



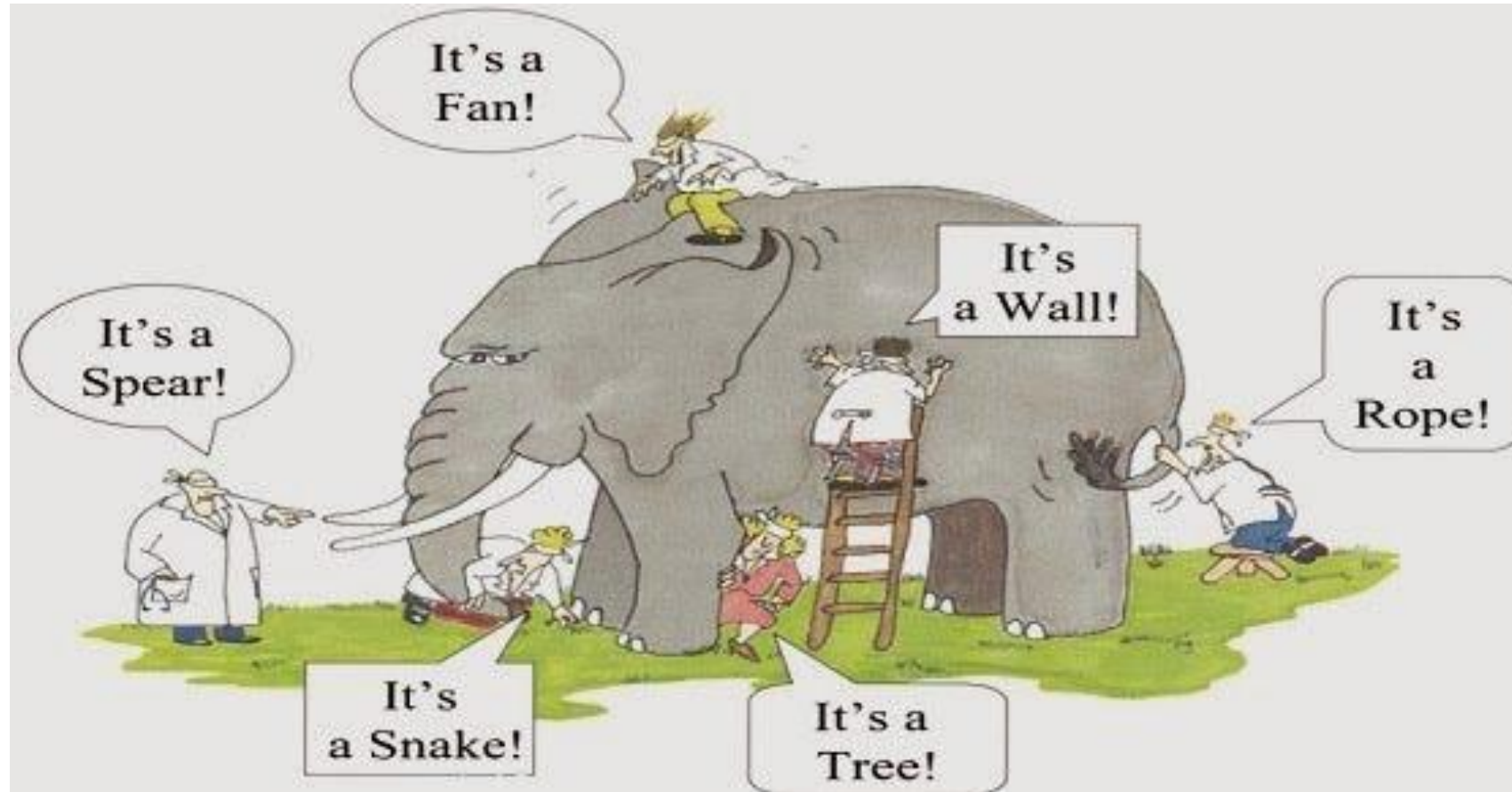
Managing Background Leakage

OFWAT Innovation Fund Water Breakthrough Challenge 2

An Update

Stuart Trow
HWM / Invenio Systems

The 5 blind men and the elephant



BABE (Burst and Background Estimates)

Reported bursts and leaks



Unreported bursts and leaks



Background leakage



What is Background Leakage?

“Leaks too small to be found with current technology”. UKWIR, 2003

Water UK Routemap

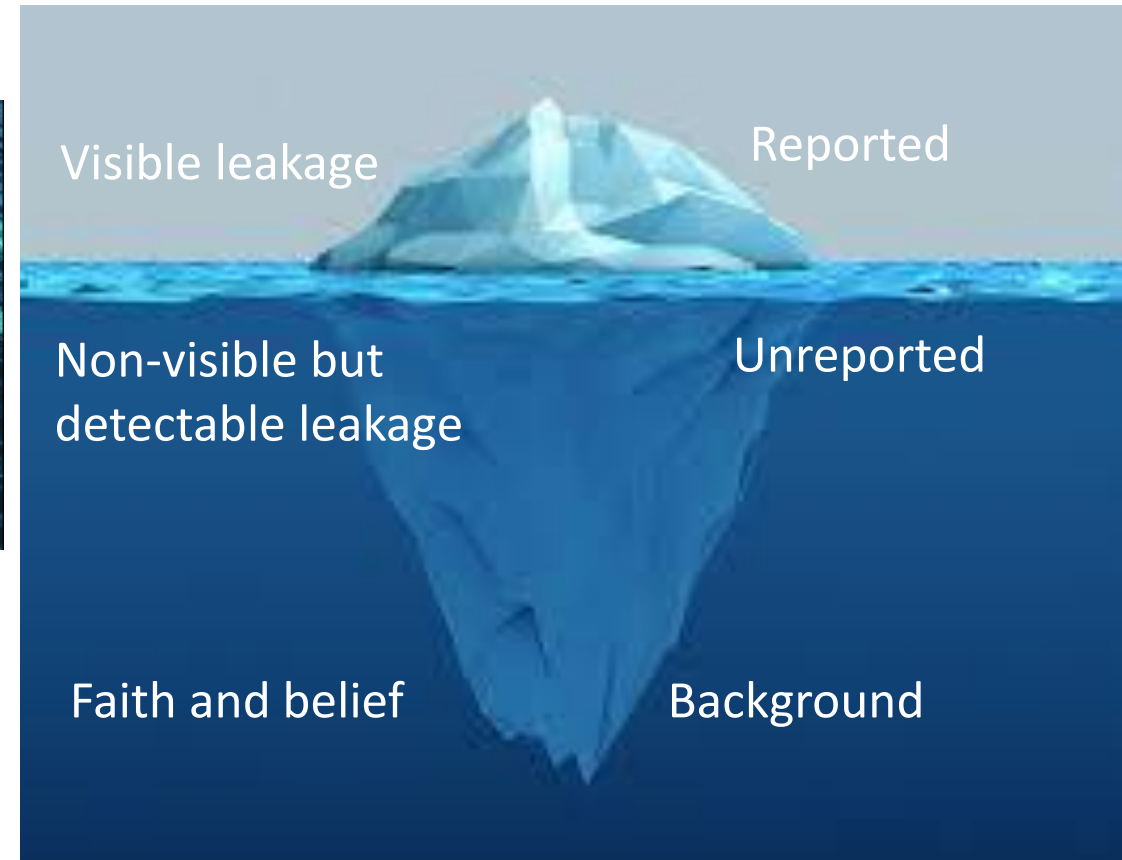
Background leakage:

