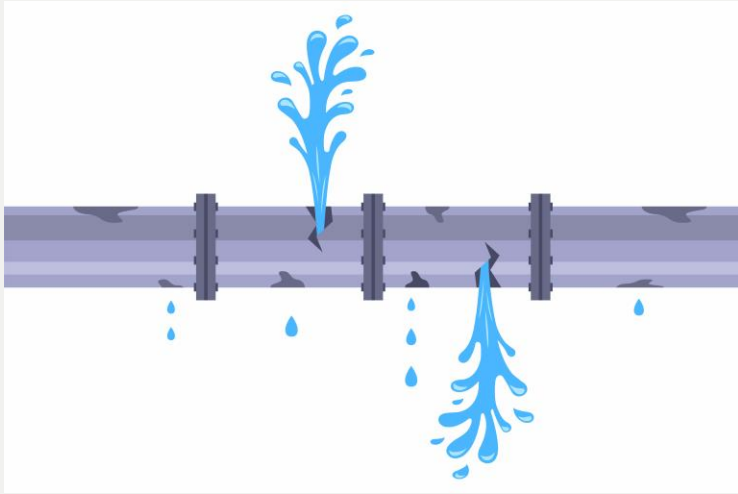
- Unbilled Authorised Consumption
- Apparent (commercial) Losses*
- Real (physical) Losses

Reducing each component requires a different approach and set of targeted interventions

The 4 Basic Methods of Managing Real Losses



Benefits of managing excess pressure



- Managing transients
- Reduction of Leak Flow Rates
- Reduction of Burst Frequencies
- Extension of infrastructure life
- Reduction in consumption

Real Losses KPIs

OBJECTIVE	GOOD PRACTICE PERFORMANCE INDICATOR FOR LEAKAGE, FIT FOR PURPOSE						
	Volume per year	litres/ service connection	m ³ /km mains	litres/ billed property	% of System Input Volume	% of Water Supplied	Infrastructure Leakage Index, with Pressure
SET TARGETS AND TRACK PERFORMANCE, FOR AN INDIVIDUAL SYSTEM	YES, for large systems	YES*	YES*	YES (UK)	NO	NO	Only if all justifiable pressure management completed
TECHNICAL PERFORMANCE COMPARISONS OF DIFFERENT SYSTEMS	NO	NO	NO	NO	NO	NO	YES
DRAW GENERAL CONCLUSIONS FROM SINGLE OR MULTIPLE SYSTEMS	NO	NO	NO	NO	NO	NO	YES, together with other context factors

Choose service connection if density >20/km; if not, choose mains, or base choice on country custom and practice

[Based on EU Reference Document](#)

What is a System Correction Factor?

- $UARL_{1999}$ equation calculates lowest estimate of Annual Real Losses for a **well-maintained whole system**:-
 - More than 5000 service connections
 - Average Pressure range 45-60m
 - **Outside these boundary conditions, it tends to over-estimate volumes for small lower pressure systems and under-estimate for larger higher-pressure systems**
- A System Correction Factor overcomes these boundary conditions and can be used:-
 - For whole system, zone or DMA
 - For any number of service connections
 - At wide range of Average Pressures
- **$UARL \text{ with SCF} = SCF \times UARL_{1999} \text{ volume}$**
- Provides Utility with priority insights for **leakage reduction** and **pressure management opportunities**, identifying maximum recoverable leakage for each DMA or Zone

Why an SCF calculation is different

- FAVAD (Fixed and Variable Area Discharges)
 - Relationship between how the leak flow area in different pipe materials responds to changes in pressure
 - N1 Power Law simplifies this pressure:leak flow rate relationship
 - Original UARL equation uses $N1=1$ for simplicity (10% reduction in pressure results in 10% reduction in leak flow rate)
 - SCF calculations use $N1=0.5$ for rigid pipes and $N1=1.5$ for flexible pipes and Unavoidable Background Leakage
- Poisson effect
 - Small, low pressure systems will have less than the average numbers of UARL bursts per year
 - Median burst frequencies modelled in SCF calculations
- Pressure:bursts
 - Original UARL equation used burst frequencies at 50m pressure
 - SCF models pressure:bursts relationship across a wide range of operating pressures

Scenarios for using SCF – Small DMA, Low Pressure

EXAMPLE

Number of service connections=**3000**
Average length of private service pipe =
3m/conn (from curb stop to meter)
Mains Length = **50 km**
Average Zone Pressure = **35m**

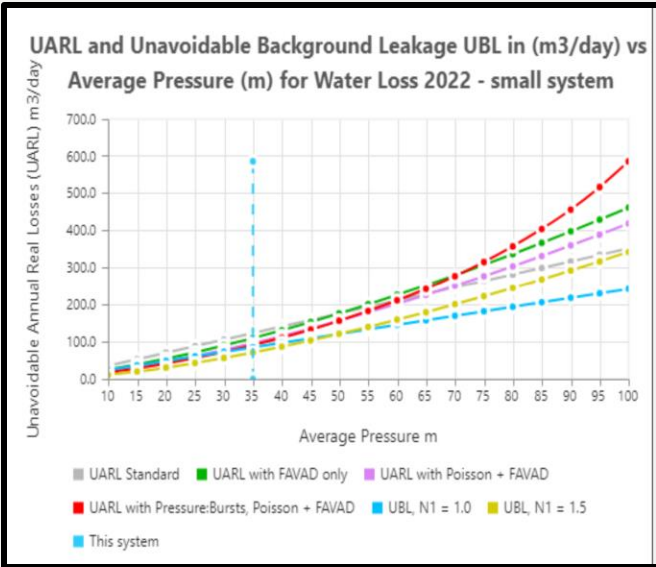
60% rigid mains
40% rigid services (mains to curb stop)
30% rigid services (curb stop to meter)

SCF result	UARL ₁₉₉₉ volume in m ³ /day	UARL with SCF volume in m ³ /day
0.74	123.4	91.0

New Target

Current Target

Scenarios for using SCF – Small DMA, Low Pressure



UARL and Unavoidable Background Leakage UBL in (m³/day) vs Average Pressure (m)

Pressure	UARL Standard	UARL with FAVAD Only	UARL with Poisson + FAVAD	UARL with Poisson + FAVAD + Pressure:Burst	UBL Standard Equation, N1 = 1	UBL Variable Area, N1 = 1.5
10.0	35.3	24.9	19.9	17.3	24.2	10.8
15.0	52.9	38.8	32.1	28.6	36.4	19.9
20.0	70.5	54.3	45.9	41.7	48.5	30.7
25.0	88.1	71.4	61.2	56.5	60.6	42.9
30.0	105.8	89.9	77.9	72.9	72.7	56.3
35.0	123.4	109.7	95.8	91.0	84.8	71.0
40.0	141.0	130.7	114.9	110.9	97.0	86.7
45.0	158.6	152.9	135.2	132.7	109.1	103.5

**In this example, if AZP can be reduced by 1m (from 35m to 34m)
UARL volume can be reduced by 3.6m³/day or 1314m³/year**

Scenarios for using SCF – Large DMA, High Pressure

EXAMPLE

Number of service connections = **6000**
Average length of private service pipe =
3m/conn (from curb stop to meter)
Mains Length = **100 km**
Average Zone Pressure = **70m**

60% rigid mains
40% rigid services (mains to curb stop)
30% rigid services (curb stop to meter)

**New
Target**

SCF result	UARL ₁₉₉₉ volume in m ³ /day	UARL with SCF volume in m ³ /day
1.17	493.5	578.2

**Current
Target**

Scenarios for using SCF – Large DMA, High Pressure

Pressure	UARL Standard	UARL with FAVAD Only	UARL with Poisson + FAVAD	UARL with Poisson + FAVAD + Pressure:Burst	UBL Standard Equation, N1 = 1	UBL Variable Area, N1 = 1.5
60.0	423.0	452.1	416.6	436.8	290.9	318.6
65.0	458.3	504.9	466.2	503.8	315.1	359.3
70.0	493.5	559.6	517.6	578.2	339.4	401.5
75.0	528.8	616.2	570.7	660.9	363.6	445.3

If AZP can be reduced by **1m** (from 70m to 69m),
UARL volume can be reduced by approx. **15m³/day** or **5475m³/year**

Why should Utilities use SCF?

- Use the original 1999 UARL equation to calculate a whole system UARL
 - Consider SCF calculations for Boundary Cases (<5000 conns, outside 45–60m Average Pressure range)
- Use SCF to map all zones and systems within a Utility for a complete top down/bottom up view of your system
 - Where can UARL volume targets be reduced?
 - Where UARL volume targets may not be achievable?
 - Target zones or systems where further pressure management may be possible to reduce bursts, leak flow rates and UARL volumes, with reductions quantified

More than 3000 SCF calculations in 13 countries



“With over 55,000 water systems in North America, and over 90% of those designated as ‘small systems’ and many others with abnormally high pressures ...These systems can now use the FWAS Version 6 to establish a baseline standing, then engage the UARL with SCF web application to refine their understanding for predictive leakage modeling and quantify the scale of improvement opportunity that exists specifically for their system”
Will Jernigan, USA

“UARL with SCF software allows us to further customise UARL calculations for each of 320 individual Zones and Sub-Zones, for the first time. Integrating this methodology within the snapshot I/I concept will result in rapid identification of Zones where we may expect to set and achieve lower leakage targets and better quantification of leakage and burst reductions from further pressure management. Fine tuning the UARL now is allowing us further scope to further reduce leakage, saving millions of euros in the process.”

