

UUW49

Innovation framework and strategy

October 2023

Chapter 8 supplementary document

This document demonstrates our strong track record of innovating across our ecosystems, tapping into the strengths of others in and out of sector and improving our performance by continually applying our learning to new innovation explorations – and sharing our learning with others.

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1. Innovation framework and strategy

1.1 Key messages

- **Innovation strategy is core to delivery of our business plan** - We recognise the significant challenges presented by the impacts of climate change, rising expectations of our customers and the need for United Utilities to contribute to protecting the environment given the increased expectations of the sector. We have challenged ourselves significantly in our plan and are committed to delivering enduring value through our innovation efforts. The challenges presented by our changing environment drive us to seek ideas from our employees, our supply chain, across the water sector and others both in the UK and internationally through our global scouting network. We have a strong evidence based track record to build on, as demonstrated through the case studies in this document.
- **Innovation delivers value** - Our open innovation model has been the backbone for delivering our return on investment for our customers and the environment in AMP7, and we can evidence over £300 million of efficiencies as well as social and environmental benefits. We will increase benefits further in this business plan by targeting an additional £1,163 million from AMP8. By using a managed investment portfolio, we ensure that both short and long-term interests are served and total innovation investment is de-risked. From our strategic innovation programmes, our radical Innovation Labs to local incremental efforts, we routinely test and adopt new ideas.
- **We routinely collaborate** - We recognise that we don't have all the solutions and we find partners from other UK and global water companies, other companies in our region and from other sectors. We don't operate in a silo; we maximise opportunities from collaboration with others, especially utilising leveraged funding, which not only increases the amount of innovation we can drive, but also delivers sector-wide impact.
- **We have improved our innovation capability** - We are experienced enough to know that not all innovation investments have a successful outcome and we routinely learn from all innovation efforts, improving our innovation capability and lowering the cost of innovating through co-operation, collaboration, formal partnership. Our leveraged funding activity has increased significantly, as evidenced by our leadership and support of a high proportion of the Ofwat innovation fund awards.
- **We nurture an innovative culture** - We have worked hard to enable an innovation culture and have hardcoded innovation into how we recruit, train and reward our people. Our teams generate a constant pipeline of new ideas that can be tested and adopted to deliver enduring benefits for customers, the environment and society. We have set expectations for innovation and incentivise our employees and supply chain to "be curious, ambitious, and solution-focused," seeking out new and innovative ways to deliver our services more efficiently and effectively.
- **We are ready to innovate again for AMP8** - For AMP8, we are ready to step up to the demands of our business plan by adopting more innovations and continuing to disrupt the UK water sector. We have our finger on the pulse of global issues and solutions in and out of our sector; including in the fast-moving digital world where we have already capitalised on smart networks, open data and Artificial Intelligence. We are well placed to take our sector-leading approach further, setting ourselves ambitious goals and we are ready to deliver the step change required for our customers, our environment and society.

1.2 Structure

- 1.2.1 This document demonstrates we have an impressive track record of innovating across our ecosystems, tapping into the strengths of others in and out of sector and improving our performance by continually applying our learning to new innovation explorations – and sharing our learning with others.

1.2.2 We use case studies and examples throughout this document (shown in Table 1) to demonstrate a track record of innovating and that our innovation efforts deliver a return on investment. Each case study describes the background and conventional solutions, the innovative solution we have considered, trial results, benefits of adoption and our next steps. In addition, where relevant, we include our key learning points, whether the innovation was successful or was not pursued.

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1.2.3 The rest of this document is structured as follows:

- **Section 2** describes how innovation delivers value through financial savings, customer service and environmental improvements;
- **Section 3** describes how we collaborate with a number of different organisations. This includes how we review ideas proven by others inside and outside of our sector and geography and how we are tapping into leveraged funding to lower the cost of innovation. It also described how we are sharing our results with others for sector-wide impact;
- **Section 4** describes how we are improving our innovation capabilities, specifically our approach to managing an innovation investment portfolio, Open Data, acting on emerging technology trends, maximising the results of our differentiator Innovation Lab programme and leveraging funding have all delivered benefits;
- **Section 5** describes how we have nurtured an innovative culture where our employees and supply chain are inspired and rewarded to innovate; and,
- **Section 6** describes how we are ready for AMP8. Innovation is hard-wired into our business plan and we have a focus on the future to a high return on investment.