This is the level where leakage cannot be reduced further, using current detection technology. This can be altered by replacing pipes in the network, but also by reducing pressure in the network. It can also change due to new technological innovations that make detection more effective.



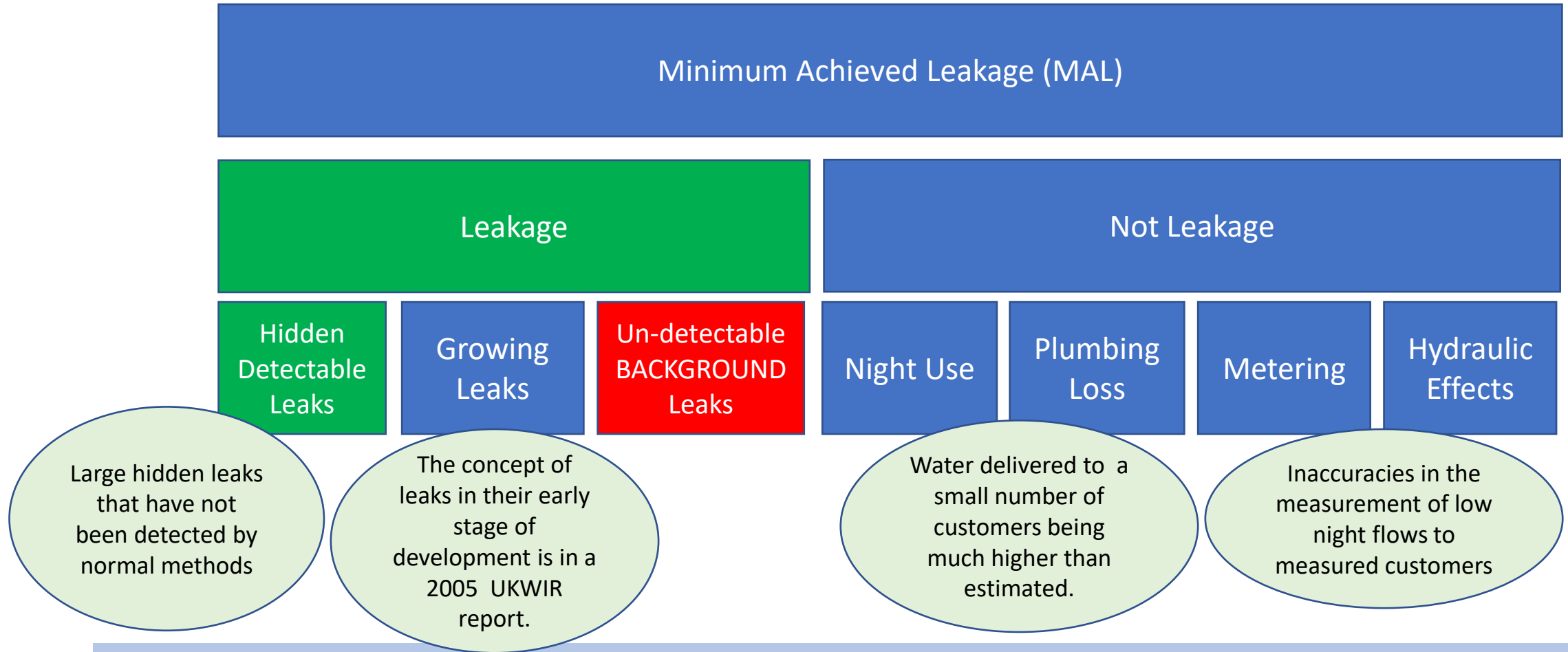
MAL = Minimum Achieved Leakage

This is the historic minimum achieved levels of leakage in DMAs from night flow measurements



MAL - Effectively all the leaks that a “normal” leakage sweep don’t pick up

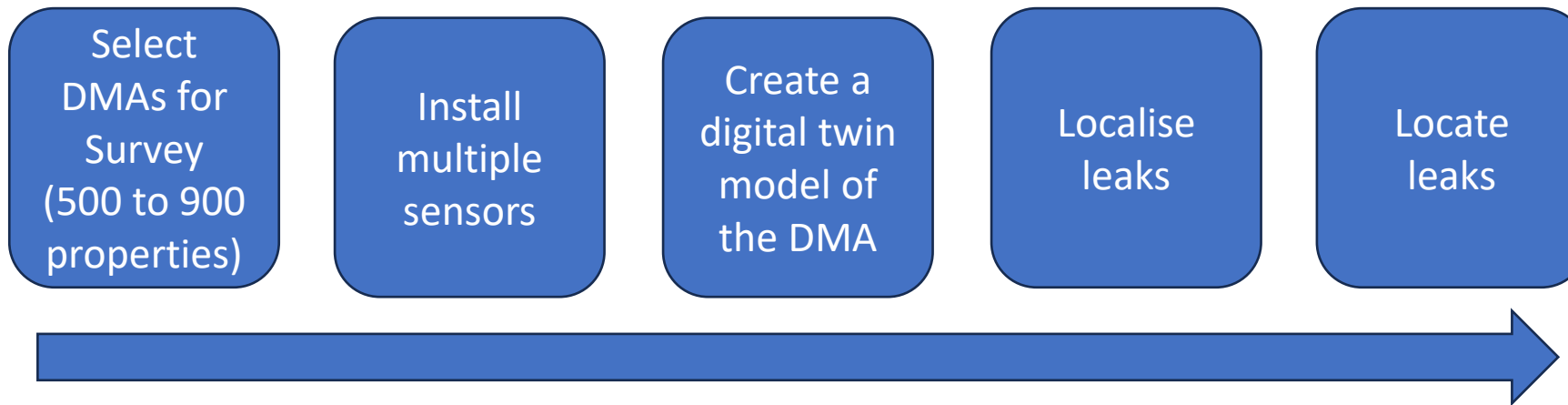
Can we reduce background leakage?



