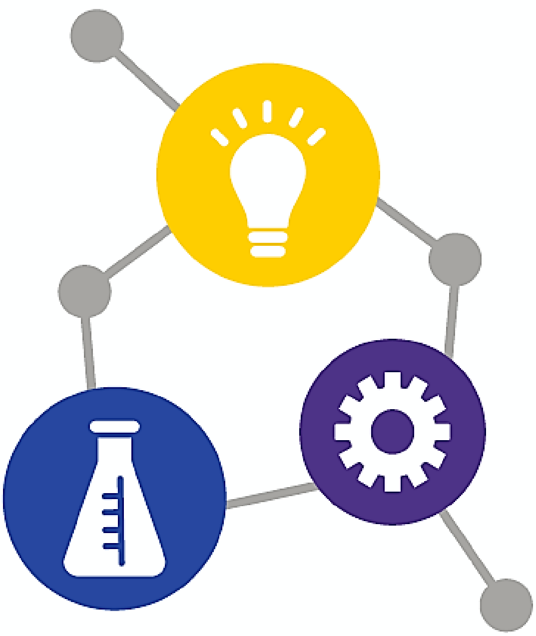
January 2023

Uisce Éireann CRU Water Services Innovation Fund

Effecting Transformational Change in Leakage Reduction within the Greater Dublin Area (GDA)

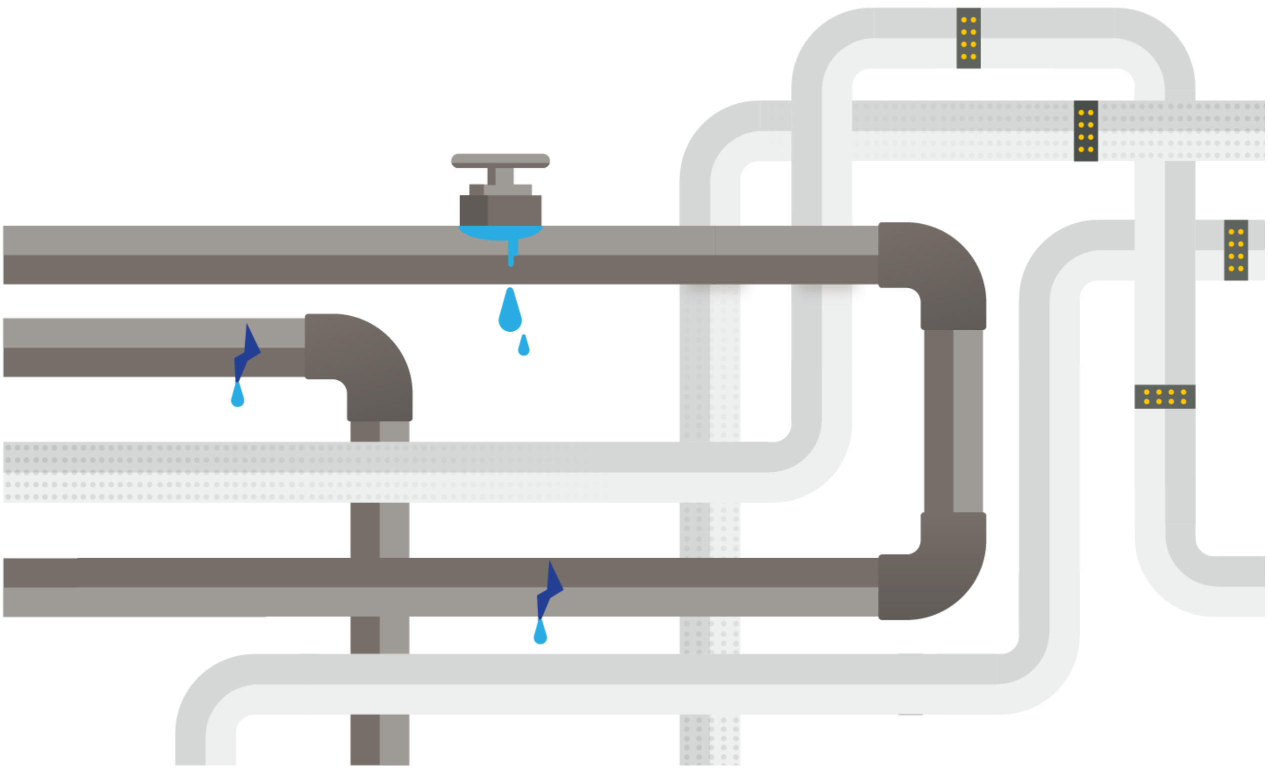


UÉ/FF/LDB/0115

Commission for Regulation of Utilities (CRU) Water Services Innovation Fund

Effecting Transformational Change in Leakage Reduction within the Greater Dublin Area (GDA)

Attached is the Effecting Transformational Change in Leakage Reduction report within the Greater Dublin Area (GDA) produced by Uisce Éireann.



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- Provision of safe, secure, and reliable water services;
- Increased understanding of customer behaviours and their drivers and effective customer engagement;
- Enhanced energy savings in the provision of water services;
- Achievement of relevant environmental standards and the objectives of the Water Framework Directive;
- Mitigation of negative climate change impacts;
- Provision of water services in an economic and efficient manner; *and*
- Improved conservation of water resources.

DISCLAIMER

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Glossary of Terms and Abbreviations	
Abbreviation or Term	**Definition or Meaning**
AL	Acoustic Logger
CRU	Commission for Regulation of Utilities
CFA	Continuous Flow Alarm
CSL	Customer Side Leaks
DMA	District Metered Areas
GDA	Greater Dublin Area
GIS	Geographic Information System
KPI	Key Performance Indicators
LMS	Leakage management System
LMS	Leakage Management System
LRP	Leakage Reduction Programme
MLD	Megalitres per Day
MNF	Minimum Night Flow
POI	Point Of Interest
RfQ	Request for Quotation
SELL	Sustainable Economic Level of Leakage
UÉ	Uisce Éireann
WSZ	Water Supply Zone

Executive Summary

This is a report into a series of Acoustic Logger (AL) technology trials. Its sole purpose is to provide a commentary on what was observed during these trials.

The benefits of this trial are directly measurable as outcomes:

1. Reduction in time to attain DMA target Minimum Night Flow (MNF) - Section 3.2.1
2. Reduction in cost to attain DMA target MNF - Section 3.2.2
3. Reduction in water volume lost due to decrease in leak run time - Section 3.2.4
4. Overall reduction in UÉ leakage figures as works undertaken more efficiently - Section 3.2.4

The outputs from this trial will be measured on the following key performance indicators (KPI's):

5. Number of and types of leaks found per cycle - Section 3.2.5
6. Volumetric leakage reduction per leak and type per cycle - Leakage reduction is captured using LMS, individual leak reduction per leak type is not possible to determine.
7. Average cycle time - Section 3.2.1
8. Cost per cycle - The cost per cycle linked to duration per cycle is detailed in Section 3.2.1 and Section 3.2.2 discuss durations and costs respectively
9. Cost per Ml/d saved - Section 3.2.3

Key questions to be answered as part of this trial:

10. Can AL facilitate more effective and efficient leakage reduction practices? - Section 3.2.1
11. Can AL work in an Irish context of very high leakage levels and relatively low pressures? - Section 3.2.3
12. Can advanced AL complement other UÉ sensors and systems to achieve more efficient leak reduction? There is potential to merge pressure and acoustic logging technologies into a singular platform to achieve more efficient leak reduction.
13. Does UÉ need to adjust its existing Leakage Strategy as a result of the findings from this project? - Section 4.2
14. Does UÉ need to amend its existing delivery processes to maximise the returns from this new innovative approach? There is no requirement to amend delivery process.
15. How should UÉ's future budgeting and resourcing plans be developed to take on board the outcomes from this project? - Section 4
16. Can AL networks minimise disruption to customers through reducing the need for step testing, finding and repairing leaks before they impact significantly on service - Section 4.1

No adverse comment is intended or should be presumed against any product, technology, service or supplier. The intention of the project is to explore types of technological solutions, rather than specific products or systems.