Water Services Corporation, Malta

“adopt the system level SCF corrected UARL as future targets to plan leakage control works i.e. pressure reduction, sensors, traditional Active Leak Detection or DMA sectorisation.”

Sydney Water, Australia

Where will the journey take us now?

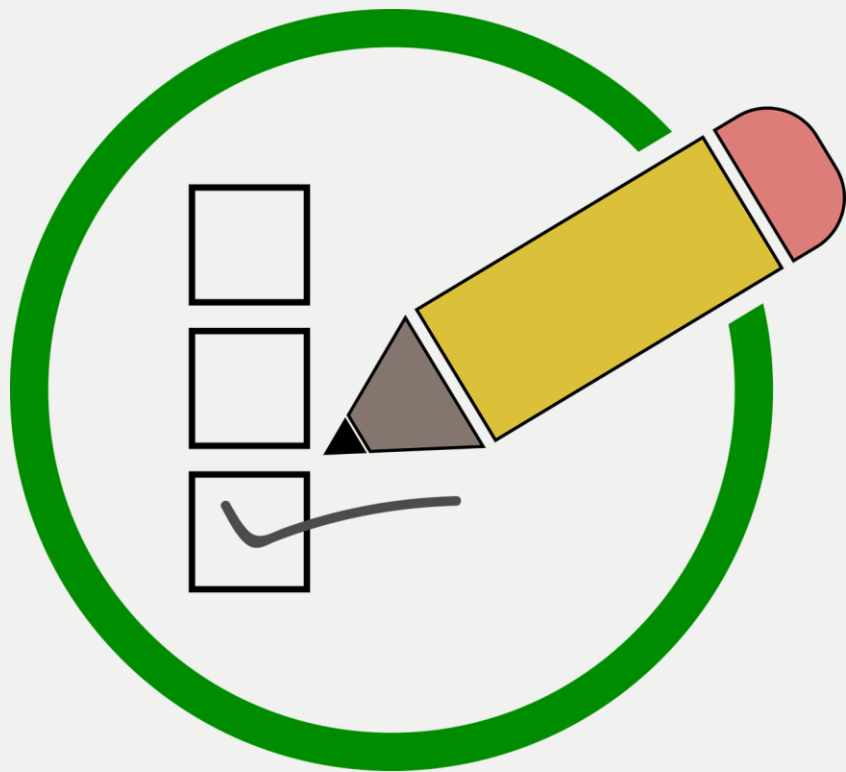
- Stand on the strong foundations built by the pioneers of water loss reduction over the last 30 years
- Wherever you are on your NRW reduction journey, there are proven conceptual data-driven and AI solutions to help you move forward
- Whatever solution you use, make sure you understand the fundamentals first!



Building A Comprehensive NRW Strategy

Start small, gain traction, and scale-it up!