If some background leakage is from detectable leaks, we may be able to find them

Water Breakthrough Challenge: Transform Stream

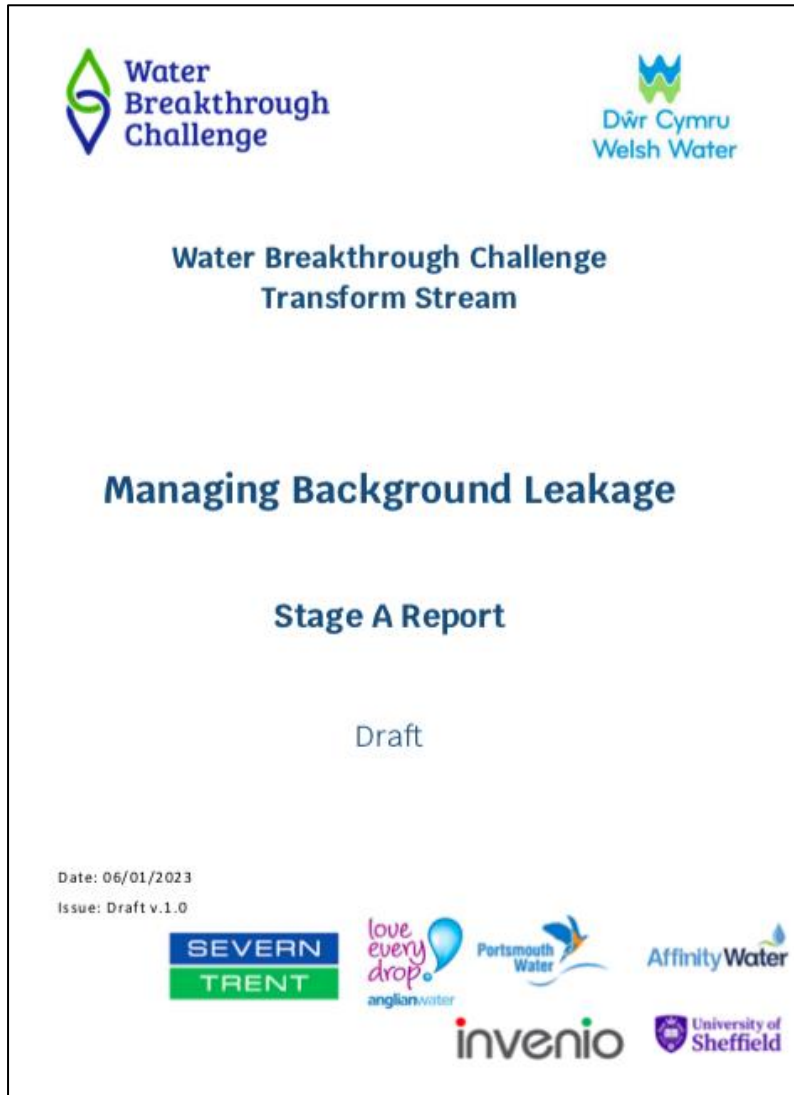
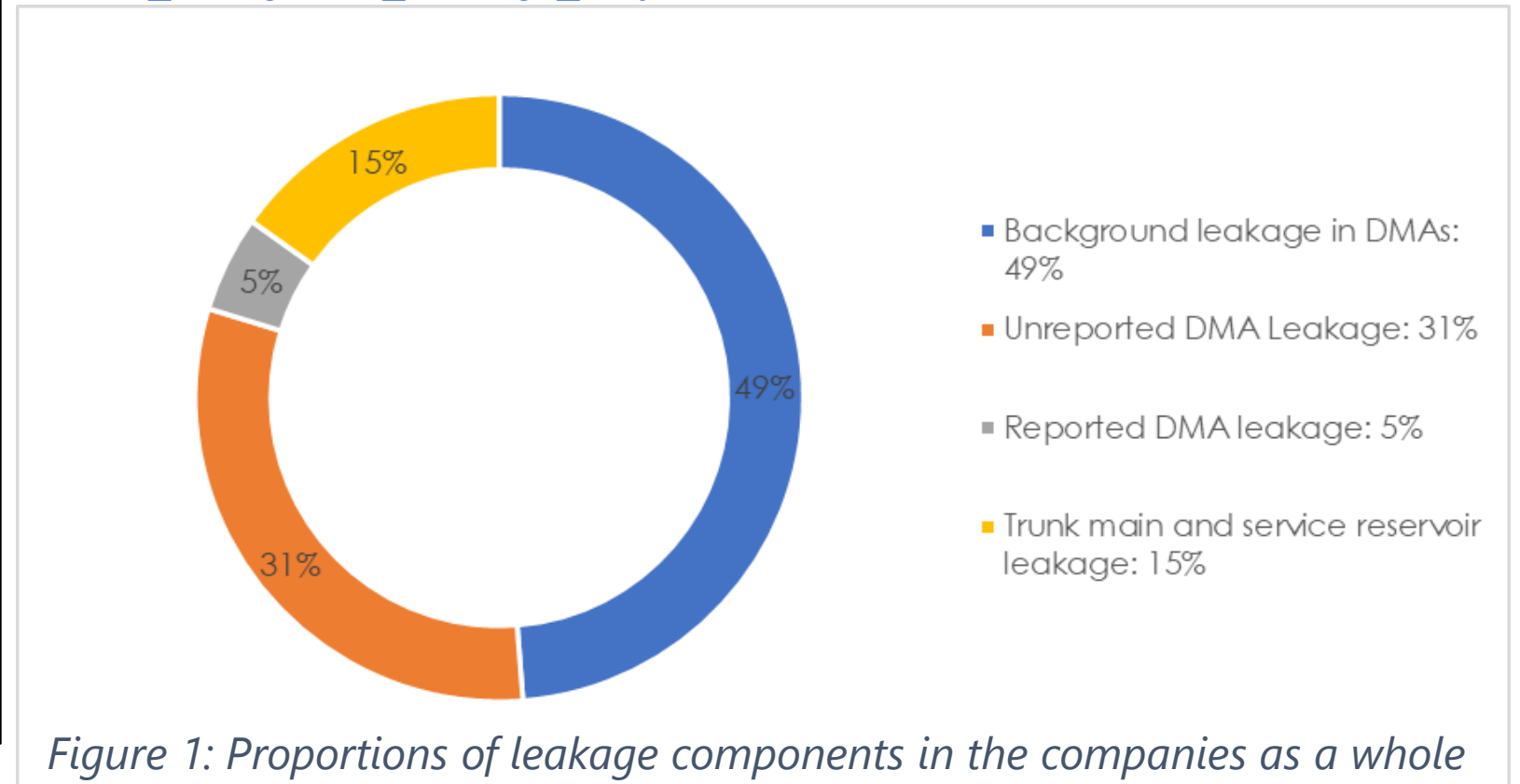
- The project aims to redefine the detectable limit of leakage by showing whether Background Leakage / MAL can be reduced by locating long running hidden leaks that have evaded detection
- Led by Welsh with direct support from Anglian, Severn Trent, Portsmouth and Affinity
- £3.5m project over 30 months
- Contractors: HWM / Invenio Systems and University of Sheffield