1. Introduction

1.1 CRU Water Services Innovation Fund

The Water Services Innovation Fund was established by the CRU in April 2015. The CRU is the economic regulator of UÉ as the provider of public water and wastewater services. As part of the revenue review, the CRU created the Water Services Innovation Fund to enable UÉ to invest in research and innovation projects. This was with a view to addressing issues across the UÉ network and to find new ways to provide and improve services outside of 'business as usual'.

The intent of the Fund is to promote innovative projects that have a reasonable probability of delivering defined, tangible benefits to customers of UÉ in a defined timeframe. UÉ must also demonstrate that proposed innovative projects provide value for money and meet at least one of several other objectives included in the CRU Water Services Innovation Fund Information Paper (April 2015)[1]. UÉ is required to provide half-yearly reports to CRU and a presentation at each Water Services Innovation Fund meeting.

In December 2019, UÉ made an application to the CRU for an allocation from the Fund on Effecting Transformational Change in Leakage Reduction within the Greater Dublin Area (GDA). This would entail a trial to investigate the potential benefits of deploying different types of advanced, highly sensitive, cloud-based Acoustic Logging (AL) networks on a relatively small scale within the GDA to assess their effectiveness on different pipe and DMA (urban, semi-urban and rural) types. In June 2020, the CRU approved funding for the project.

1.2 Background

UÉ delivers its Find & Fix programme in partnership with Local Authorities (LAs) and contractors using traditional methods of leak detection. These methods include the following:

- Step testing to apportion the District Metered Area (DMA) into smaller areas
- Bulk meter reads
- Customer meter reads
- Closing valves
- Interruptions to customer supply
- Night works
- Leak identification through sound, listening and/or correlating equipment typically covering the entire DMA

Transformational change is required to deliver leakage targets in a more cost and time efficient manner. The purpose of the trial was to determine the potential benefits of ALs and associated cloud-based technologies over traditional leak detection methods in an Irish context.

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[1] Ref: CER/15/076 Water Services Innovation Fund Information Paper published 2015/04/15, which can be found here.

An AL is a small device that is installed directly onto a water network fitting. These devices log noise levels throughout a pre-determined period of the night (i.e., 02:00 – 04:00am) recording a sound file which is sent to a cloud-based platform for spectrum analysis.

The loggers ‘listen’ for the characteristic noise that is transferred through pipe walls by a leak and upon detection of this sound they send an alarm to the systems interface. This data is reviewed by an analyst, including cross referencing between multiple loggers, to identify points of interest (POI) which are investigated by leakage engineers to pinpoint the leak location.

1.3 Business Case

A trial to investigate the potential benefits of deploying advanced highly sensitive, cloud-based AL and data analytics was proposed as previous deployments in Ireland involved a small number of loggers for a short duration (days) with limited associated data analytics or machine learning to inform future leakage detection or proactive capital maintenance works. The activity did not include intelligent cloud-based machine learning systems and was not of a scale that one could derive any conclusions that would impact on an overall UÉ Leakage Strategy.

The purpose of this trial was to investigate the semi-permanent deployment (3 – 6 months) of ALs with follow on advanced data analytics. This add-on advanced data analytics and cloud-based machine learning has the potential to transform operating arrangements used by UÉ to deliver its Leakage Reduction Programme (LRP). The technology is established in other jurisdictions, such as the UK, however, the leakage levels in Ireland are significantly higher (43% in 2019) than those in the UK (c. 15-20%).

In addition, operating water pressures in the UK are higher than in Ireland. For example, Anglian Water’s average operating pressure is 4.4 Bar, Scottish Water is 4.5 Bar, whereas average operating water pressure in the GDA is 3 Bar. This makes leak detection more difficult in the GDA, i.e., lower pressure equates to lower noise level generated from leaks. The variation in UÉ’s network compared to other networks where AL technology has already been proven lead to a high degree of uncertainty around whether the system would work on UÉ networks. It is not possible to make a direct comparison with other utilities given the challenges that exist in Ireland. Thus, a comprehensive trial was required to prove the efficacy of the technology prior to giving consideration to undertaking fundamental changes to the traditional approach taken to reduce leakage in UÉ networks.

Summary of challenges in an Irish context:

- Very high leakage levels (43% in 2019 nationally, 38% in GDA)
- Complex network configurations in urban areas
- Advanced pressure management zones; resulting in lower leak noise and additional pressure reducing valve noise
- High proportion of plastic watermains in UÉ network
- Geographic Information System (GIS) confidence, i.e., material and diameter of watermains mapped in GIS
- Unknown (unmetered) Customer Side Leaks (CSL)

2. Implementation

2.1 Competition

A Horizon Scan was carried out in 2019 on Distribution Mains Leak Detection Technologies. 43 technologies were identified in the Horizon Scan, reviewed by UÉ and six companies were short-listed to present during a one-day Expo in October 2019.

Following the CRU's approval to proceed with the trial in June 2020, a Request for Quotation (RfQ) for the Supply of Leakage Detection Equipment was issued in July 2020. Tender Award letters were issued in September 2020 to three successful companies offering four different ALs.

2.2 Specification & Scope

UÉ's application to CRU in December 2019 outlined that 1,000 ALs would be deployed across six LAs and rotated quarterly across 40 DMAs. Following the tender process and market rates, the purchase of ALs was reduced to 710 as per the Fund allocation. Key trial elements are detailed below, including DMA selection based on their characteristics and representative of urban, semi urban and rural types, leakage levels and pipe type.

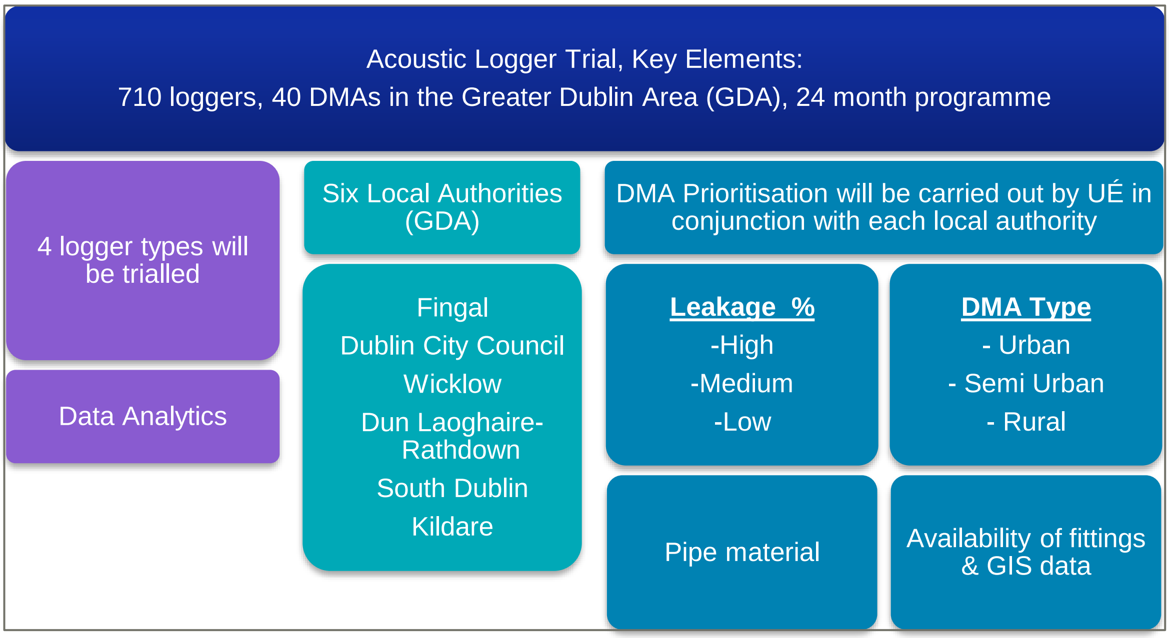

Figure 2.1 Key Elements of the Acoustic Logger Trial

2.3 Stakeholder Engagement

Stakeholder engagement with each of the six LAs commenced in September 2020. Clear communication and building strategic working relationships between the suppliers, LAs and UÉ staff was a critical enabler in carrying out this trial. Information sessions were held with the LAs outlining the key elements of the trial, potential benefits and proposed strategy. DMA selection took place in collaboration with the LAs to ensure the most appropriate DMAs were selected from an operational and leakage reduction viewpoint, while adhering to the criteria set out in the application to CRU.