1.3 Overview

1.3.1 United Utilities Water's (UUW) purpose is to provide great water for a stronger, greener and healthier North West. It drives us to deliver our services in an environmentally sustainable, economically beneficial and socially responsible manner, and innovation plays its part in our ambition and success.

1.3.2 This document demonstrates we have an **impressive track record** of innovating across our ecosystems, tapping into the strengths of others in and out of sector and improving our performance by continually applying our learning to new innovation explorations – and sharing our learning with others.

1.3.3 Our innovation efforts over multiple AMPs have delivered **quantified value to customers and the environment**, continuing in AMP8 and beyond. We have sector-leading examples of:

- **Delivering financial efficiency:** such as the use of smart networks and thinking of our operations as a series of interconnected systems;
- **Improving customer service:** such as our use of Open Banking to simplify the customer experience, making it easier to access the right payments tariff – and using gamification to simplify void property management;
- **Improving environmental performance** – our innovative use of nature-based solutions to deliver extra natural capital benefits in our Water Industry National Environment Programme (WINEP) and in our ground-breaking approaches to circular economy (such as producing graphene from the wastewater treatment process) and use of lower carbon materials;
- **Adopting emerging trends** – early adoptions of artificial intelligence (AI) to detect water leaks faster (FIDO-Tech, a world first) and reduce flooding risk through rapid CCTV analysis of sewer pipe condition (VAPAR – a UK first) enabled by our improved capability on trend-watching;
- **Connecting customers to the world of water** – our multi-partner Catchment Systems Thinking Co-operative project (CastCo) that trains more citizen data scientists to river water quality and how we help customers find their own solutions to reducing their water consumption, saving them money and helping the environment.

1.3.4 Looking forward, a **reliance on innovation is embedded in our business plan** and we will use our innovation model to deliver more value. Further, through our approach we share how our innovation capability has continued to improve and that we are confident in our innovation efforts will support success in AMP8.

- 1.3.5 The best performing companies innovate, and they all have a clear **innovation model** to consistently deal with the wide range of types of innovation to be successful. Without such a framework, we waste energy and effort looking at wrong problems to fix and the wrong solutions to implement.
- 1.3.6 Our innovation framework model has been in place since 2018, recognising that it is not just about technology but also about harnessing the right culture and exploiting key innovation enablers such as data, leadership, customer engagement, collaboration and connectivity.
- 1.3.7 During AMP7, we reviewed our model by comparing to others in global water companies and other sectors, as well as obtaining feedback from suppliers and customers. It fits well with the ambitions and visions for Ofwat innovation priorities, Water 2050 strategy and UKWIR, and having served us well to date remains fit for purpose for AMP8.
- 1.3.8 The model starts with our definition and has three additional elements, described in more detail in section 6:-
- **Innovation definition:** “Innovation is about harnessing and exploiting good ideas, big or small to make us better at what we do”
 - **Innovation strategy:** based on five key themes that set out how we approach the diverse world of innovation, how we focus our efforts on the tactics to deliver more for less for customers. The five components of our innovation strategy help us improve our performance in key areas of service and environmental improvement, while reducing the cost of that service for customers.
 - **Innovation core process:** the end-to-end sequence of steps needed to make sure every idea receives appropriate opportunity that we de-risk the investment and we learn from every innovation.
 - **Innovation enablers:** from data, leadership, collaboration and ambition, these are the specific factors that are needed and promoted within our organisation to succeed.
- 1.3.9 Figure 1 shows our innovation model and Table 2 shows how this model has helped us deliver value and sets our AMP8 ambitions.
- 1.3.10 We will go further in AMP8 on innovation by:
- Being a role model for innovation in our sector and geography, showing alignment to the Water 2050 strategy and confirming our AMP8 innovation focus areas;
 - Collaborating across the sector, tapping into external funding, new partners and sharing our innovation portfolio results for sector benefit;
 - Finding, testing and adopting even more ideas to adopt in AMP8, learning from our successes and also ideas that have not progressed;
 - Taking the results from others and considering them for adoption including outcomes from the Ofwat innovation funds;
 - Taking advantage of technology trends – capitalising when the time is right;
 - Maturing our effective innovation scouting and internal talent programmes;
 - Allocating innovation investment funding; and
 - Looking beyond this business plan and considering innovation investment for AMP9 benefit.
- 1.3.11 In time for AMP9, we will review our open innovation model and all of our innovation investments, recognising the growing maturity of sector-wide support such as STREAM for Open Data and SPRING as the innovation sector of excellence.