Poll 2



Surface-level problems

High Cost
Inefficiency

Falling behind
regulatory targets

Disrupted water
service delivery

Root causes

budget
limitations

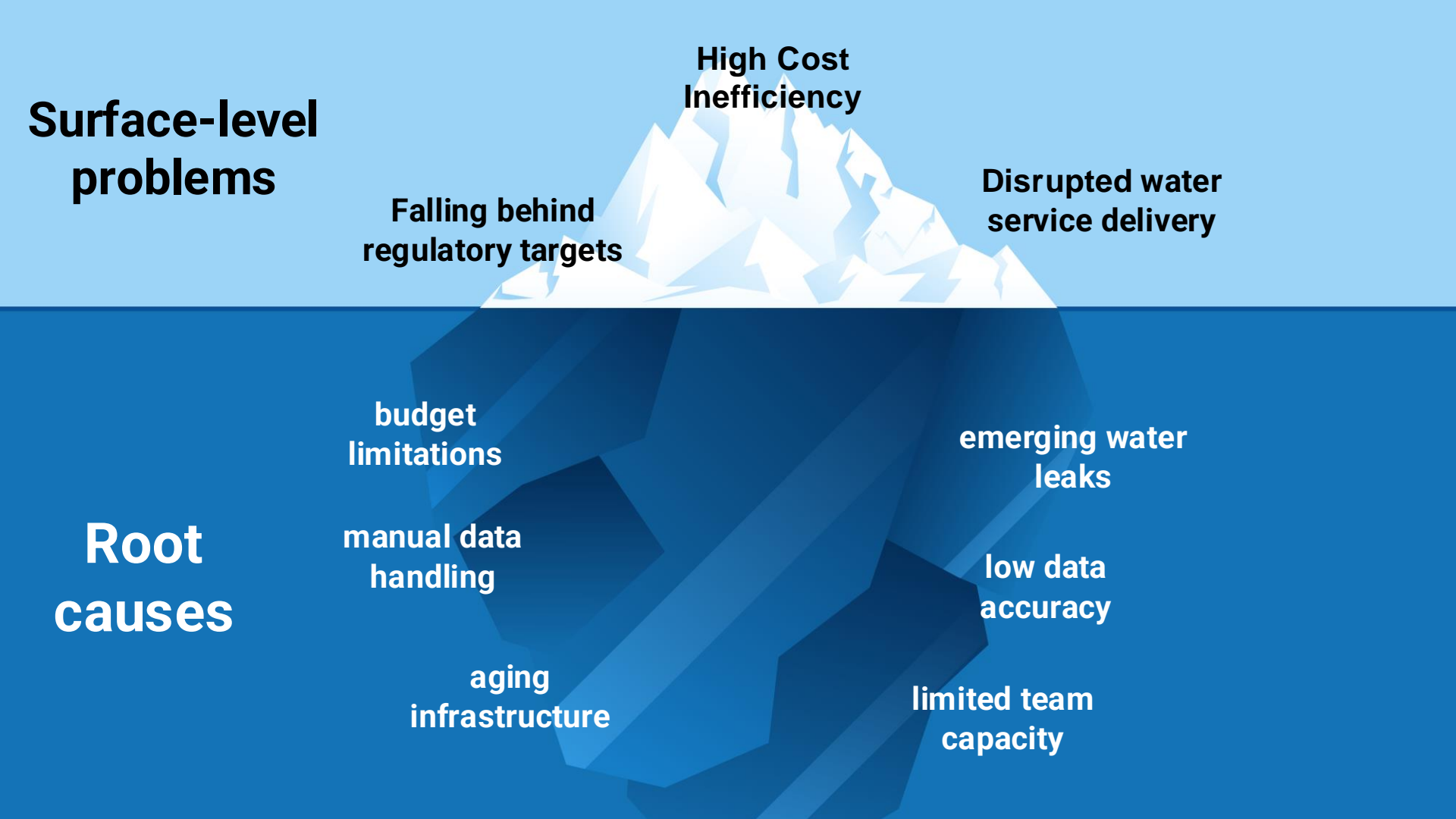
emerging water
leaks

manual data
handling

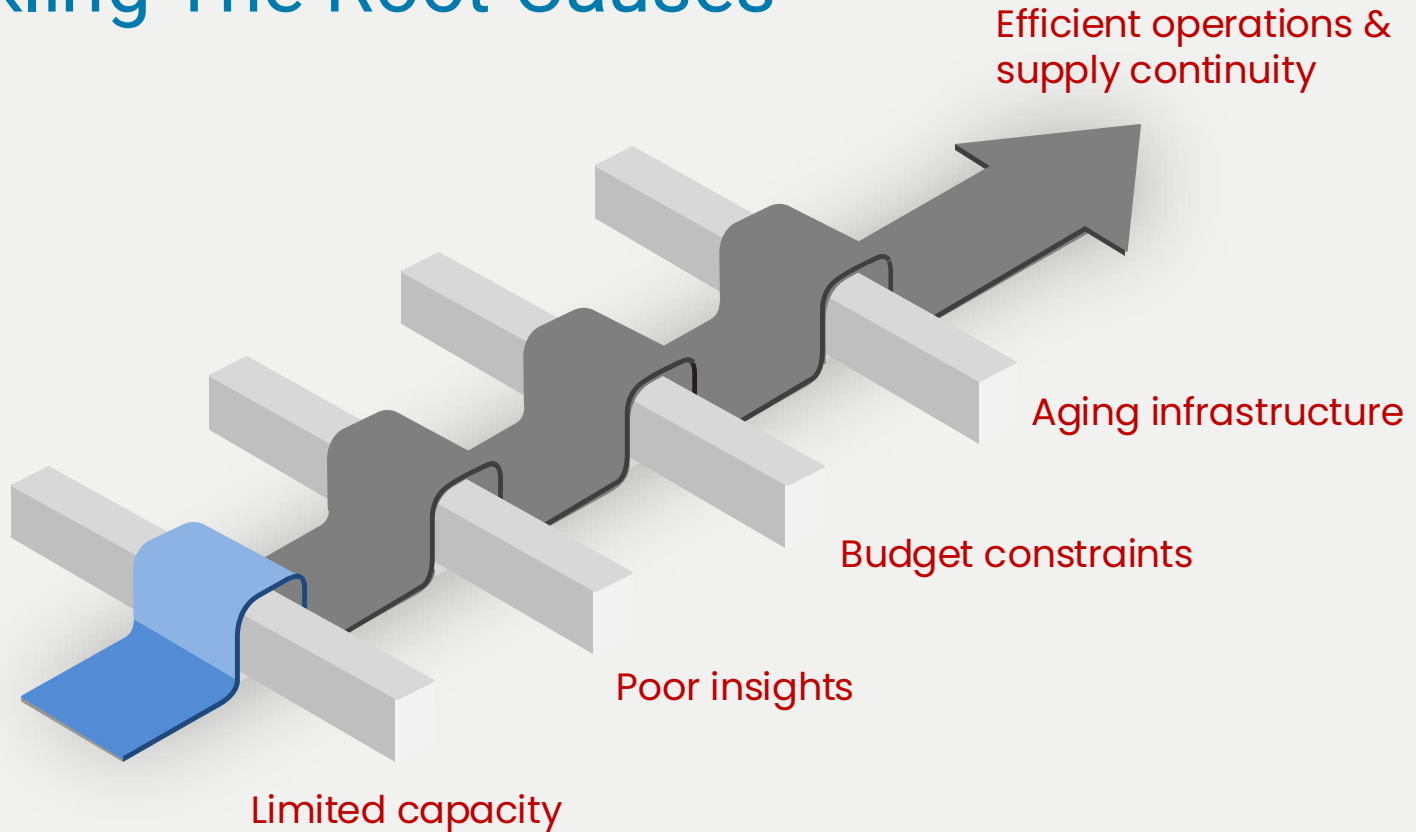
low data
accuracy

aging
infrastructure

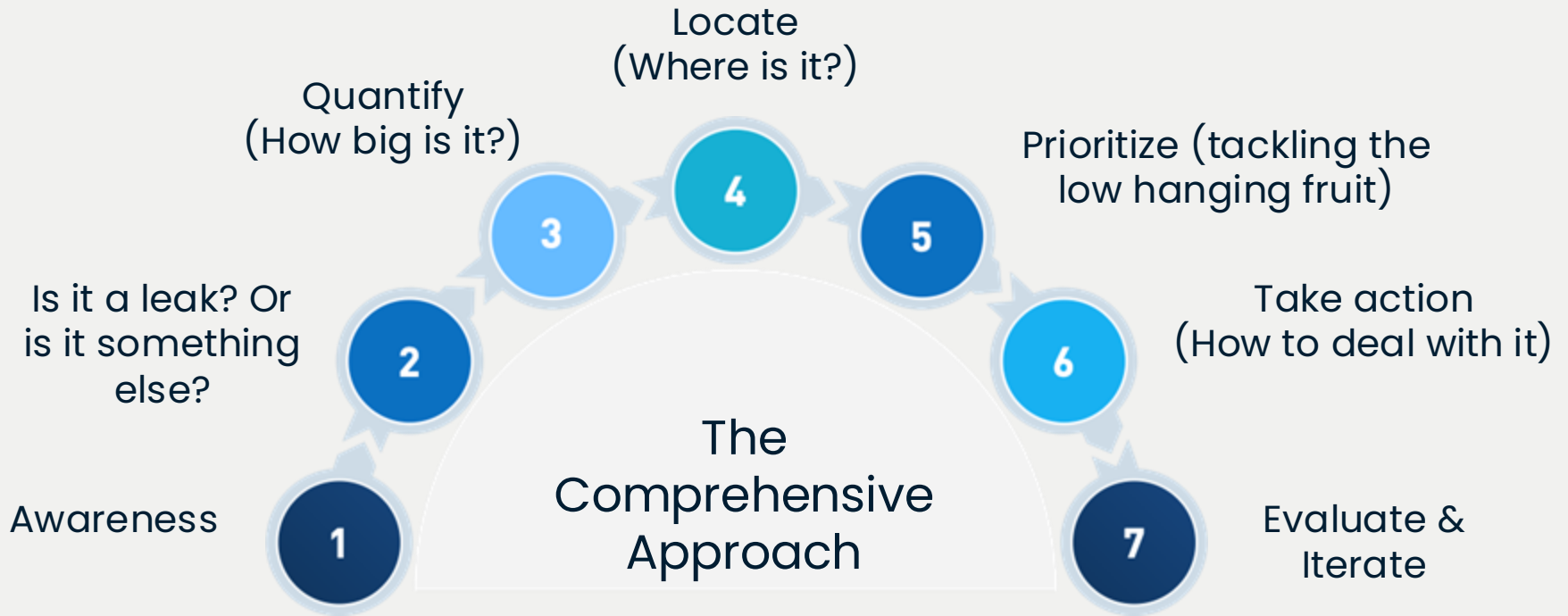
limited team
capacity



Tackling The Root Causes



Losses Lifecycle Management



Leveraging Technology

For effective NRW Management

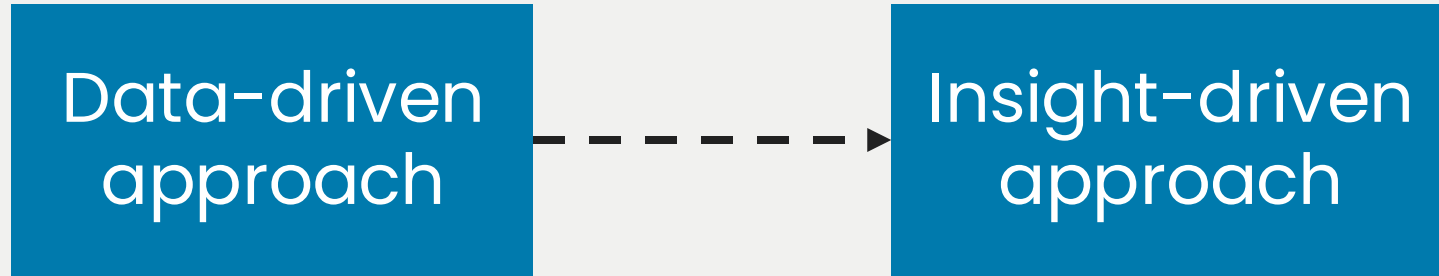
“

Technology is not a
magical wand!

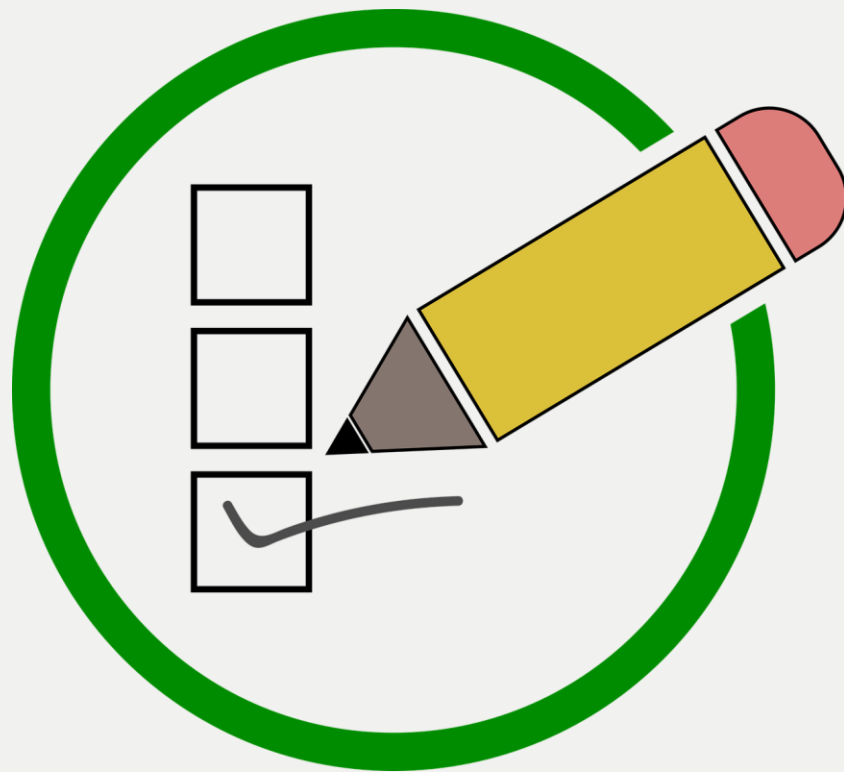
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Said by a wise NRW guru!