31 Page Report sets out work carried out in Stage 1 at end of 2022

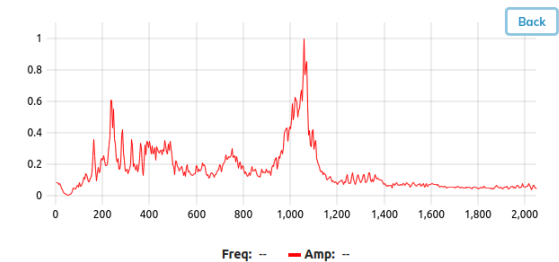
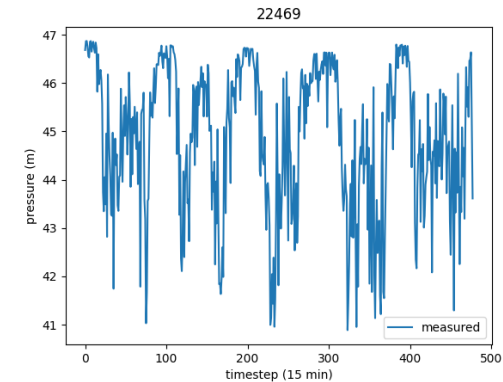
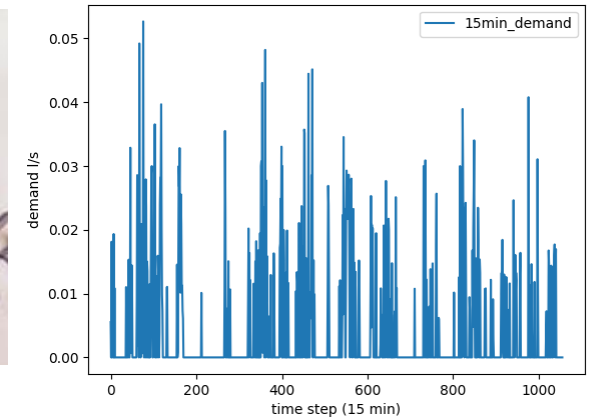
In the public domain via a Figshare link:

https://figshare.shef.ac.uk/collections/Reports_Collected_From_the_Managing_Background_Leakage_Project/6322910