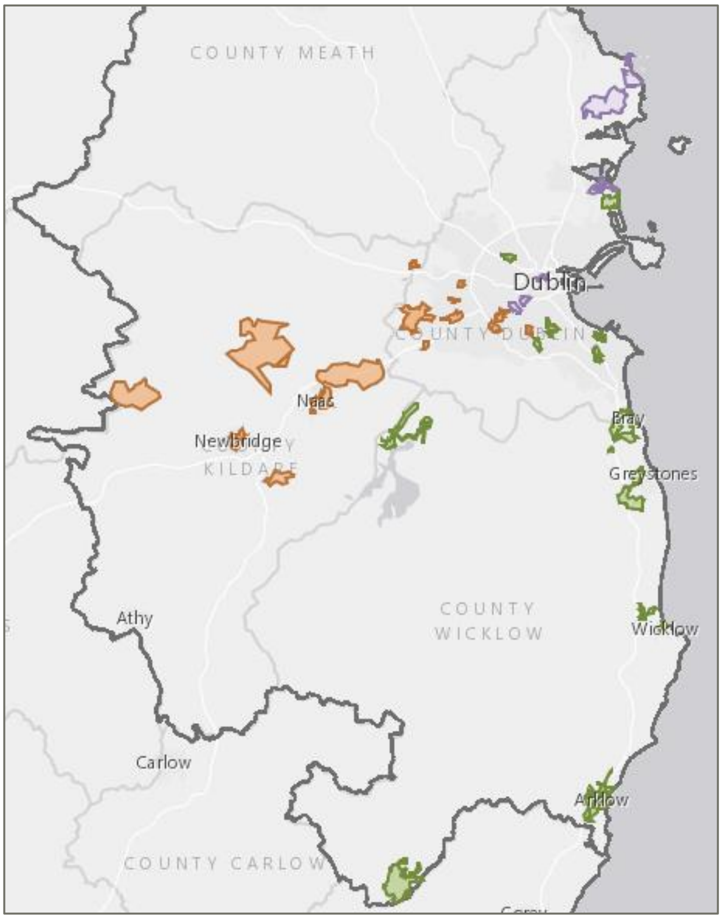

Figure 2.2 DMAs Selected During the Trial

Weekly meetings were scheduled during the trial, where the Points of Interest (POIs) were discussed with the LA, UÉ and the AL supplier for that particular LA. Feedback on previous week's Find activities (pin-pointing) was also shared at these meetings.

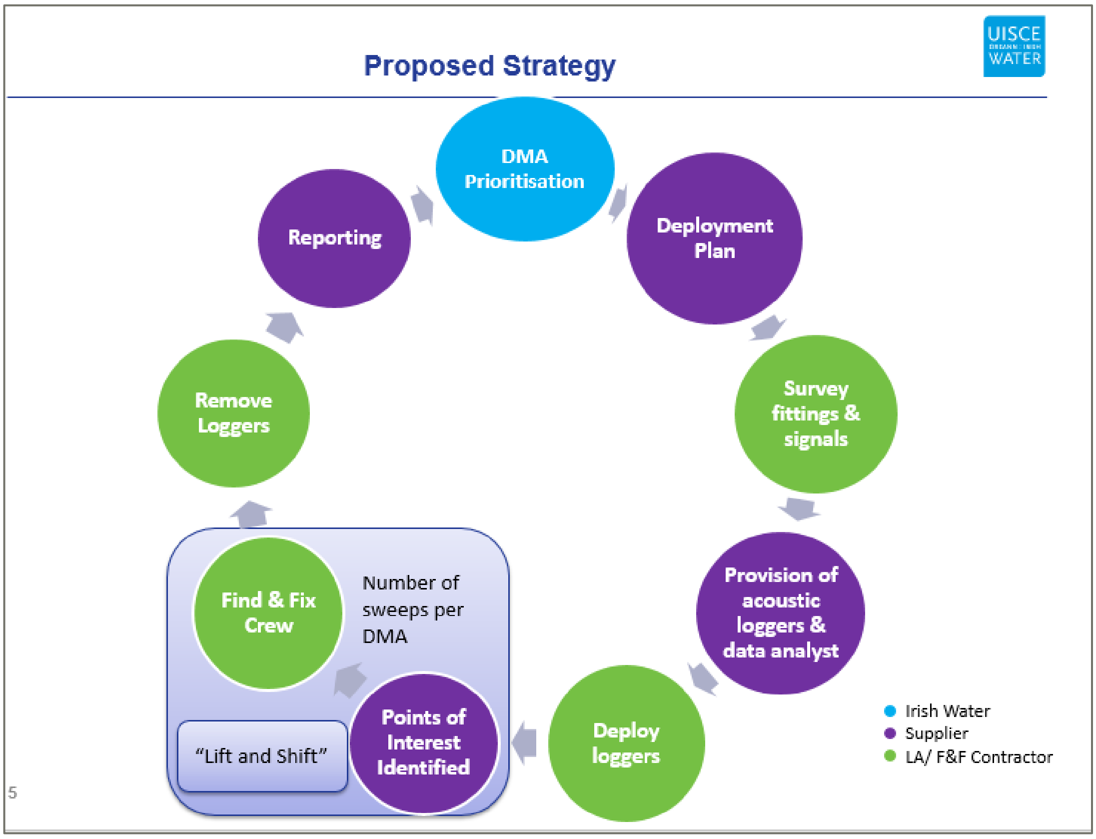

Figure 2.3 Proposed Strategy

2.4 Acoustic Logger Deployment

AL deployment commenced from December 2020 to January 2021 (longer lead times for delivery of some ALs). Suppliers met with LA staff on site to carry out training over two days. The remaining ALs were deployed by LA staff with technical support available from the supplier as required. It was noted throughout the trial that the availability and expertise of the AL supplier to provide technical support when queries were raised, was a key element to ensuring progress during the trial. Following on from the learning phase, LA staff carried out “Lift & Shift” of the ALs from DMA to DMA without assistance from suppliers.

Figure 2.4 Examples of Acoustic Logger Deployment

2.5 Acoustic Logger Technology and Cloud Based Data Analytics

Each AL supplier provided access to the cloud-based platforms (five-year provision) via a link and login. Usernames were set up for LA staff to view their own area while UÉ staff on the project were provided with access to view multiple LAs collectively. Due to Covid-19 restrictions at this time, training took place via Zoom and Microsoft Teams. Data from the ALs deployed in GDA was analysed during these training sessions, which outlined how Points of Interest (POIs) were generated or illustrated in the platform. The suppliers provided POIs to LA and UÉ throughout the trial, and these were reviewed at weekly meetings. These meetings also provided an opportunity to gain further insights and learnings on the technology and associated cloud-based data analytics.