Figure 1: Our Innovation Model

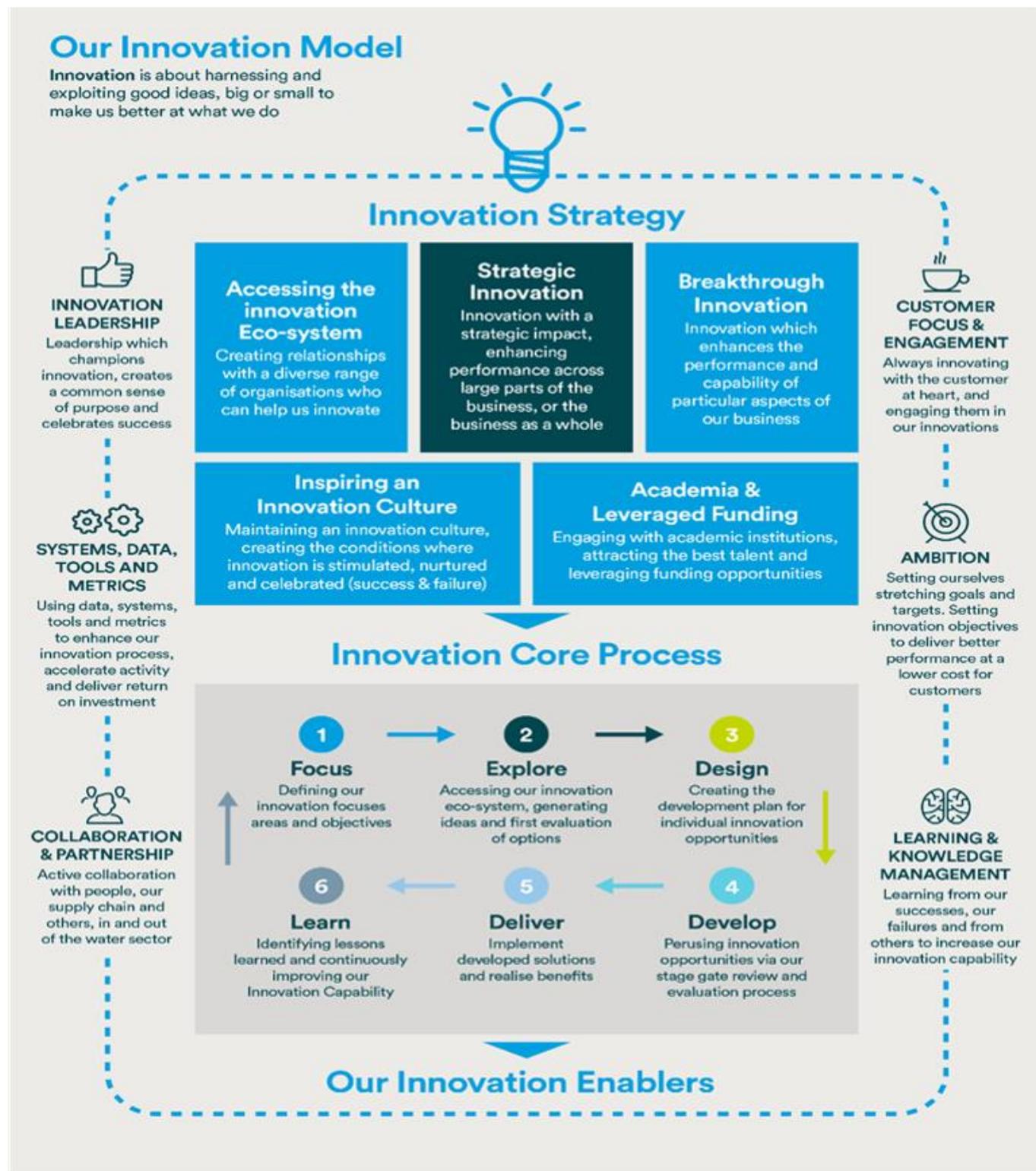


Table 2: AMP7 delivery to drive AMP8 ambitions

Innovation model	AMP7 Effort and Impact	AMP8 Ambitions
Strategic Innovation	<ul style="list-style-type: none"> Open data vision and strategy progressed and first five open datasets published Invested in cross-cutting innovation themes in a managed portfolio Increased our systems thinking capability Delivered over £300 million from innovation including >£40 million stretch efficiencies from radical, sector-disrupting ideas 	<ul style="list-style-type: none"> Deliver around a further £56 million from strategic innovations Increase value engineering and solution optimisations in our capital programme Deliver open data vision, increase systems thinking maturity Increase the innovation portfolio and deliver opportunities for AMP8 and AMP9 Review our innovation model for effectiveness
Accessing the innovation ecosystem	<ul style="list-style-type: none"> Over 3000 innovation ideas reviewed – from our website and scouting Worked with four global scouts and 15 expert forums 110 innovation partnership relationships created 35 new jobs created in the sector from business growth of our innovators 	<ul style="list-style-type: none"> Find and adopt best practice from others to replicate success Share our results with others for sector-wide learning Expand our global idea scouting networks including out of sector Tap into the central support of SPRING and STREAM Drive our supply chain to innovate through support and incentivisation