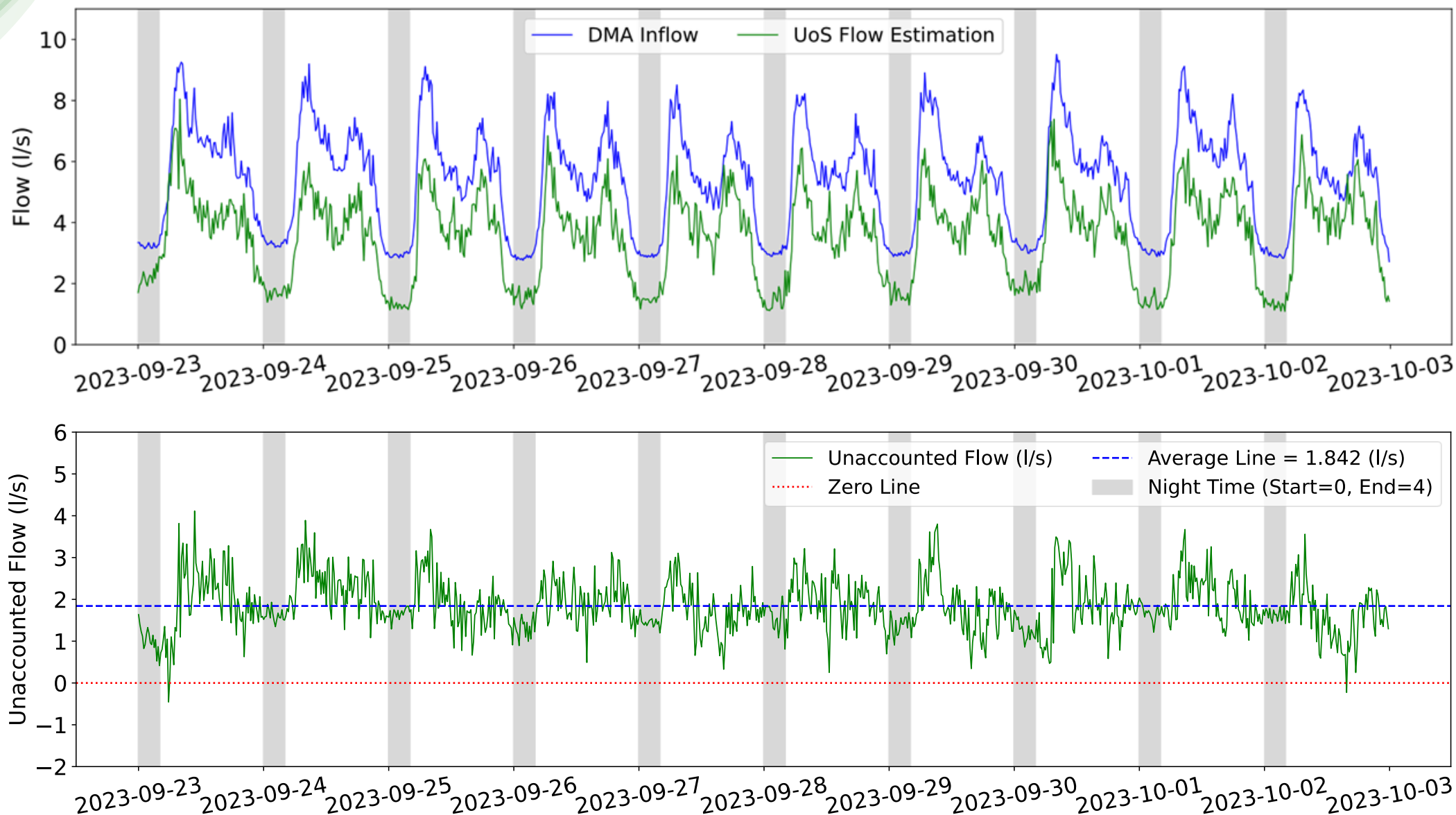


DMA Surveys

- All connections network model of each DMA
- Actual consumption profiles @ 1 min resolution based on Stop.Watch
- Modelled consumption profile for connections not logged
- Paradigm demand data also being reviewed
- Fitting pressure loggers to every available hydrant: 20 to 25 per DMA; 15-minute values
- Transient 100Hz Pressure Logging 24/7 using HWM LX Loggers that have been newly developed for this Project
- Installing acoustic loggers at high density sending nightflow acoustic readings
- Combining data sets to identify areas of interest



Flow Balance Analysis



Size	Tier 1	Tier 2
Small Flows	6	12
Medium Flows	3	4
Large Flows	2	6
Size	Tier 1	Tier 2
Small Flows	10	22
Medium Flows	5	6
Large Flows	0	7

Size	Tier 1	Tier 2
Small Flows	9	14
Medium Flows	0	10
Large Flows	0	9
Size	Tier 1	Tier 2
Small Flows	6	14
Medium Flows	2	1
Large Flows	0	0

Size	Tier 1	Tier 2
Small Flows	10	19
Medium Flows	14	2
Large Flows	1	9
Size	Tier 1	Tier 2
Small Flows	10	25
Medium Flows	7	4
Large Flows	3	12

Size	Tier 1	Tier 2
Small Flows	4	6
Medium Flows	1	6
Large Flows	0	2
Size	Tier 1	Tier 2
Small Flows	0	15
Medium Flows	0	6
Large Flows	0	0

Size	Tier 1	Tier 2
Small Flows	9	19
Medium Flows	14	2
Large Flows	1	1
Size	Tier 1	Tier 2
Small Flows	9	6
Medium Flows	7	9
Large Flows	3	0

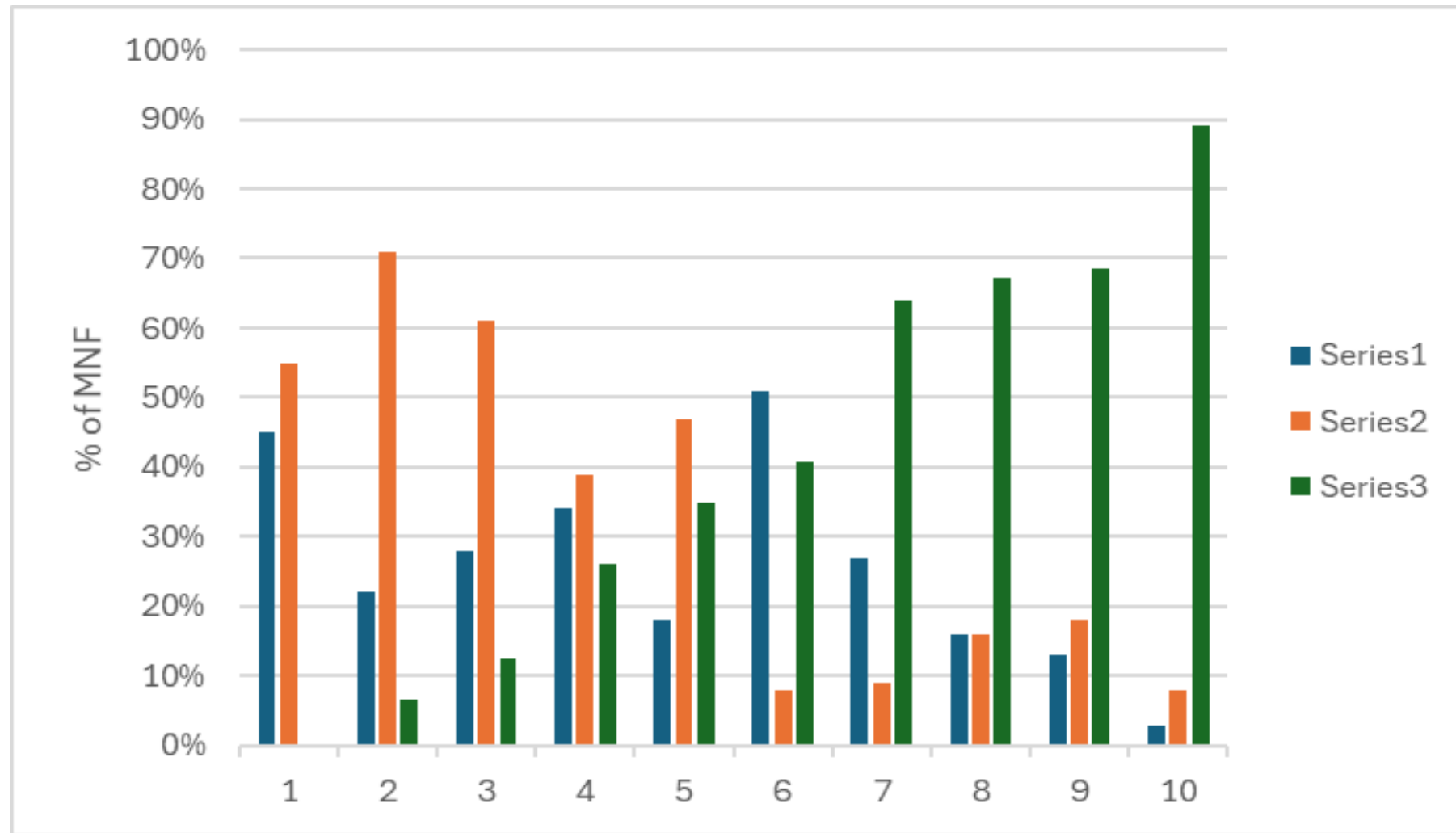
Size	Tier 1	Tier 2
Small Flows	72	152
Medium Flows	53	50
Large Flows	10	46