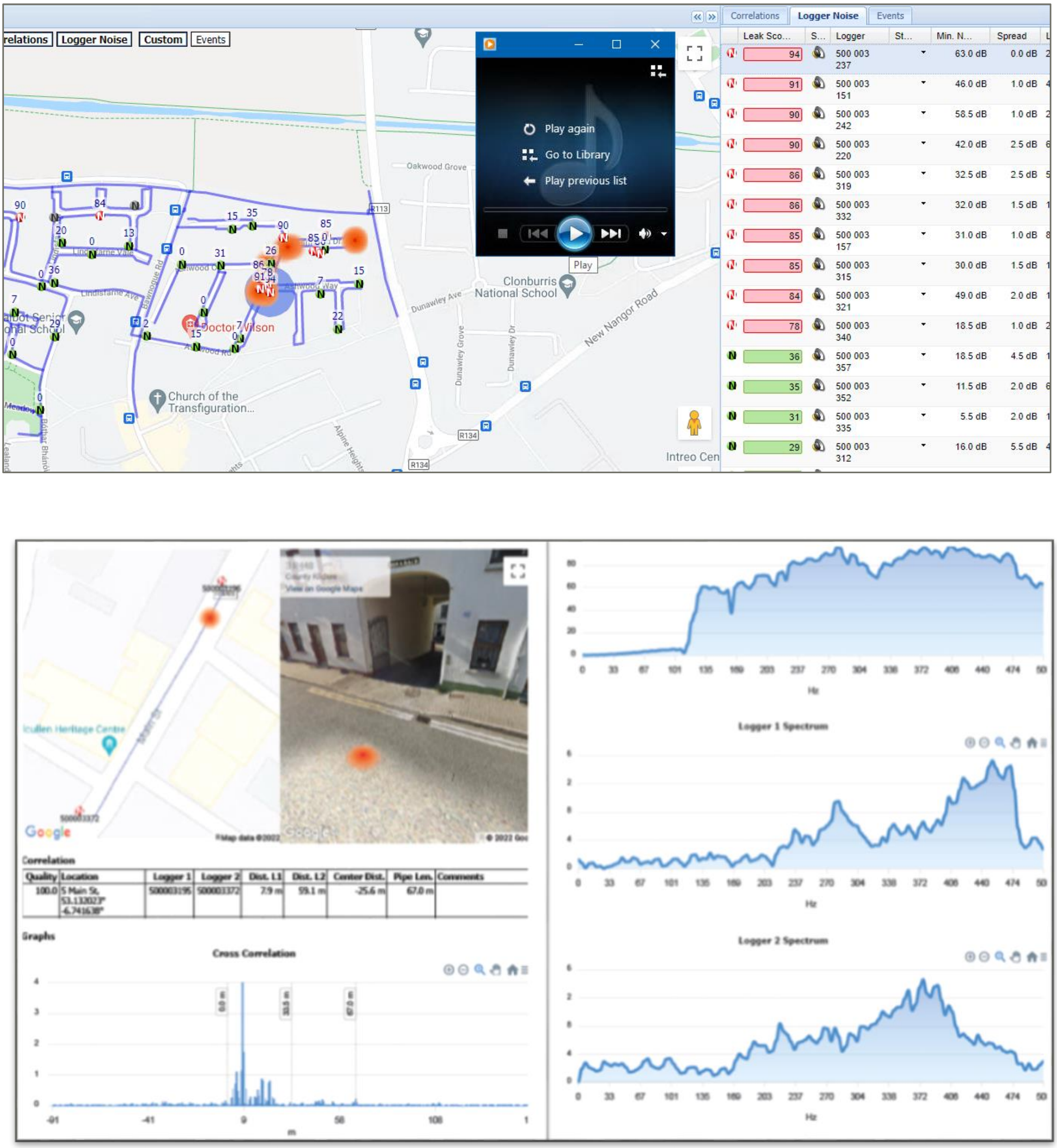

Figure 2.5 Examples of Cloud Based Platforms and Data Analytics

3. Performance Review

3.1 Introduction

This section summarises findings from a series of technology trials. Its sole purpose is to provide a commentary on what was observed during these trials. No adverse comment is intended or should be presumed against any product, technology, service or supplier. The intention of the project is to explore types of technological solutions, rather than specific products or systems.

The purpose of this chapter is to discuss the outputs of each AL and associated cloud-based data analytics and identify key findings. It is not intended to draw specific conclusions about the relative qualities of any technologies or services. Similarly, any recommendations are addressed in the closing chapter. ALs will be referred to as Logger A, Logger B, Logger C and Logger D in this section.

3.2 Outputs

3.2.1 Reduced time in DMA to achieve target MNF

As the trial was time bound to a 24-month programme, including procurement, design and deployment, AL deployment was designed across 4 phases. Each phase was designed to complete 10 DMAs per phase to ensure 40 DMAs were completed as per the trial criteria. DMA prioritisation, carried out in conjunction with each LA, ensured all leakage levels (high, medium, low) and mixed DMA types (urban, semi-urban and rural) were captured during the trial. Figure 3.1 illustrates the duration of the ALs in each Phase to achieve target MNF for each DMA. Logger A and Logger B completed Phases 1-3 during the trial, while Logger C and Logger D completed 4 phases. The average duration for traditional methods, measured on DMAs closed out in 2021, was 180 days. Note: AL time in DMA includes “Lift & Shift” time in deploying/re-deploying loggers.

The key findings were:

a) Logger A: average duration 200 days, +11% on traditional methods.
b) Logger B: average duration 150 days, -17% on traditional methods.
c) Logger C: average duration 98 days, -45% on traditional methods.
d) Logger D: average duration 83 days, -54% on traditional methods.

Overall efficiency increases by 34% (i.e., 180 days to 120 days); however, Logger C and Logger D results show a combined total of 50% reduction on traditional methods (i.e. 180 days to 91 days) during the trial. This value was further reduced in Phase 4. Full details for each logger are shown in Figures 3.3 – 3.6.

In summary, two of four ALs have proven successful in reducing time in DMA to achieve target MNF. Efficiency increased further (-61% over traditional) as experience with the technology and data analytics improved during Phases 3 and 4 for loggers C and D. The performance of cloud-based data analytics was a key factor in reducing time to achieve target MNF. Where POIs resulted in accurate leak location, user experience with data analytics outputs was improved and efficiencies gained. Conversely, where users experienced limited confidence in POI resulting in leak location and repair, stakeholder engagement was difficult to maintain. Proving results from the beginning and throughout the trial was key in driving efficiencies. The variations between the four AL types demonstrates how a straight application of one or more products, without benchmarking each product, could not have resulted in a positive outcome to advance acoustic logging technology with associated cloud-based data analytics.