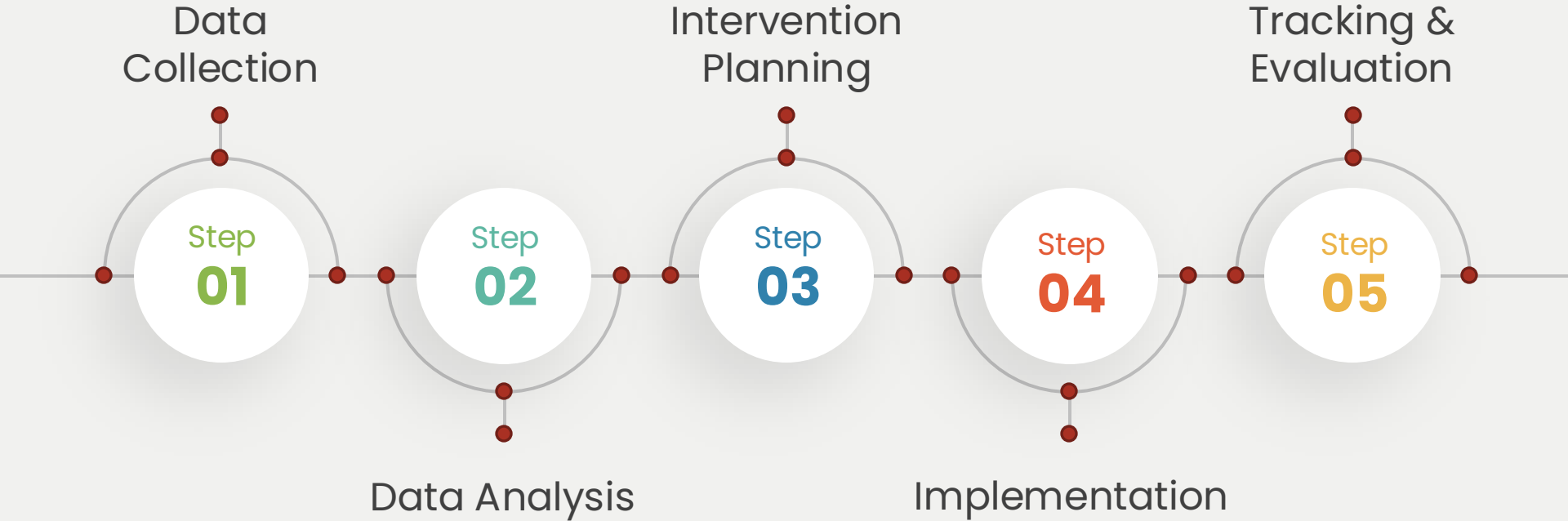
Paradigm Shift



Poll 3



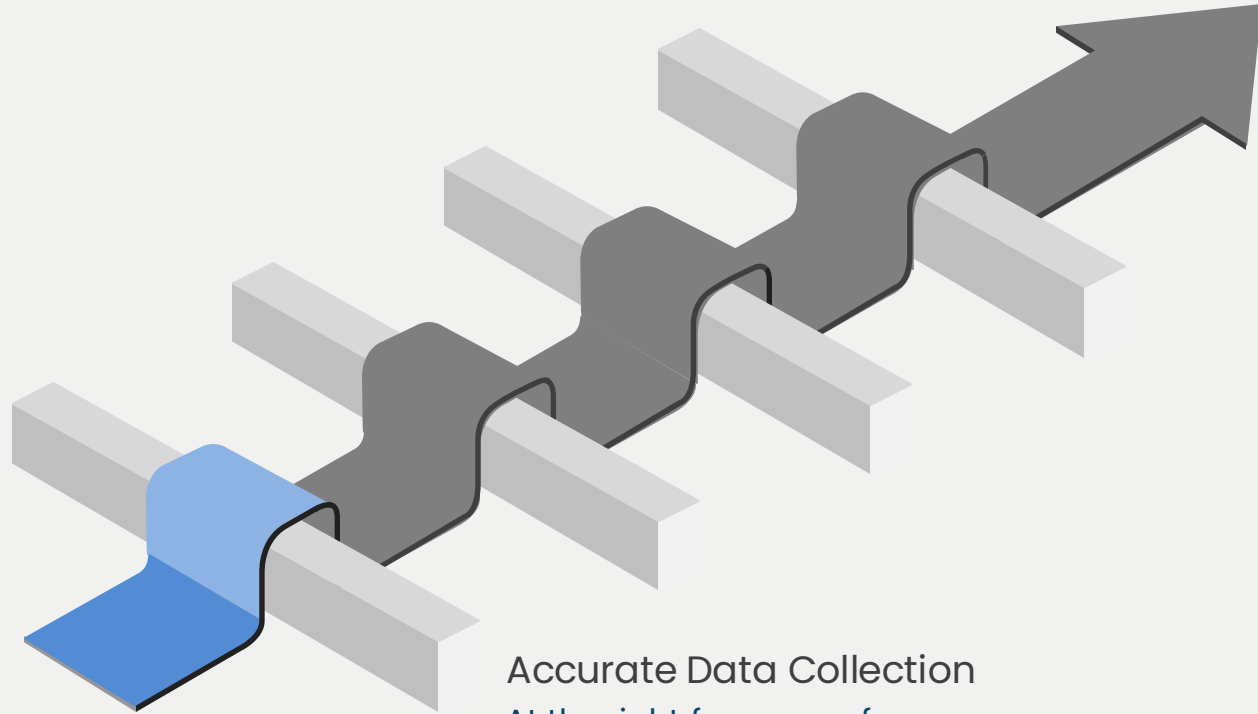
It's NOT Only About Data Collection!



A close-up photograph of a person's hands holding a smartphone. The phone's screen displays a mobile application interface with a blue and white color scheme. The text on the screen is in Arabic, including "مركز الخدمات" (Service Center) and "تسجيل الدخول" (Login). There are several icons and buttons visible on the screen. The background is blurred, showing what appears to be a hospital or clinical setting with white linens and a green wall.