Breakthrough Innovation	<ul style="list-style-type: none"> 30+ new market entrants ideas trialed 15 “world first” ideas discovered and tested 12 new ideas co-created with suppliers Complete our AMP8 early pilot programme – embedding proven ideas 	<ul style="list-style-type: none"> Continue our sector-differentiating Innovation Lab programmes Increase our innovation co-creation including customers Increase testing and adoption of lower carbon, nature-based solutions Deliver £80 million of efficiencies from new innovation – backing our capability
Academia & Leveraged Funding	<ul style="list-style-type: none"> Four strategic University partnerships, 36 sponsored post-graduate research projects Tapped into £120 million of additional funding Supported over 70 bids via the Ofwat innovation fund, leading on 25% awarded 	<ul style="list-style-type: none"> Continue supporting UKWIR and University relationships Ensure successful delivery of all leveraged fund projects Maximise opportunities from leveraged funding
Inspiring an Innovation Culture	<ul style="list-style-type: none"> Introduced new training on innovation for employees Six crowdsourcing campaigns - 23 ideas adopted Acted on employee suggestions with 16 improvements to operations >300 people managers trained in operational excellence – ready to innovate Inspired 100+ graduates to be innovative through innovation training 	<ul style="list-style-type: none"> Expand the reach of Operational Excellence Over 500 continuous improvement projects, led by employees Share our innovation training programmes with suppliers Refresh all employee training Introduce companywide innovation awards