Customer side leaks detected by Stop.Watch

Components of minimum night flow

Anonymised Network Name	Property Count (from survey)	MNF (l/p/hr)	HWM estimate of night use (not including plumbing losses PL) (l/p/hr)	HWM estimate of customer side leakage (including PL) (l/p/hr)	HWM estimate of network leakage (l/p/hr)	Network Leakage as % of the MNF
netA1	519	14.13	4.87	5.56	3.69	26%
netA2	670	7.60	3.43	4.32	0	0%
netB1	665	12.15	3.26	7.37	1.51	12%
netB2	516	9.50	4.87	0.75	3.88	41%
netC1	766	13.80	2.53	6.46	4.81	35%
netC2	764	14.06	3.09	10.05	0.92	7%
netD1	404	53.69	1.73	4.19	47.78	89%
netD2	980	8.02	2.13	0.76	5.13	64%
netE1	849	16.48	2.71	2.71	11.07	67%
netE2	679	16.95	2.23	3.09	11.62	69%
Total / Ave.	6812	14.94	3.00	4.48	7.48	
Percentage %		100	20	30	50	
Exc D1	6408	12.50	4.50	4.50	3.50	
Percentage %			36	36	28	

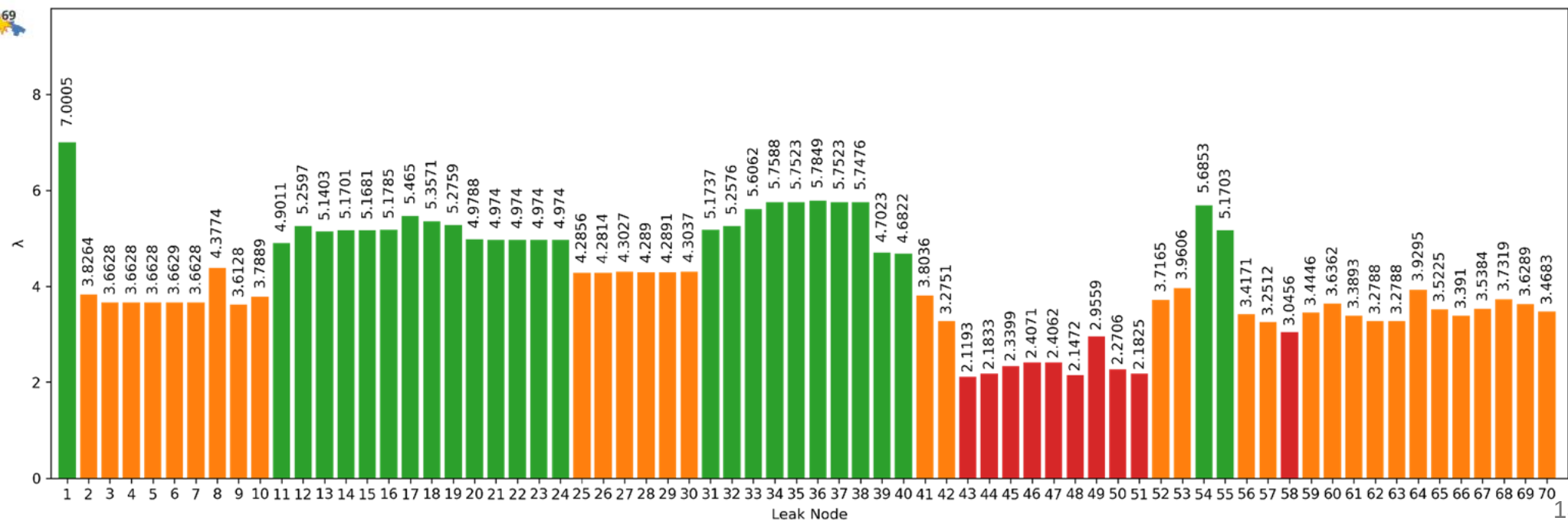
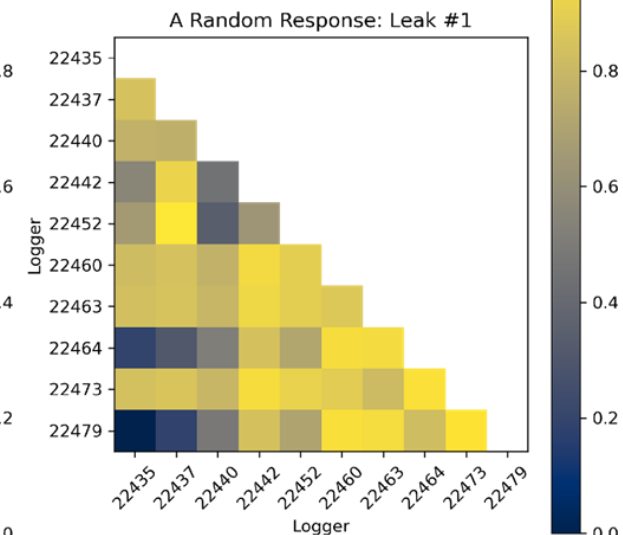
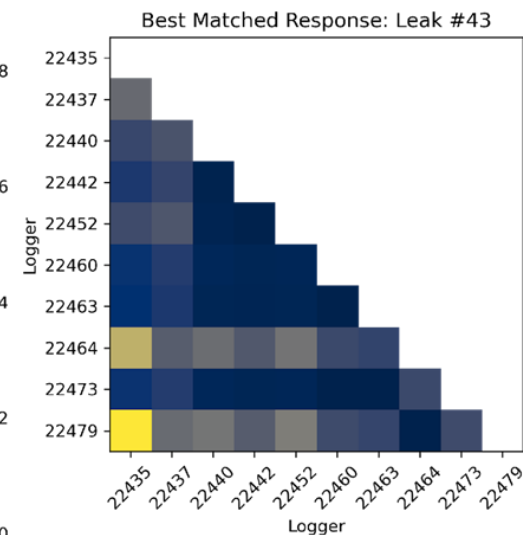
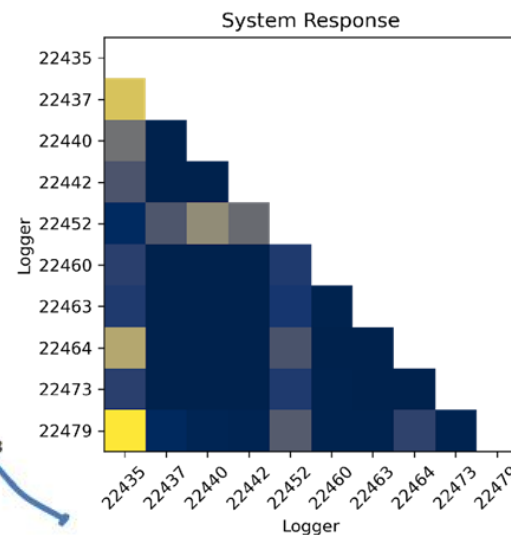
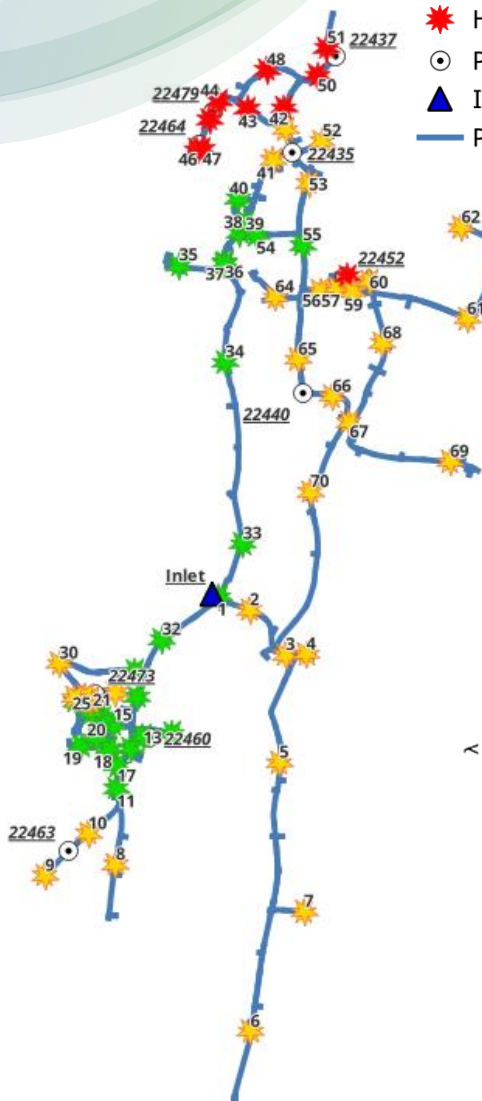
Components of minimum night flow