Smooth Tech Adoption Journey

Step 1: Understand The Needs

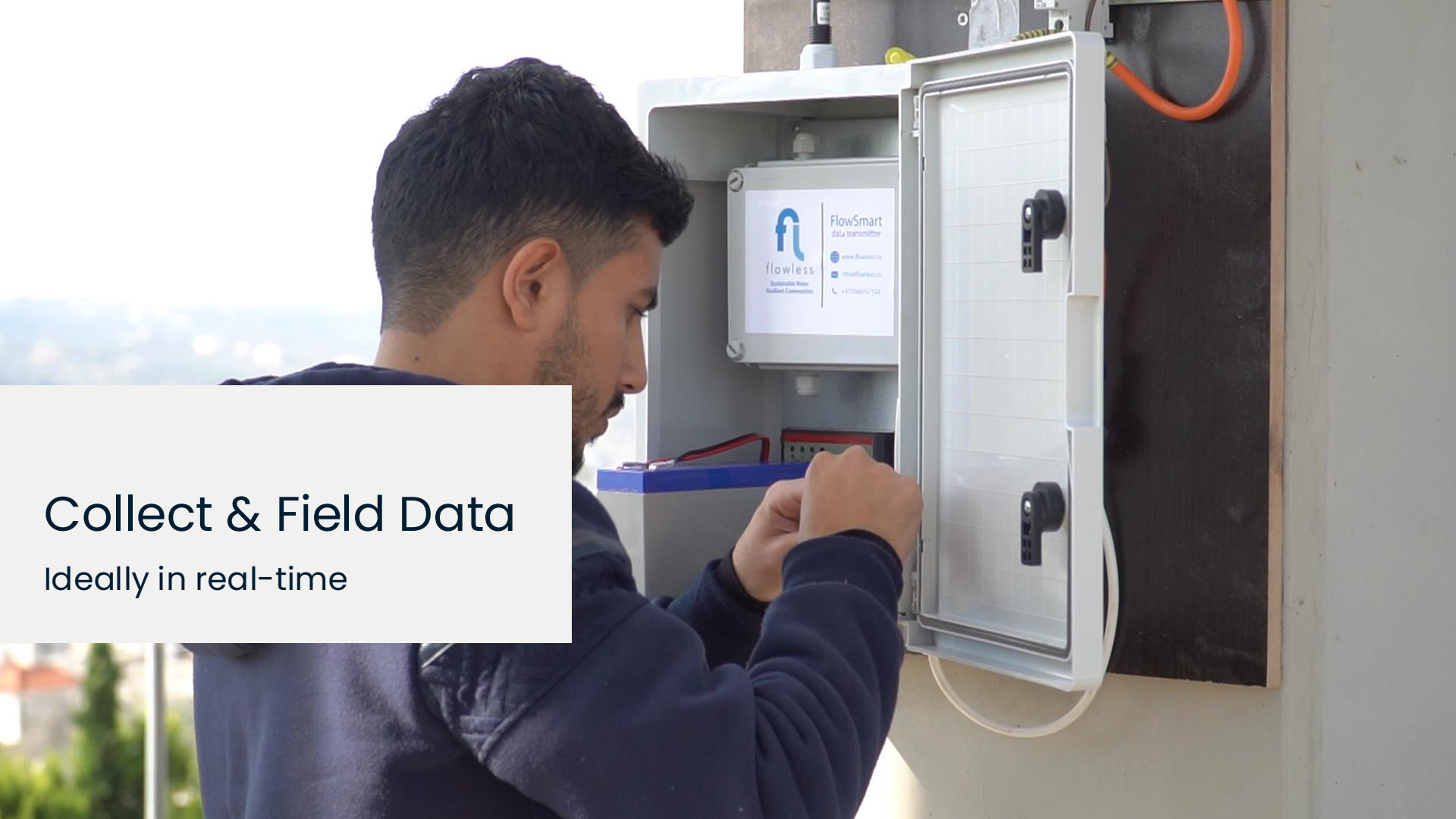


Accurate Data Collection
At the right frequency for
accurate & timely insights



Intervention Planning

go to the field, understand the context



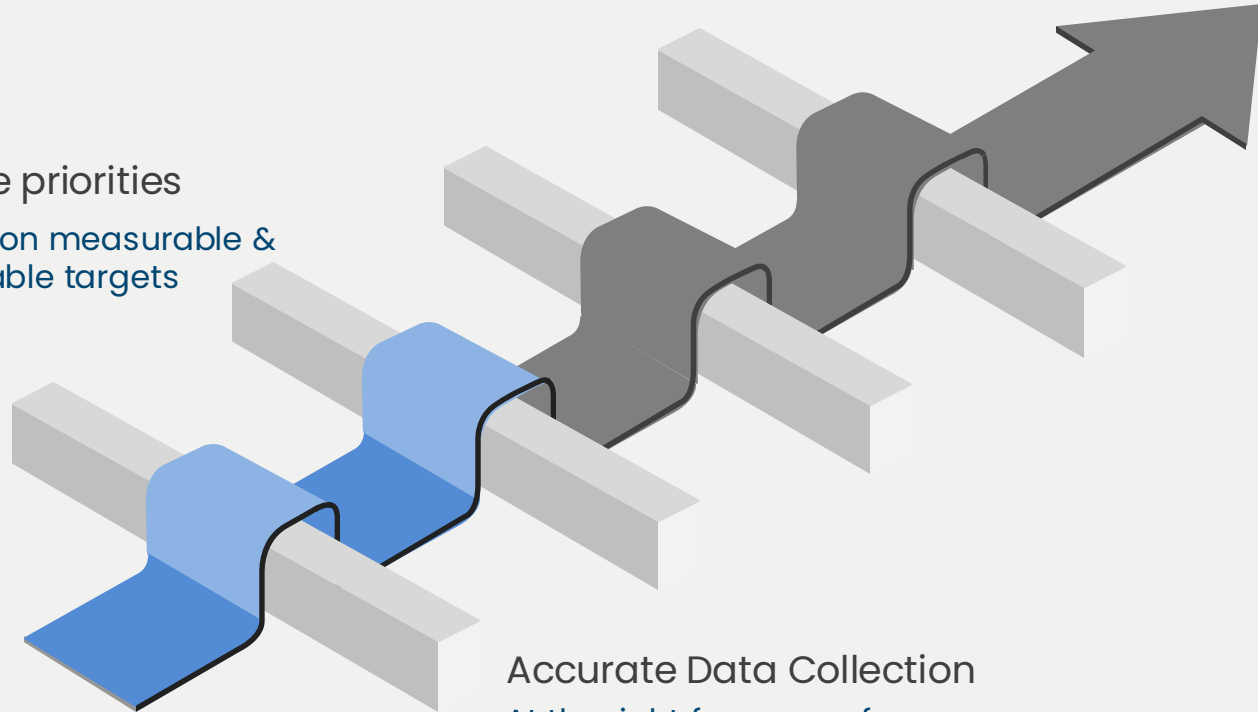
Collect & Field Data

Ideally in real-time

Step 2: Set your targets

Define priorities

based on measurable &
attainable targets

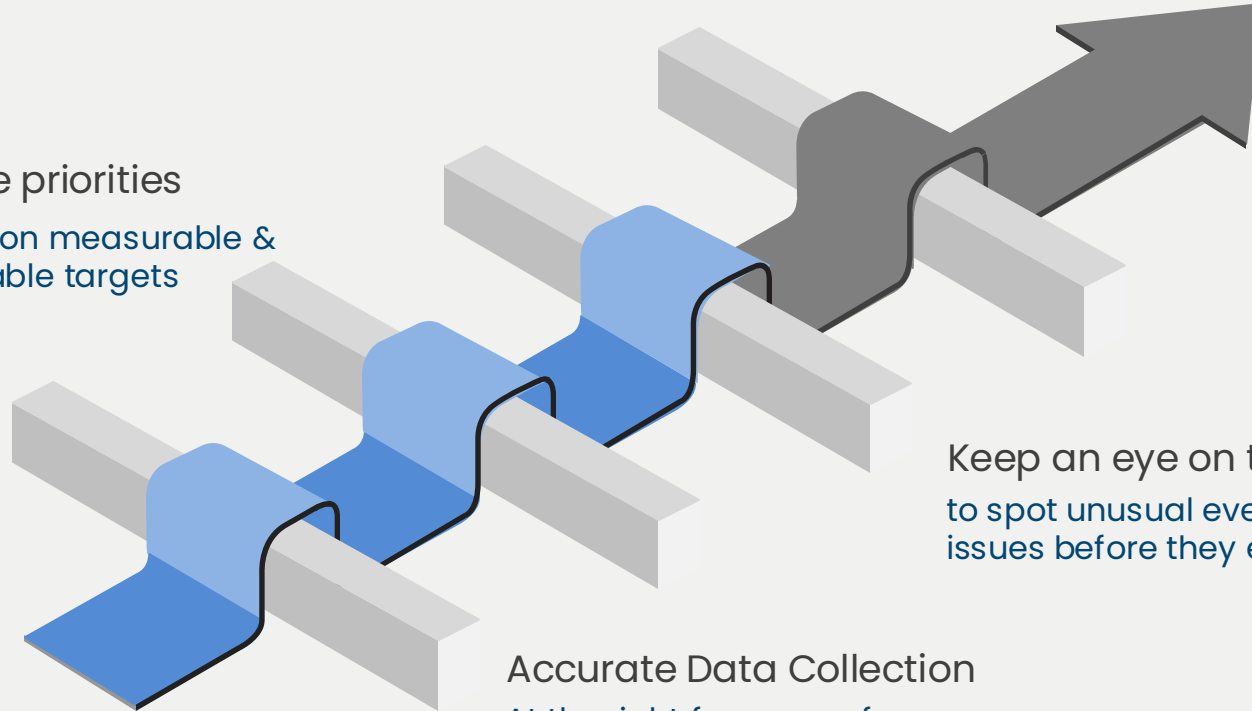


Accurate Data Collection
At the right frequency for
accurate & timely insights

Step 3: Watch & Analyze

Define priorities

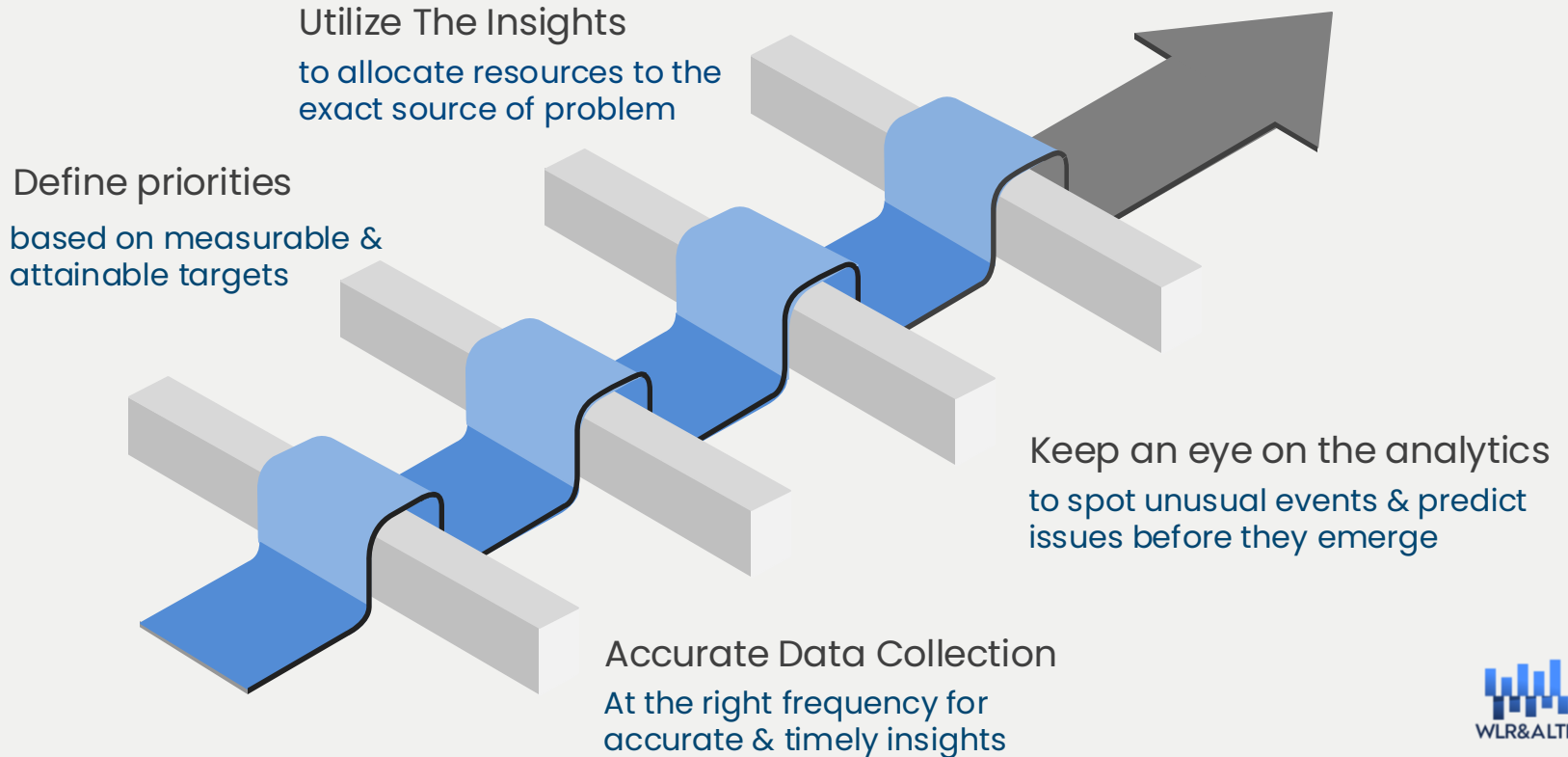
based on measurable &
attainable targets