1.3.12 We have applied our innovation model during AMP7 and delivered over £300 million financial efficiency.

1.3.13 Our AMP8 plan sees us target a further £1,163 million of efficiency from innovations as part of a larger plan.

1.3.14 We want to continue to disrupt the sector and be the sector role model for innovation.

2. Innovation delivers value

2.1 Introduction

- 2.1.1 Our co-ordinated approach to innovation has contributed over £300 million of efficiencies in AMP7 and we are targeting over £1 billion of efficiency in AMP8. In addition to the quantified financial benefit that reduce the impact of large new investment needs, our deployment of innovative ideas significantly contributes to both customer service and environmental improvements.
- 2.1.2 In addition to the quantified financial benefits that reduce the impact of large new investment needs, our deployment of innovative ideas significantly contributes to both customer service and environmental improvements.
- 2.1.3 We engage with customers to understand their priorities, as well as our senior leaders, to focus our development of our business plan including where we need to apply innovation effort; this creates the conditions for a strong return on investment and significantly increasing our ability to deliver value for money for customers.
- 2.1.4 For AMP8, our portfolio is packed with promising ideas being optimised for adoption, and others being tested that may have potential to contribute to our efficient business plan.

2.2 Financial value

- 2.2.1 Since AMP6, we have used innovation to deliver over £445 million of financial value. Our AMP7 contribution from innovation is £300 million compared to £145 million in AMP6.
- 2.2.2 During AMP7 we delivered:
- £200 million from strategic innovations that have multi-AMP effort and benefit, such as our approach to whole system thinking where we consider our operations as a series of interconnected systems;
 - £45 million from our pioneering work at ‘frontier’ sites such as West Cumbria/Williamsgate Water Treatment Works and our UK-first adoption of Nereda Wastewater Treatment has led to AMP7 savings of over £33 million;
 - £15 million from environmentally beneficial approaches such as reducing physical construction footprints, reducing need for fossil-fuel chemical additives and producing more biogas (to be converted to electricity used onsite); and
 - At the start of AMP7, we set ourselves a ‘stretch’ target (to offer financial value from ideas that we had not yet been discovered nor proven) as we backed our innovation model and capability to deliver. We are on track to deliver further £40 million from our general innovation capability such as world-first uses of artificial intelligence to improve the management of our pipe networks.
- 2.2.3 We will build on this multi-AMP track record to offer more efficiencies in AMP8; the major building blocks for these efficiencies are:-
- **Value engineering** in our capital programme such as:-
 - standardising repeatable designs – so we design solutions once and “build many” from this design,
 - flexible permitting and partnerships – where we can take more unconventional approaches to achieving the same goal and using the power of others to help us deliver
 - adopting low build and novel low carbon, nature-based solutions such as reactive media treatment solutions and wetlands,

- new ways to reduce sludge at treatment works, alongside opportunities for circular economy opportunities (reducing waste and reusing materials),
 - **Optimising solutions** – refining and continually improving solutions so we extract the most value from them; example such as Operational Excellence and replicating best practice
 - **Strategic innovations** – such as Open Data, where we allow others to show us new insights and services – and how we consider our operations as a series of interconnected systems (systems thinking)
 - **‘Stretch’ efficiencies** - realised from ideas that are not yet proven. Typical sources include our employees and supply chain and our early AMP8 pilot projects, fast moving global emerging trends (capitalising on new opportunities,) co-creation with others (reducing adoption time and realising benefits earlier,) all Ofwat Innovation Fund projects (whether we are a partner or not) and our global scouting including our unique Innovation Lab programmes.
- 2.2.4 All of these activities depend upon our capability to innovate in AMP8. This document sets out the activities already underway and the supporting innovation framework that give us confidence that innovation will be able to help us deliver the plan we have described.