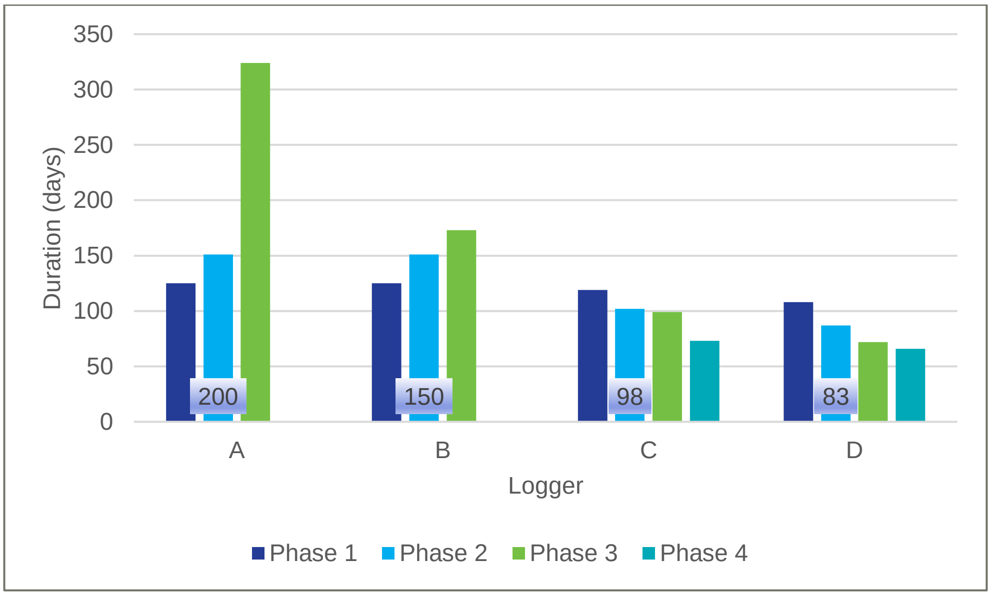

Figure 3.1 Acoustic Logger Type – Duration in Phase (days)

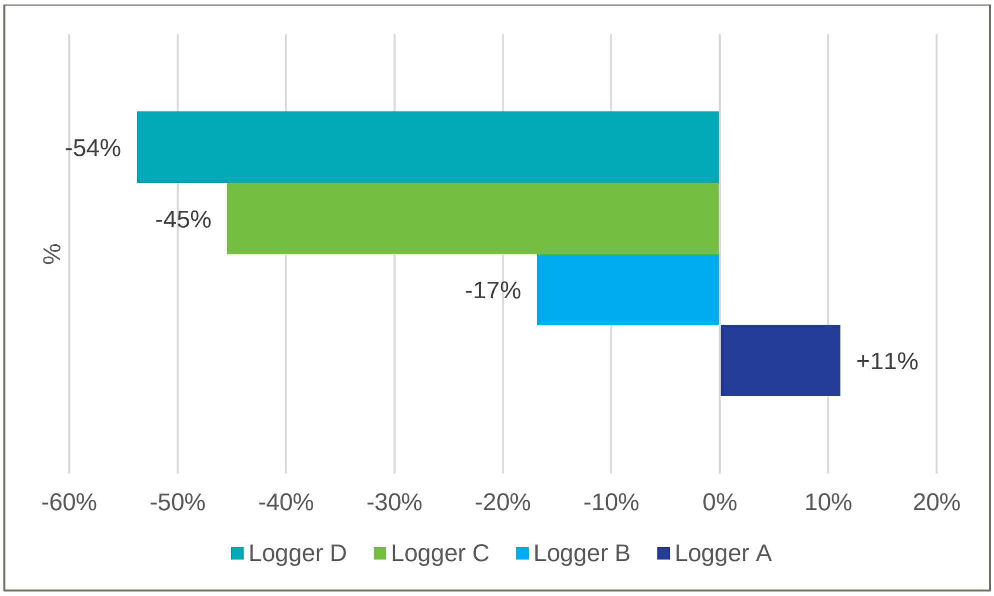

Figure 3.2 Reduced Time in DMA over Traditional Methods

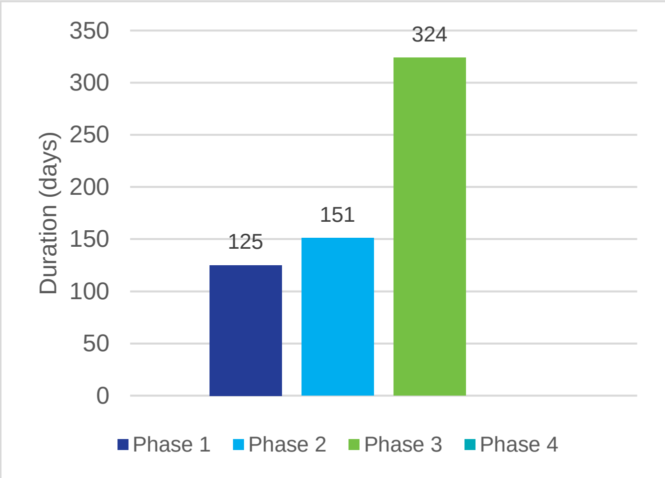

Figure 3.3 Duration per Phase – Logger A

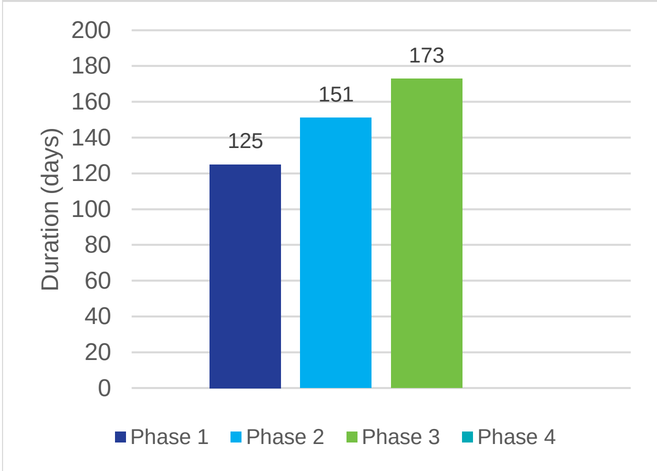

Figure 3.4 Duration per Phase – Logger B

Note: At the time of finalizing the trial report, Logger A and Logger B had not yet progressed from Phase 3 to Phase 4.

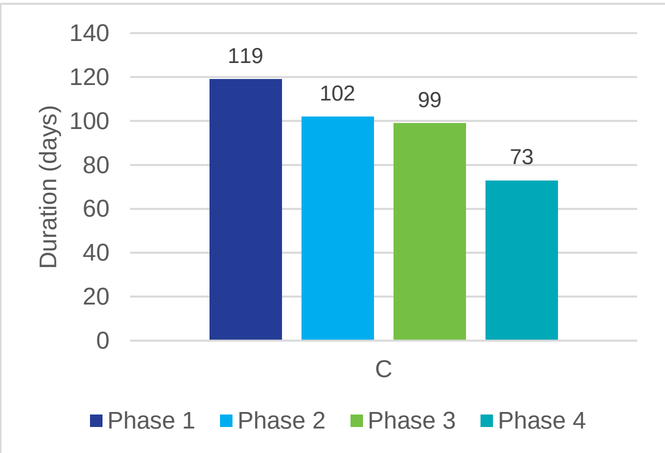

Figure 3.5 Duration per Phase – Logger C

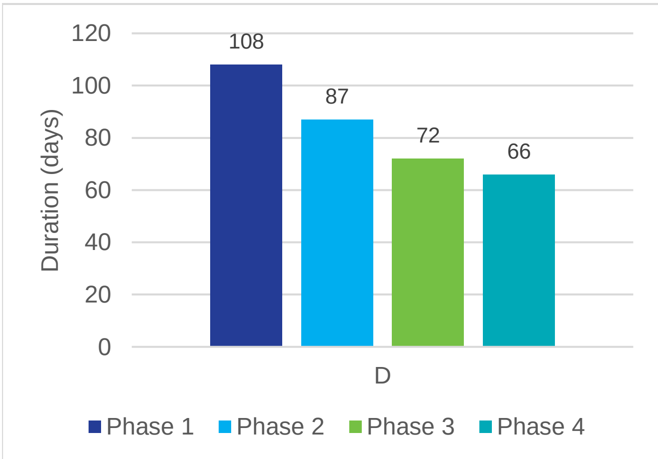

Figure 3.6 Duration per Phase – Logger D

3.2.2 Cost Efficiency Analysis - Reduced cost to achieve target MNF

As outlined in Section 3.2.1, Loggers C and D reduced the duration by 50% on average over the trial, with greater efficiencies gained in Phases 3 and 4. While the time was reduced, it is worth noting that cost of Find is not reduced, i.e. more Find activities can be carried out in the same period of time. This increase in efficiency is critical to achieve leakage targets. The investment cost of the ALs measured against DMA count and length of network covered during the trial was evaluated based on length of main covered in 19 months (January 2021 – August 2022). This initial cost is a one-time payment for the hardware, along with five-year provision of roaming SIM cards, web hosting and access to the cloud-based analysis software.