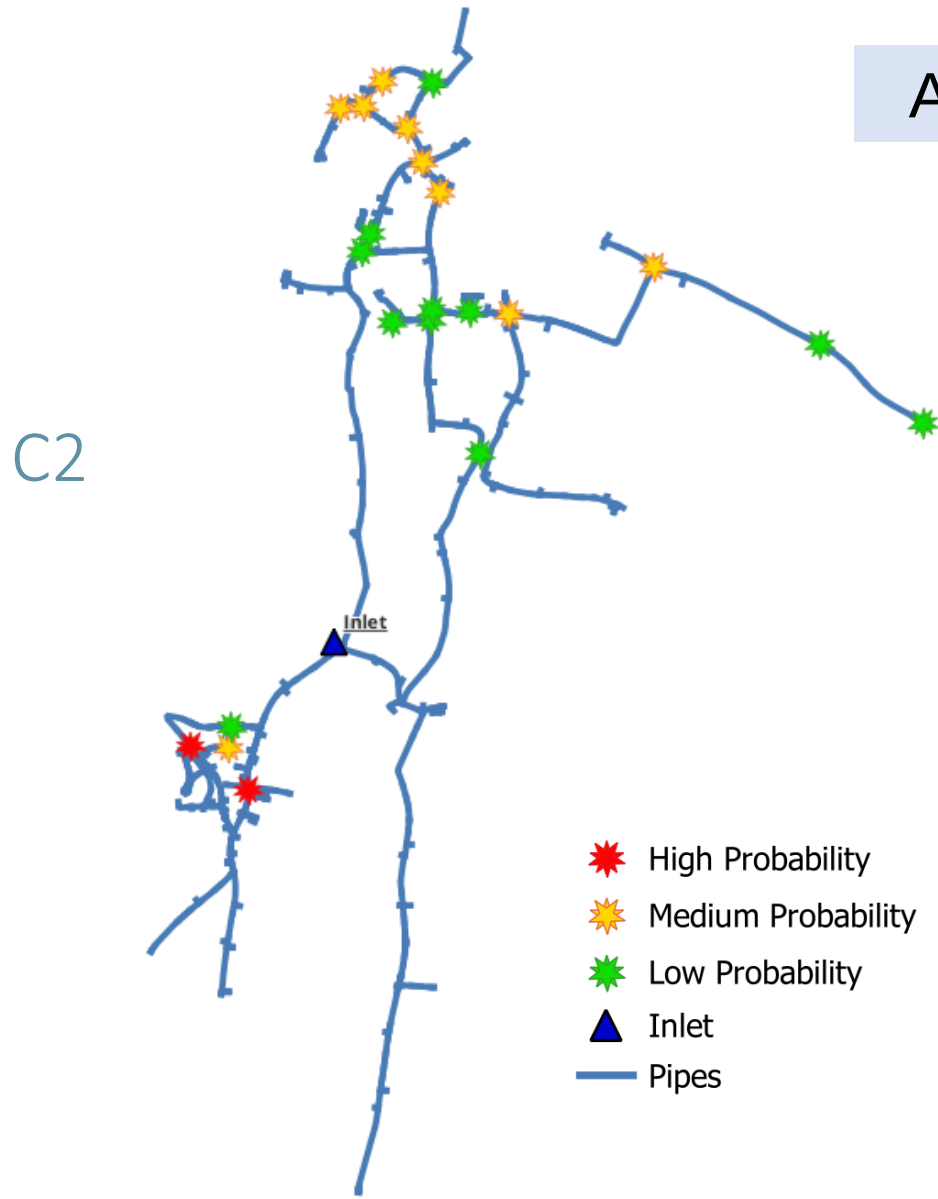
1 = Night Use
2 = Customer side leakage
3 = Network Leakage