2.3 Strategic innovation

- 2.3.1 A cornerstone of our strategic innovation in AMP7 has been the wide scale adoption of systems thinking, where we focus on understanding the whole end-to-end system and the interactions and impacts that individual parts have on each other. We use innovative technologies to recognise and respond to predictable patterns of behaviour in our systems and we believe this predictability brings significant opportunities for smart networks and dynamic catchment and treatment management.
- 2.3.2 With the size and scale of challenges in front of us, we believe that a traditional approach won’t succeed so we have invested in delivered an enduring capability and new mind-set across our organisation that delivers benefits both now and long into the future. Our strategy is based on cross sector research, co-creation and collaboration from both in and out of the sector. We believe an enhanced ability to understand wider, complex systems across multiple decision-making horizons differentiates our innovation capability and unlocks value for customers and the environment.
- 2.3.3 We actively seek challenge and feedback on our approach from other sectors and geographies and have commissioned independent assessments of our capability for systems thinking from Accenture each year – as described in section 4. Figure 2 below shows the systems thinking mindset that is needed to embrace the benefits of interconnected systems. We are forecasting that this will contribute £56m of financial benefits in AMP8

Figure 2: A different mind-set is needed to embrace interconnected systems

Systems Thinking Mind-set

The challenge and the reality

Systems Thinking is about...



Looking at the **bigger picture**, taking a step back when we make decisions



Understanding the **interactions and impacts** that individual parts of that bigger picture, or system, have on one another



Identifying within those interactions any **predictable patterns** of behaviour

...which is achieved through...



Balancing competing short and long-term priorities



Getting out of our silos and **collaborating** across teams



Delivering **enduring capability**, not single use solutions

2.3.4 The first four case studies in this document showcase our systems thinking and smart networks results.

Case study 1: Using smart networks: improving wastewater network performance - DNM

Applying systems thinking to our water and wastewater network activity guides us to create a new vision for how a modern utility could operate using smart networks. We have embedded that vision into our Dynamic Network Management (DNM) programme, which we have applied initially to wastewater networks. Here, the goal is to Reduce the risk of flooding to customers and pollution to the environment through investment in system analytics, installation of monitoring devices, rain gauges, cloud-based platforms, system level AI, machine learning and bespoke alert hierarchy.

Our approach is a live visualisation of the wastewater network, enabling our operators to manage our sewer network using data and analytics, rather than relying on customer calls and system alarms. This innovative transformation is an example of systems thinking – our integrated system analyses, visualises and raises alerts on the performance of wastewater infrastructure through predictive analytics and machine learning.

Our real-time visibility across the wastewater network, including sewer networks, combined sewer overflows, detention tanks and pumping stations helps to quickly identify issues such as the formation of blockages and unexpected rising levels in sewer networks to enable proactive action to be taken before they impact customers or the environment.

We have created a smart network that learns the typical behaviour of an area in a range of environmental conditions and is able to raise an alert when performance moves out of the expected boundaries. Our network now consists of:

- 17,500 intelligent sensors installed and enhanced monitoring implemented on more than 1,500 sites (pumping stations, detention tanks and CSOs);
- Data integration from newly installed sensors with the pre-existing data into cloud analytics; and
- Adoption in over 160 drainage areas across our region.

DNM provides a way to better control network performance. One aspect is the visualisation of performance and connectivity across the complete network, allowing our operators to manage the drainage network as a complete system. It provides insight into how external factors influence the performance of our network, and how individual assets within the system influence each other. This means we proactively manage the network as a whole, rather than responding to individual reactive issues as they emerge.

The system can accurately detect deviation against expected performance, for any given location, time and weather pattern and in combination with alert logic, identifies potential issues and root causes. This combination of live data, AI and logic-driven analytics allows the identification of issues such as infiltration, inundation and blockage formation in addition to deterioration of performance of our powered assets such as pump efficiency and asset health.

The solution provides improved situational awareness and allows us to respond proactively to emerging issues, as well as providing insight to drainage engineers to optimise the drainage area plans and inform decisions about long-term service improvement. Whilst primarily intended to support operations in the network, DNM has other benefits. For example the use of DNM has also identified culverted watercourses and third-party pumping stations connected to the sewer network and even detected previously unidentified clean water leakage. DNM has been fully embedded in wastewater and is proven to be an effective tool in managing the network. It is in use by many teams – providing real-time visualisation of performance across connected systems and providing alerts when performance deviation requires investigation, leading to a proactive resolution. Interventions are then carried out by dedicated Alert Response Teams.