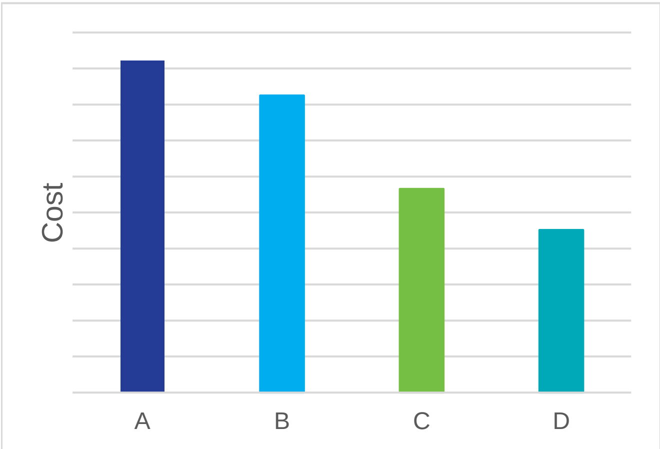

Figure 3.7 Cost per DMA by Logger Type

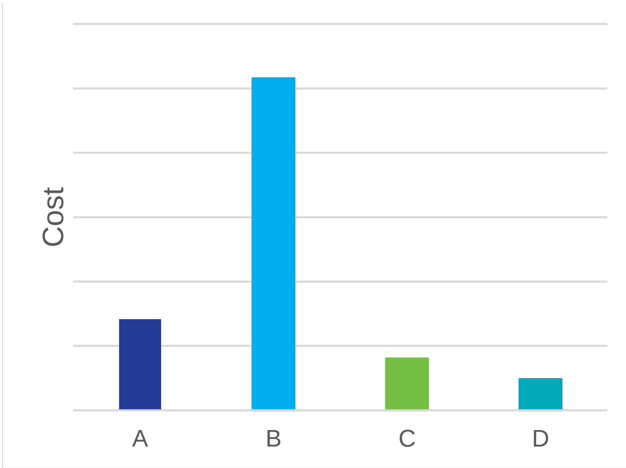

Figure 3.8 Cost per km by Logger Type

The key findings were:

e) Logger A: Highest cost per DMA.
f) Logger B: Highest cost per km network covered.
g) Logger C: Lower cost per DMA and lower cost per km.
h) Logger D: Lowest cost per DMA and lowest cost per km.

Contributory factors when considering cost efficiency are speed and accuracy of leak identification when working through DMAs. Figures 3.7 and 3.8 are directly linked to the reduced time in DMA to achieve target MNF discussed in Section 3.2.1. As these ALs are redeployed into more DMAs over the next period up to five years, i.e., no investment up to five years, the capital cost per DMA/km will reduce further.

3.2.3 Cost Efficiency Analysis – Cost per MLD saved

When analysing the cost per MLD saved, the number of DMAs covered within each DMA leakage level (high, medium, low) should also be considered, see Table 3.1 below. Cost per megalitre per day (MLD) saved by AL type is illustrated in figure 3.10. During the trial, 15 DMAs with low pressures were included. The ALs were effective in identifying POIs on high leakage levels with low pressures.

Logger Type	High Leakage (DMA Count)	Medium Leakage (DMA Count)	Low Leakage (DMA Count)
Logger A	2	1	1
Logger B	4	1	0
Logger C	9	8	2
Logger D	5	8	9
Total	**20**	**18**	**12**

Note: High > 350m^3/d, medium 100 – 349m^3/d, low 0 – 99m^3/d

Table 3.1 DMAs by Leakage Level and Acoustic Logger Type

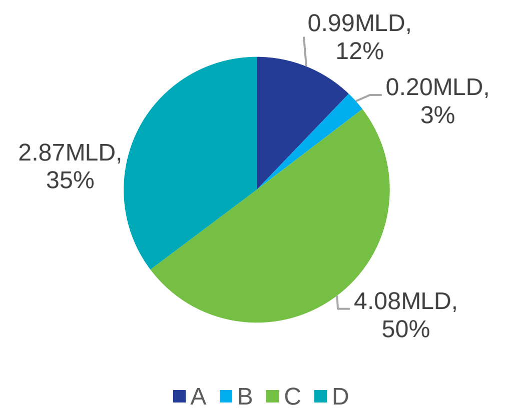

Figure 3.9 Leakage Reduction (MLD) by Logger Type

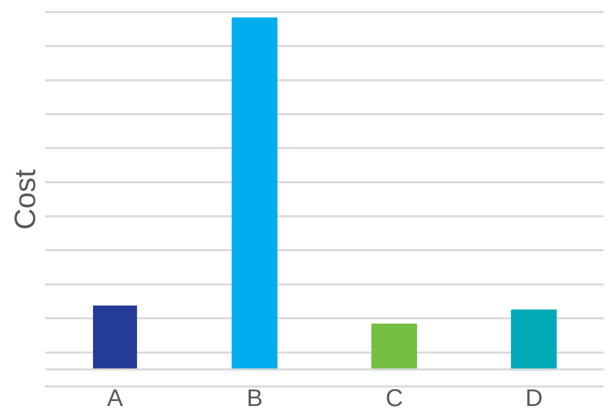

Figure 3.10 Cost per MLD reduction by Logger Type

The key findings were:

a) Logger A: 12% of leakage reduction at relatively low cost per MLD.
b) Logger B: 3% of leakage reduction at highest cost per MLD saved.
c) Logger C: 50% of leakage reduction at lowest cost per MLD saved.
d) Logger D: 35% of leakage reduction at relatively low cost per MLD, note: 75% of all “low leakage” DMAs were with Logger D, i.e. potential leakage reduction that could be achieved decreased in these DMAs.

3.2.4 Reduction in water volume lost due to decrease in leak run time.

As discussed in Section 3.2.1, the reduction in duration to achieve target MNF was 34% more efficient than traditional methods; however, Logger C and Logger D have shown results of 50% reduction over the trial. Total leakage reduction achieved during the trial was 8.14MLD.

The total combined leakage reduction achieved on Loggers C and D (50% efficiency improvement) is 6.95MLD of 8.14MLD (Table 3.2). Some leaks identified by ALs may have been missed by traditional methods due to low noise level. One example of this is shown below (figure 3.11) in an expected 'dry dig' as no noise was detected upon pin-pointing on site where ALs identified a leak present.