Hydraulic Analysis

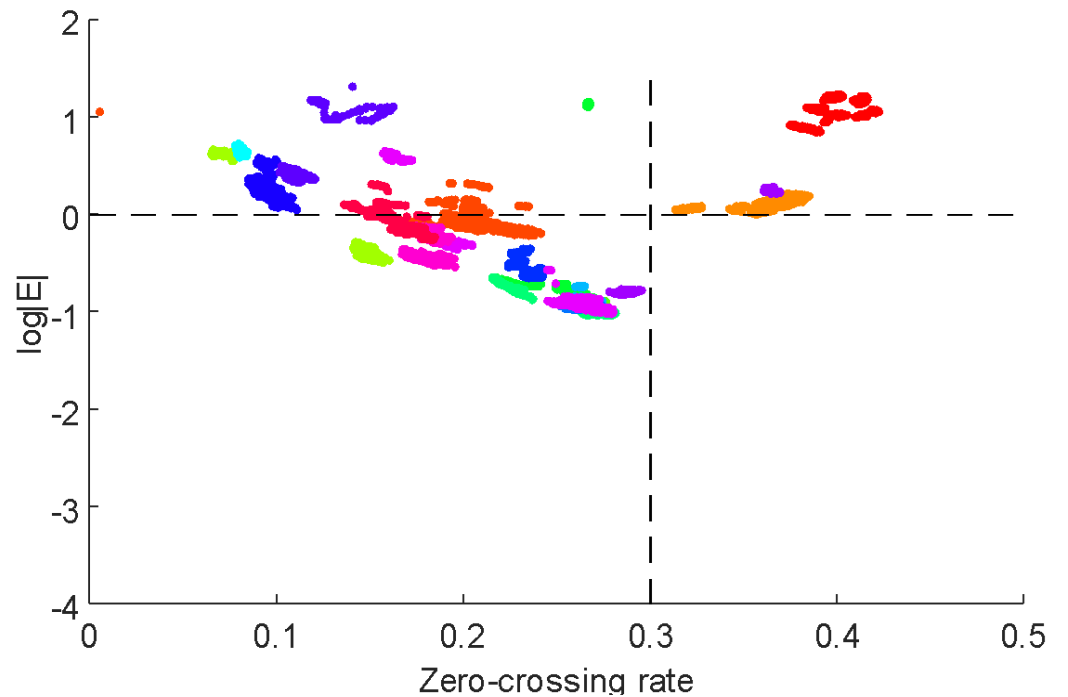
- ★ Low Probability
- ★ Medium Probability
- ★ High Probability
- Pressure Loggers
- ▲ Inlet
- Pipes



Acoustic Analysis



Analysis of all the acoustic data for netC2



DMA	Comment on UoS analysis	Rating of UoS analysis	Re-run analysis	Network Leak ?	Next steps
A1	Presence of pressure zones complicated analysis	Network issue	Y	Y	Apply techniques developed in project. 0.7 l/s UFW
A2	Presence of pressure zones complicated analysis	Network issue	N	N	Next to no network leakage. All customer side
B1	Leak area identified but large, acoustics found 2 potential leak locations	Good	N	N	Low network leakage. 9 large CSLs + others being followed up. May do additional logging.
B2	Leak found. Good agreement between hydraulic and acoustic. Possible areas localised	Good	N	Y	CSLs being followed up
C1	Hydraulic analysis inconclusive, Acoustic identified potential leak. 2.5 l/s network UFW	Inconclusive	Y	Y	Possible follow up work to locate network leak CSLs being followed up
C2	Leak found. Good agreement between hydraulic and acoustic data. 2 l/s network UFW	Good	Y	Y	Correlate in areas of interest
D1	Very high UFW on the network. Probably not a burst. More likely a breach or hidden use	Network issue	N	N	Ongoing discussions with the water co.
D2	Uneven pressure sensor coverage. Data missing for part of the survey period	Deployment issue	Y	Y	Re-run the analysis using best data from the survey
E1	Hydraulic and acoustic inconclusive. Leak found during survey period. Numerous CSLs	Inconclusive	?	?	No additional follow ups until CSLs investigated
E2	Hydraulic analysis strongly identifies potential leak area. Numerous CSLs	Good	Y	Y	Additional loggers to be installed. 1 to 2 l/s of network UFW.

Some provisional learnings

- It is highly unlikely that BL is due entirely to small leaks below the detectable threshold as defined in Managing Leakage and the WaterUK Routemap
 - It is more likely that MAL is due to a combination of detectable leaks, gross errors in flow measurements, and errors in the leakage estimation process
-
- Customer side leakage (CSLs and Plumbing Losses) account for 30% of the MNF (36% exc D1)
 - Customer side leaks may not be detected using acoustic means alone
 - Thorough Company follow up to customer side POIs are essential
 - Company average values for night use and customer side leakage can give misleading estimates of network leakage
 - It does seem to be possible to localize network leaks in the majority of DMAs
 - In other DMAs the MAL is due to customer use and CSL or network issues

Next steps 2025

- Follow up actions in 4 or 5 of the 10 Phase B DMAs
- Analyse data from the first 5 DMAs in Phase C. Lower level of Stop.Watch coverage and using DX-Mic to detect customer side leaks
- Complete surveys in 10 of the 15 Phase C DMAs and follow up by summer 25
- Phase D – Uncertainty Analysis – has started and will complete mid 25
- Consultation with the industry
- Phase E – Report Summer through Autumn 25
- Dissemination:
 - Spring event
 - Support from Arup and Challenge Works

The elephant in the room



How can we half leakage if half is due to MAL levels in DMAs ?

Thank you

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