Our results so far

- **Reactive wastewater call-outs – 25 per cent reduction in non-infrastructure and 10 per cent in infrastructure**
- **Wastewater complaints – 37 per cent reduction**

- **Wastewater proactive issues – over 5,000 issues detected and responded to proactively**

Our investment in DNM has delivered impressive results in AMP7 helping to reduce the risks of sewer flooding and pollution through proactive management of the wastewater network based on live data, analytics and AI. This has enabled us to identify a more efficient reactive maintenance programme for AMP8, and is a key enabler for the reduction in pollution that we are aiming to deliver in AMP8 through base expenditure.

We propose to expand the use of smart networks further in AMP8 with the opportunity to optimise it to deliver Dynamic Treatment Management, and ultimately work towards Dynamic Catchment Management – looking across everything we need to do in the end-to-end water and wastewater system on a strategic catchment basis, and evaluating how we could do it differently, with innovative and network solutions as well as treatment solutions.

We are also looking at the opportunity to apply our learnings from DNM in the wastewater network to expand it to our water network to maximise the benefits of proactive management of leakage and network issues through data and AI.

Case study 2: Using smart networks: Reducing wastewater network blockages - Deragger

Sewage pumping stations are at the centre of our improvements to the operation of wastewater networks in reducing the risk of failure and managing operating costs. Blocked pumps account for 80–90 per cent of all unplanned sewer work, and evidence shows that blockages, and the build-up of rags prior to blockages, increases pumping energy costs, which has a detrimental impact to asset life.

Our global scouting discovered the Deragger solution, which monitors in real-time the energy demand of the power to the pump, detecting the instant that even a single wet wipe starts to impede the pump impellor (from increased or abnormal energy demand.) This detection allows the Deragger to slow and stop the pump the instant that an impediment forms, briefly reverse the pump to dislodge the impediment and, therefore, allows the wipe to pass in suspended flow through the system, preventing the creation or build-up of rag-balls.

We used our innovation process to pinpoint areas of focus by asking '*where would new innovation provide the most benefit?*' From this, we selected the Deragger anti-ragging device, which addresses the problem of ragging of wastewater pumps (such as the inappropriate disposal of wet wipes). Conventional solutions merely detect any blockage once it has already started to form, by which time it is too late.

We collaborated with Wessex Water on this solution, where we both provided sites for Deragger trials and shared information on the operational activities, reducing the time to trial by sharing knowledge. We have now rolled out at scale in over 300 locations.

This innovation supports our reduction in reactive blockage call-outs and saves 10 per cent energy/carbon compared to conventional solutions.

Case study 3: Using smart networks: using AI to improve asset resilience – VAPAR

Another example of smart networks and whole systems thinking in action is our use of VAPAR's artificial intelligent model to improve pipe condition assessment of our wastewater network.

Background and conventional solution

In order to maintain the efficiency and functionality of our water and wastewater networks, it is crucial to have accurate information about their condition. One of the methods to achieve this is to conduct frequent surveys, including routine internal sewer inspections. Currently, the industry standard for monitoring wastewater pipes is CCTV inspections, which have seen incremental improvements in camera technology and work scheduling. Traditionally, pipeline inspection using CCTV has relied on skilled operators who view live video footage and manually identify potential pipe defects. This 'stop-start' approach is time consuming and limits the amount of surveying that can be completed in a single shift. Operators must also manually enter defect codes and relevant information based on their experience and judgment.

This current method of monitoring has limitations. It is time consuming and relies on operator recommendations, making it difficult to access all types of surveys and obtain a comprehensive view of the network's current status.

With a vast wastewater pipe network spanning approximately 77,000km, there is an opportunity to optimise our monitoring approach. This aligns with our commitment to reducing sewer blockages and flooding incidents during AMP7 and remains a priority in AMP8. We wanted to find a solution that accelerates the pipe inspection process, while increasing the reliability and accuracy of defect classification and repair recommendations.