Logger Type	Reduction in Duration over Traditional Methods	Total Leakage Reduction Achieved (MLD)
Logger A	+11%	0.99
Logger B	-17%	0.20
Logger C	-45%	4.08
Logger D	-54%	2.87
Total	**-34%**	**8.14**

Table 3.2 Efficiencies and Leakage Reduction by Acoustic Logger Type

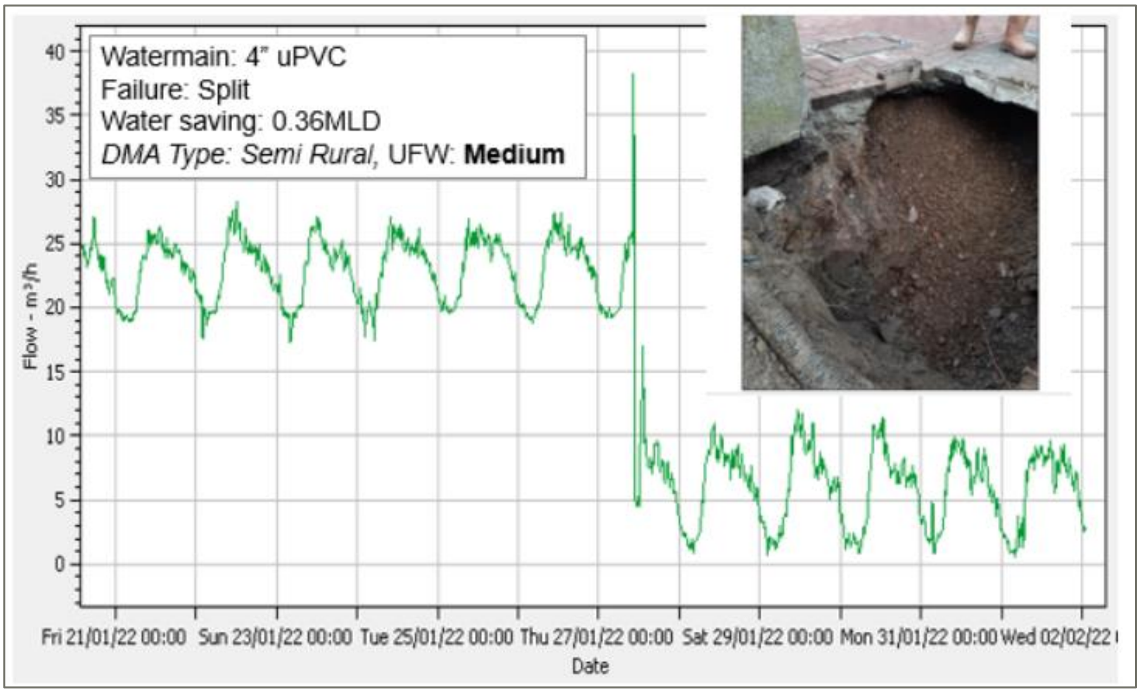

Figure 3.11 Leak identified by Acoustic Loggers (0.36MLD saved)

3.2.5 Types of Leaks Found – Public Side (PSL) and Customer Side (CSL)

Figure 3.12 shows a breakdown of public side and customer side leaks (CSL) by logger type. During the trial it was found that 26% of leaks were CSLs. Many of these CSLs were unmetered, thus ALs and data analytics have enabled a greater proportion of CSLs to be identified and forwarded to the First Fix Free programme, that would not have been identified by traditional methods, i.e. Continuous Flow Alarms (CFA) on customer meters. In addition, metered CSLs were also identified where the CFA was not triggered. This may be caused by read cycles or not meeting the threshold for CFA (6 litres/hour).

The sample size at this stage may be too small to predict which AL identifies more CSLs as the number and type of DMAs varies. For example, Logger D identified CSLs in 32% of total leaks found for this logger type; however this logger was deployed in more low-level leakage DMAs.

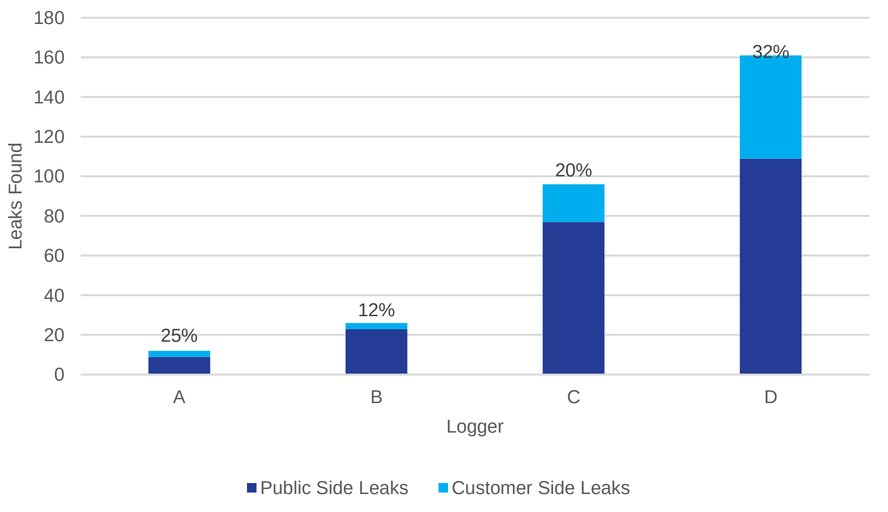

Figure 3.12 Type of Leak (PSL/CSL) by Logger Type

Analysis of CSLs by DMA leakage level shows that high leakage DMAs had 20% CSLs to achieve target, whereas low leakage DMAs had 33% CSLs. More repairs are required on the customer side where leakage level is low in a DMA.

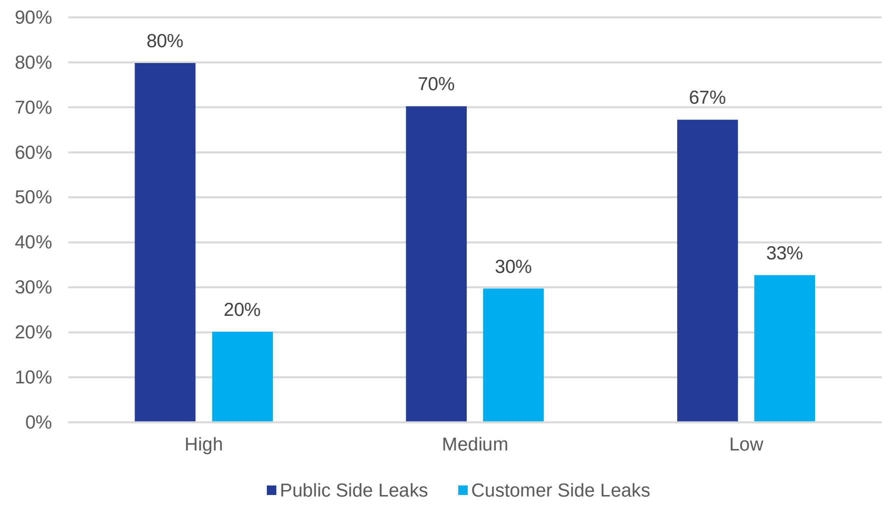

Figure 3.13 Customer Side Leaks by DMA Leakage Level

3.2.6 Web Hosting Platforms and Cloud Based Data Analytics

The purpose of this section is to discuss the outputs of each web platform and associated cloud-based data analytics and identify key findings. It is not intended to draw specific conclusions about the relative qualities of any technologies or services.

Overall, it was found that the platforms and data analytics associated with Loggers C and D were easier to use, understand and navigate than Logger A and B platform, which required additional training and manually running analysis. Note, Logger A and B were driven off the same platform. The capability of platforms for Loggers C and D to upload multiple DMAs or an entire Water Supply Zone (WSZ) from GIS proved to be a useful feature as repeated request for GIS data was not required. This was a limiting feature of the platform associated with Logger A and B.

Table 3.2 outlines technical, operational and process comparisons for each of the cloud-based analytics and web platforms.