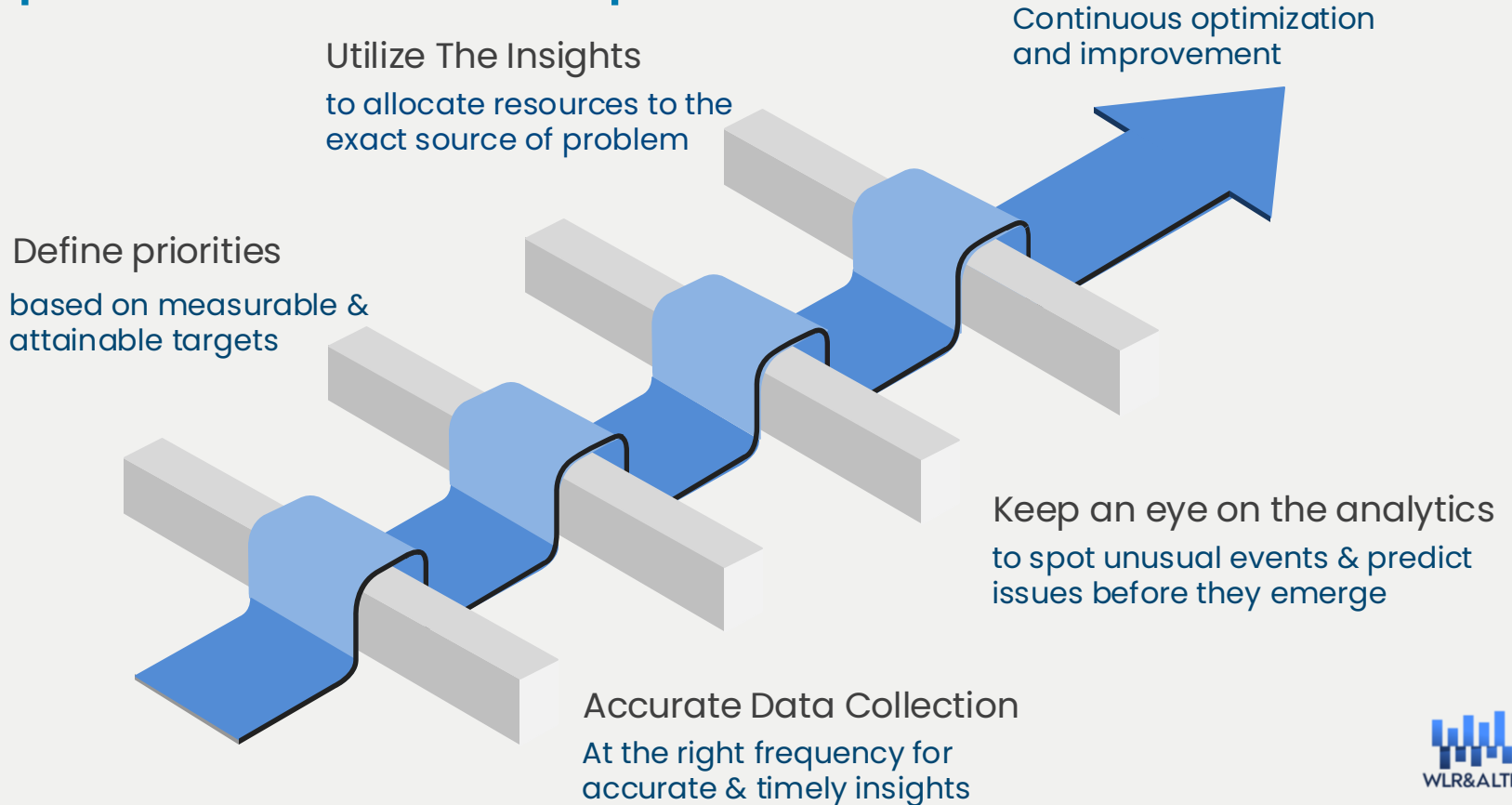
Keep an eye on the analytics
to spot unusual events & predict
issues before they emerge

Accurate Data Collection
At the right frequency for
accurate & timely insights

Step 4: Tackle The Low-Hanging Fruit



Step 5: Evaluate & Improve

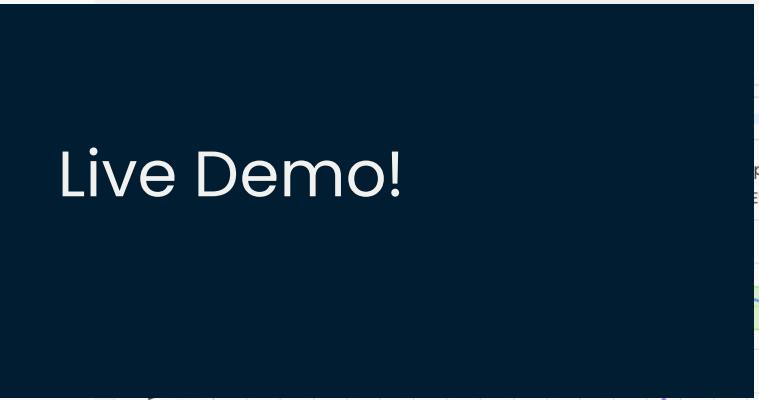
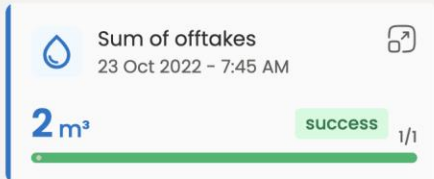
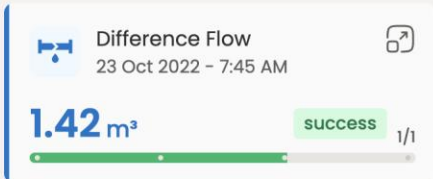
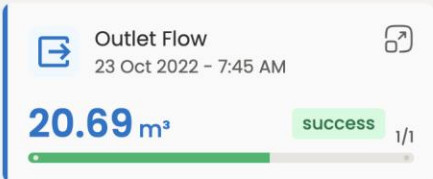
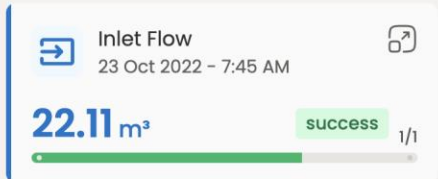


WaterCloud & SCF



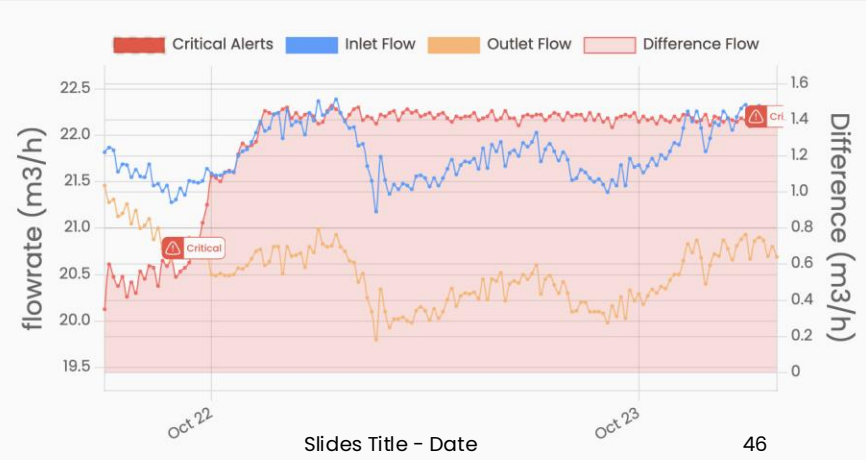
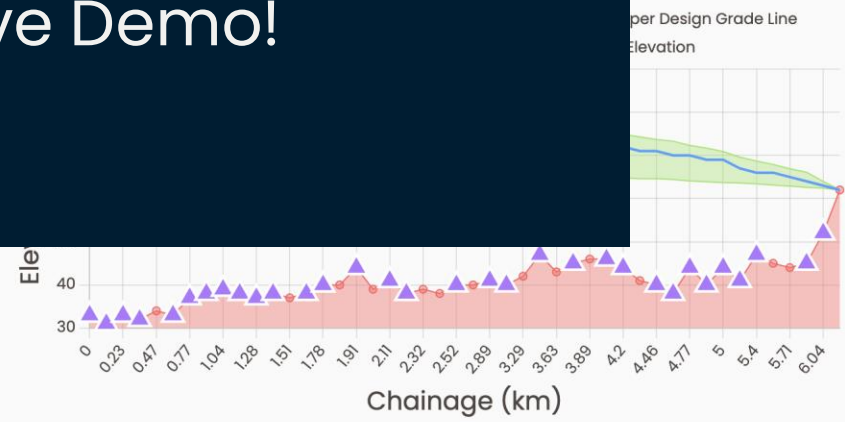
>> **Daily tracker** Facilities Overview