Item	Logger A and Logger B	Logger C	Logger D
Technical	Each DMA shapefile must be extracted from GIS separately and uploaded to system.	Multiple DMAs or WSZ extracted from GIS and visible on system.	Multiple DMAs or WSZ extracted from GIS and visible on system.
Process	Pre-surveying required on fittings.	Pre-surveying not required.	Pre-surveying not required.
Usability	Complicated system, requires additional training.	Quick, easy system to use, understand and navigate.	User interface is easy to use, understand and navigate.
Technical	Limited deployment training and software training raised by LA staff.	Good training provided.	Good training provided.
Technical	Analytics to be run manually to identify POIs. Delays during LA meetings.	POIs/noises on loggers (by colour) visible when system is opened. Edit require manual recalculation.	POIs/noises on loggers (by colour) visible when system is opened.
Operational	Supplier recommended installation of purpose-built boxes for deploying loggers – additional cost. Effective on boundary boxes.	Existing fittings suitable for deployment. Reduced effectiveness on boundary boxes.	Existing fittings suitable for deployment. Reduced effectiveness on boundary boxes.
Technical	Data analytics and resulting POI identified entire street rather than leak location, all loggers listening and multiples POIs.	Correlation feature very useful and easy to use. Manual correlation window snip function to send to LA to investigate.	Additional features added to audio file tab. Correlation feature more difficult to use. All loggers must be set to record at the same time. Can take a number of days to produce the correlation.
Operational	Summary front page: number of loggers called in, leaks and highest confidence based on last manually run analysis, not automatic.	Summary front page: noises and correlations ranked by confidence factor %. Email notifications of new leaks available.	Summary front page: number deployed in DMA, number of loggers in alarm and new alarms tabs.
Operational	POI reports quite limited (excel format). Inaccuracies on Eircode's and labels on filter settings.	Printable report with all characteristics documented, including Streetview image. Occasional address issues.	No reports available.
Operational	Investigation on POIs recommended at 50m radius for first 12 months on the trial. Now reduced to 25m. 500m spacing recommendation now reduced to 350m in order to improve data analytic results.	Investigation on POIs within 10m radius. Logger spacing at 50m on plastic.	Investigation on POIs within 10m radius. Logger spacing at 50m on plastic.
Technical	New platform recently released (July 2022). Slight improvements	No new releases/updates during the trial.	Server change: overall system slightly slower. User is logged-

	to usability. Analysis of correlation results continuing.		out of system frequently, may affect user experience.
Operational	Loggers delivered ready to deploy.	Loggers delivered ready to deploy.	Logger “wake-up” required on delivery. 5 mins per logger. Additional fee to wake up in advance of delivery.
Technical	Upload of deployment photos not available.	Upload of deployment photos not available.	Upload of deployment photos is available.
Check-in meetings & communication	Average	Good	Good

Table 3.3 Comparison of Cloud-Based Analytics and Web Platforms

3.2.7 Additional Benefits

Additional benefits of using ALs and associated cloud-based analytics outside of leak identification were noted.

a) **GIS verification**: carrying out a desktop study of each DMA prior to deployment, along with feedback on fittings availability following deployment, lead to GIS corrections. Pipe material and network layout anomalies were corrected through discussions with the LAs. Breached boundaries were identified by ALs in some cases.

b) **Reduced Lag Time**: in DMAs where ALs were deployed and a new leak occurred, the response time was immediate as the data analytics provided a POI overnight. It is worth considering permanent deployment of ALs across the network to aid quick reactive responses.

4. Recommendations

4.1 Conclusions

The objectives of the trial project were to determine if the outputs from the AL approach could be used to directly compare against traditional methods.

a) Reduced **Leak Detection Time**

The trial was successful in demonstrating that ALs can reduce leak detection time by 34% overall, with greater efficiencies on two of four ALs (50% reduction). It is also clear that a straight application of either Logger A or Logger B would not have achieved sufficient reduction in leak detection time.

- Logger A: average duration 200 days, +11% on traditional methods.
- Logger B: average duration 150 days, -17% on traditional methods.
- Logger C: average duration 98 days, -45% on traditional methods.
- Logger D: average duration 66 days, -54% on traditional methods.

b) Overall **faster** reduction in leakage levels in each DMA:

By reducing leak detection time, as per a) above, overall faster reduction in leakage levels in each DMA can be achieved. However, speed and quality of repairs is a key component in maintaining this accelerated reduction in leakage levels. By reducing the leak detection time and moving through DMA leak detection activities more efficiently, the volume of repairs to be carried out increases (i.e., more DMAs per annum) and is dependent on available resources. To maximise the benefit of more efficient leak detection, additional resources may be required to ensure quick repairs.

c) **Less disruptions** to supply and associated water quality issues in comparison to traditional leak detection methods (e.g., step testing).

Step testing was only required in 1 of 50 DMAs during the trial, to investigate a trunk main with no fittings available at required spacing for AL deployment. This trial has proven that leak detection activities can be carried out without disruptions to supply and associated water quality issues. Customer service is maintained during active leak detection, in addition, bursts are recognised and located immediately where ALs have been deployed.

d) Leveraging more value from recent UÉ investments in enterprise systems (LMS).

LMS was used as a tool for DMA selection throughout the trial. Flow data to identify high/medium/low leakage DMAs and two other factors such as **DMA type** (urban, semi-urban, rural) and **mains characteristics** (plastic, metallic, asbestos cement, other), which had not previously been utilised to prioritise DMA selection for leak detection activities.

e) Greater **productivity** from leak detectors leading to increased **engagement**.

Results from this objective varied based on AL type. Where data analytics resulted in accurate POIs, leak detectors were more engaged with the process. Stakeholder engagement and positive results from the initial stages is key in improving productivity, i.e., identifying leak locations more efficiently. Greater job satisfaction was achieved by increasing skill sets of LA staff.

f) Supports a more effective approach to prioritising **mains rehabilitation** works.

The web platforms maintain the history of the leak locations in a DMA even when ALs have been redeployed to new DMAs. As this data builds up over time, it has the potential to identify repeat burst locations, thus prioritising mains rehabilitation works.

g) Reduced **carbon footprint**.

By reducing the duration to achieve MNF in each DMA, the leak run time is reduced. When leakage is reduced, the carbon footprint of treating and pumping (where required) water is reduced.

h) Increased likelihood of UÉ achieving Sustainable Economic Level of Leakage (SELL) in faster time period.

ALs have the potential to increase the likelihood of UÉ achieving SELL in a faster period of time as the leak detection duration is reduced (Section 3.2.1). Locations of bursts can be identified within one day, which leads to more efficient use of leak detection resources. Additional leak repair resources and reduced lag times remains a key component of this objective.

i) Potential to achieve **historically low** leakage levels in DMAs due to “always on” logger technology.

ALs are effectively carrying out a “step test” every night. This results in new leaks being detected and repaired locations updating on the system as noise levels change. One benefit is picking up the new leaks as they occur on the back of repairs being carried out which may have been “left behind” using traditional methods, thus not achieving historical low leakage levels. Historical low leakage levels have been achieved during the trial.

j) Will result in a **transformational change** to the way UÉ develops its Leakage Strategy and associated budgeting & resourcing.

ALs could be rolled out nationally, which will require dedicated investment and resources to manage the Programme. A portion of the Find & Fix budget should be ring-fenced for purchase of ALs and associated data analytics. This will yield a better return on investment in Find activities and ultimately leakage reduction.

4.2 Key Recommendations Arising from the Trial

The benefits of the ALs and associated cloud-based data analytics have been outlined in this report, with success proven with Logger C and Logger D. Note, these ALs require fitting spacings of approximately 60m – 100m, which is possible in most urban and semi-urban DMAs. Solutions for rural DMAs will need to be investigated further. ALs could be used predominantly on a “lift and shift” basis to reduce leakage, with the remainder in “permanent” deployment mode in larger towns/cities and critical WSZs. i.e. those schemes where there are ongoing supply demand challenges.