Key Performance Indicators



! Latest ↕

Transmission Line Flow rates v... ! Last 48 Hour ↕



PI

Source vs destination pressure

! Last 72 Hour ↕

Daily Balance Bar

! Latest ↕

Case Studies

Palestine, Malaysia, Brazil, Malta, Quebec, Australia

A man with short dark hair, smiling, stands in a water treatment facility. He is wearing a plaid shirt and a high-visibility orange and blue safety vest. He holds a small notebook and a pen. The background shows industrial equipment, including large blue pumps and pipes, and a dark door on the left. The scene is brightly lit, likely from overhead lights.

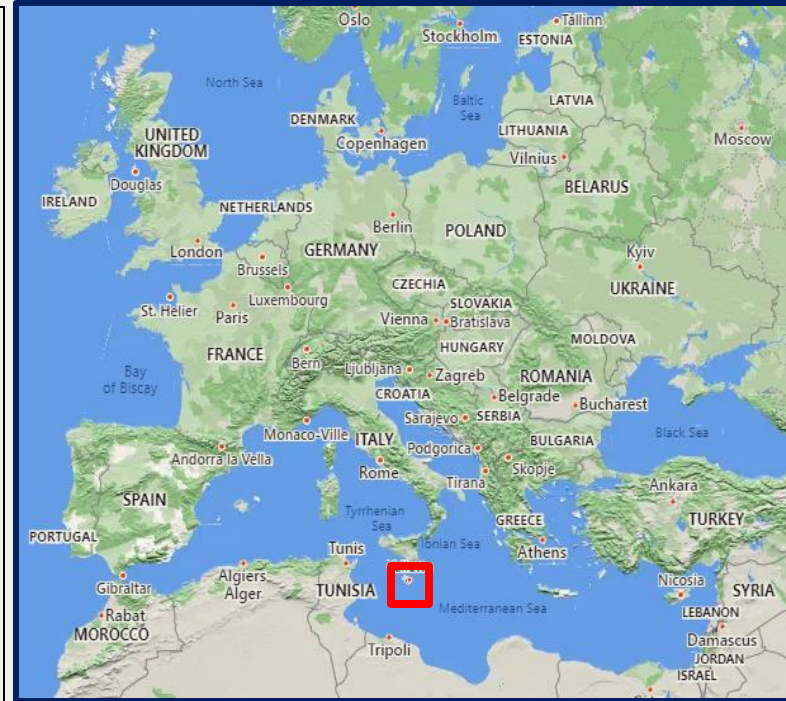
Case Study:

Saving 10,000 m³/month

Salfeet Municipality, Palestine

Case Study 1 – Water Services Corporation (Malta, Europe)

- All properties supplied through roof storage tanks
- 57% of Malta's potable water produced by 3 reverse osmosis plants; the remainder is pumped from underground aquifers.
- 130,000 service connections
- 1330 miles (2,141 km) mains
- Average Pressure 45.5 psi (32m ,3.2 bar)
- Customer meters are located at the curb stop
- 93% rigid mains, 5% rigid services (mains to curb stop)
- 320 UARL with SCF calculations to map all zones and DMAs across 4 regions
- Latest ILI 1.8, reduced from ILI of approx. 20 in 2000



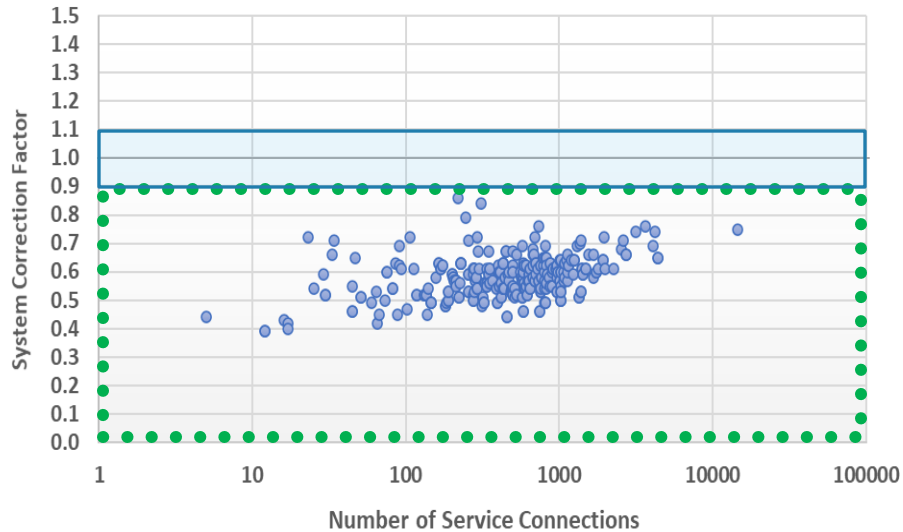
All data reproduced with kind permission of Water Services Corporation, Malta

Case Study 1 – Water Services Corporation (Malta, Europe)

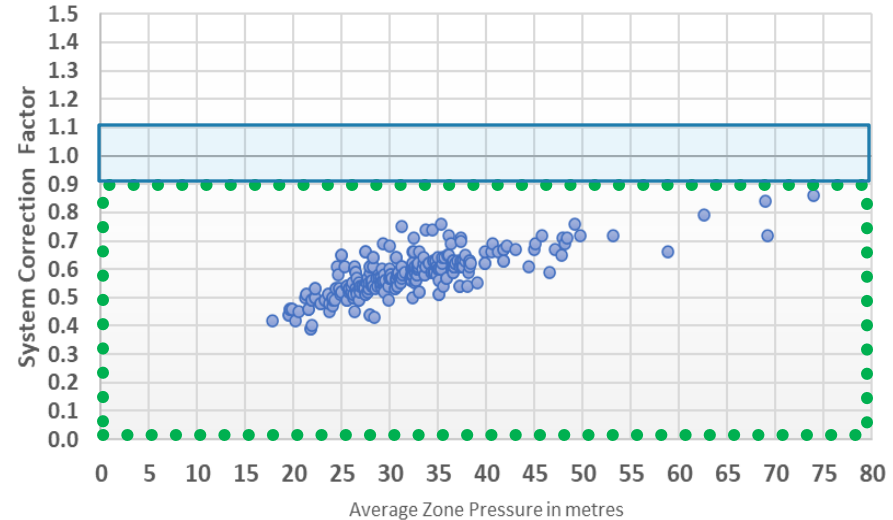
Case Study characteristics

Zone/System size	5 – 14,000 service connections
Small Systems	>99% zones have <5,000 service connections
Managed AZP ranges	24–105 psi (17–74 m)

SCF vs. Number of Service Connections



SCF vs. Average Zone Pressure



Case Study 1 – Water Services Corporation (Malta, Europe)

SCFs at current operating pressures range from **0.39 – 0.86**

Standard UARL equation **over-predicts** UARL volumes in some zones **by 61%–14%**

Why are these SCFs all < 0.9 ?

A continuous program of Pressure Management over > 20 years

A large percentage ($>99\%$) of small systems with less than 5,000 service connections

Mostly flexible materials on service connections

How are WSC using SCF calculation results?

SCF calculation results are being used in conjunction with Snapshot III to rapidly identify zones where lower leakage targets could be set , and to better quantify leakage and burst reductions from further pressure management

Case Study 2 – Quebec Province (Canada)



- 626 Individual water utilities
- 2,111,989 service connections
- 26,000 miles (41,429 km) mains
- Average Pressure 70.7 psi (49.7 m)
- Overall, 67% rigid mains, 95% rigid services (mains to curb stop), 95% rigid services (curb stop to meter)
- 855 UARL with SCF calculations to map DMAs and zones across 17 regions
- Latest overall IRI 6.6 in 2019
- 65% of networks (in number, not length) achieved a low or moderate IRI of <4 in 2019

Québec



Réseau
Environnement

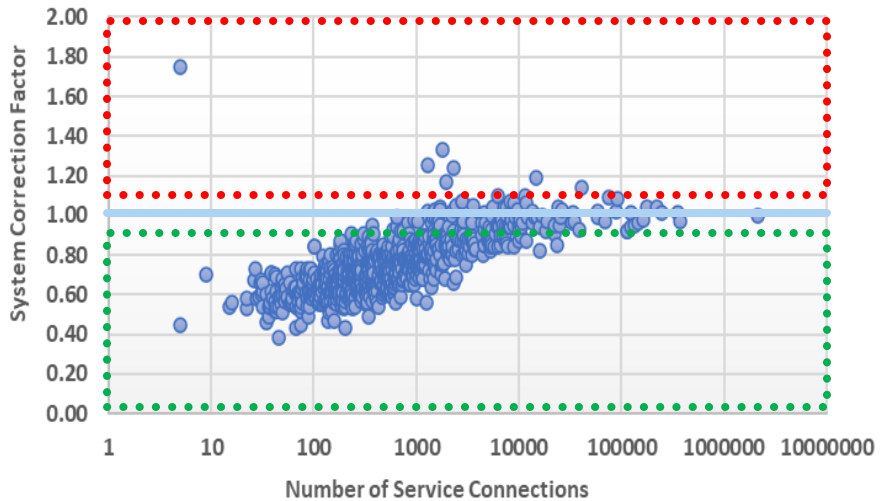
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Réseau Environnement, Quebec

Case Study 2 – Quebec Province (Canada)

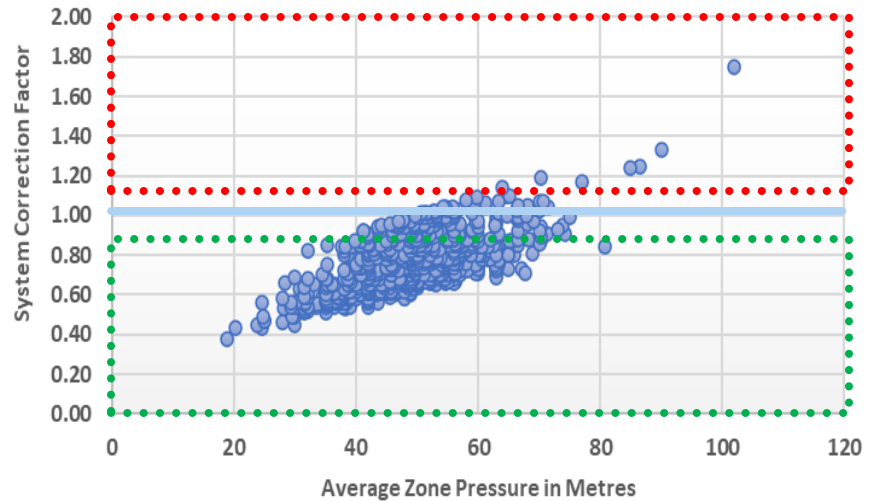
Case Study characteristics

Zone/System size	5 – 377,362 service connections
Small Systems	>88% zones have <5,000 service connections
Managed AZP ranges	25–145 psi (18–102 m)

SCF vs. Number of Service Connections



SCF vs. Average Zone Pressure in metres



Case Study 2 – Quebec Province (Canada)

SCFs at current operating pressures range from **0.38 – 1.75**

For some zones or regions, standard UARL equation **over-predicts** UARL volumes by up to **62%**

For some zones or regions, standard UARL equation **under-predicts** UARL volumes by up to **75%**

Why are these SCFs so varied?

A large percentage (>88%) of small systems with less than 5,000 service connections

A wide variety of system/zone size

A wide range of operating pressures

Mostly rigid service connections

How are SCF calculation results being used?

SCF calculation results are being used so that Quebec Efficiency Strategy has a better understanding of their systems and the way to reach their water loss objectives.

Case Study 3 – Sydney Water (Australia)



Sydney
WATER

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Sydney Water, Australia

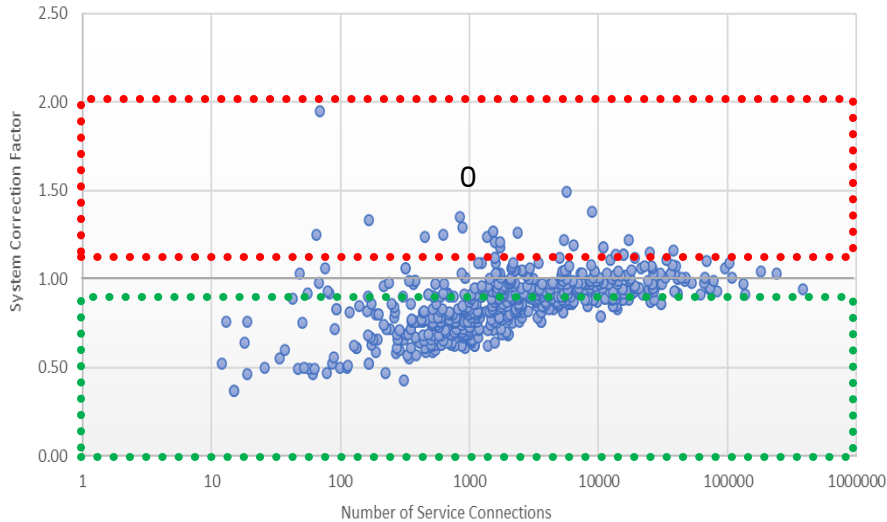
Sydney Water supply over 1.5 billion litres of drinking water to over 5.3 million people every day. Water is supplied from 11 major dams through 13 water delivery systems with:

- 1.37 Million service connections
- 12900 miles (20,800 km) mains
- Average Pressure 75 psi (52.8m)
- 82% rigid mains, 85% rigid services (mains to curb stop)
- 248 reservoirs, 152 pumping stations
- 9 water filtration plants, Sydney Desalination Plant
- 655 UARL with SCF calculations to map all pressure zones, supply zones, and distribution systems across 13 water delivery systems
- 2020 ILI = 1.3

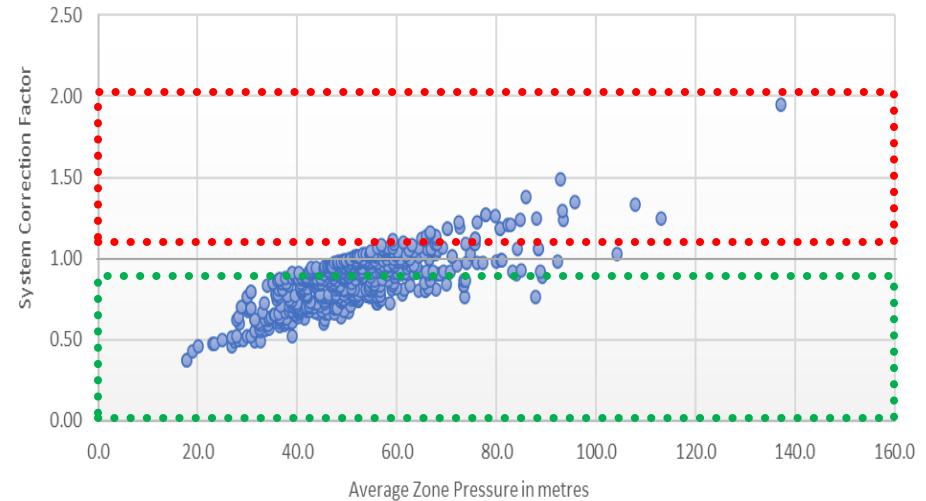
Case Study 3 – Sydney Water (Australia)

Case Study characteristics	
Zone/System size	12 – 384,864 service connections
Small Systems	>68% zones have <5,000 service connections
Managed AZP ranges	21-195 psi (15-137 m)

SCF vs. Number of Service Connections



SCF vs. Average Zone Pressure in metres



Case Study 3 – Sydney Water (Australia)

SCFs at current operating pressures range from **0.37 – 1.95**

For some zones, standard UARL equation **over-predicts** UARL volumes by up to **63%**


For some zones, standard UARL equation **under-predicts** UARL volumes by up to **95%**

Why are these SCFs so varied?

A wide range of operating pressures
A wide variety of system/zone size
Mostly rigid mains and service connections

How are Sydney Water using SCF calculation results?

Contributes to a complete assessment of all their pressure zones, supply zones, distribution zones and delivery systems –
this will be used for better targeting of further active leakage control and pressure management activities

A close-up photograph of a person's hands holding a smartphone. The phone's screen displays a water management application with a blue and white color scheme. The interface includes a search bar at the top, a list of items, and a detailed view of a specific item. The background is blurred, showing what appears to be a hospital or clinical setting with white linens and a green wall.

Want to achieve similar
impact in your water network?
Here are the steps to get you started:

Leverage smart tech in your network

- Understand the context
- Define your targets
- Deploy the technology
- Utilize the insights, implement the interventions
- Improve and iterate!

References

- The carbon footprint of desalination: An input-output analysis of seawater reverse osmosis desalination in Australia for 2005–2015, <https://doi.org/10.1016/j.desal.2018.12.008>
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Q&A Session

Any questions for Allan, Baker and Kate?

Thank You!

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