Innovative solution

We used our Innovation Lab programme in 2019 to find better solutions and we discovered two engineers, based in Australia, had formed a start-up company, VAPAR, which was developing fledgling software that had potential to help and they submitted their untested AI idea to our Innovation Lab in 2019, and they were successful to proceed.

The collaborative partnership allowed the AI platform to be tested in a live operational environment and gain insightful feedback. We saw the potential in their model – rather than relying on people to review the data as the camera progresses, and stopping and starting the video to assess the condition, we can now allow the camera to continuously progress through the pipeline to capture the footage, which is then sent to the AI system to review and make recommendations.

Based on the recognised defect type, the system can provide the engineer with the best repair recommendations, enabling faster and consistent decision making. Ultimately, the engineer retains the final decision, and the data presentation supports consistent investment decision making for repair or replacement recommendations.

We instigated a series of trials with a focus on:

- **Accuracy:** improving defect classification and repair recommendation;
- **Productivity:** completing the inspection and recommendation tasks faster than conventional approach; and
- **Collaboration:** creating the right environment for close working with two-way feedback.

Like many new and radical innovations, the trials were not successful first time. We continued over 24 months to improve and test, providing extensive resources to support this innovation, using machine learning, data visibility and discovering how to work with the AI outputs.

Results

Through our collaborative efforts, we have achieved significant success. The AI system now boasts an impressive accuracy rate of 91 per cent and consistently outperforms our targets for defect location accuracy, demonstrating its reliability and effectiveness. We had the confidence to transition from a traditional human-based approach to an AI-led system that surpasses our initial expectations and provides the process improvements we needed. As a result, VAPAR has been awarded a multi-year contract to deliver early benefits in AMP7 and optimise performance for the full five-year AMP8 period.

This system is now fully adopted, saving £2 million in AMP7 – forecasting £6 million in AMP8.

Next steps

As the accuracy of the system improves, we see potential for expanding this approach to cover more sewer and defect types, integrating with new CCTV robotic cameras, and allowing sewer repair teams to confirm the quality of their repairs. Our goal is to automate high-volume, routine tasks. Our relationship allows for new ideas to be explored faster and we intend to exploit this “first mover advantage.”

Case study 4: Using smart networks: Reducing leakage using AI – FIDO-Tech

We focus innovation efforts on the areas that customers tell us are most important, which includes environmental performance, such as leak reduction. Historically, across the industry, leak detection still relies on skilled technicians ‘sounding’ our mains. This labour-intensive process involves walking the length of mains, placing a listening rod on available fittings (e.g. valves or hydrants) and listening to identify the tell-tale sound of a leak – as shown in Figure 3 below.

Figure 3: Leakage technician using conventional leak detection methods



This requires a substantial amount of experience on the technicians’ behalf to recognise the difference between ambient noise, such as traffic or streetlights, and the sound of a leak. The noise of some leaks is simply so slight that it is almost inaudible for even a skilled and experienced human technician.

Installing acoustic loggers throughout our demand management zones allows them to fulfil a similar role to leakage technicians, listening for the noise of leaks and sending files of alarms of possible leaks to investigate. The information returned by this network of loggers is interrogated to distinguish between background noise and the constant signature of a leak, and use the difference in sounds between adjacent loggers to pinpoint leak locations. Logger technologies have developed such that alarms are sent in many file formats from different hardware manufacturers, making data processing and analysis more complex.

We have 67,000 devices generating 600 new leak alarms every day. With no way of identifying false positives, each alert had to be analysed manually. This task alone took seven full-time analysts a day. This process was sub-optimal, which led to delays in leak repair (backlogs and high volumes detected) and false positives (readings that were not leaks and abortive visits).

We wanted to reduce the time from alert to follow up, and make better use of the limited skilled resource. We adopted the best market-ready solutions available; however, in some cases, the available technology did not match our ambitions, so we sourced innovative development partners (including new entrant start-ups) to co-create new solutions. Our approach led us to consider if new AI could supplement operators, reducing their workload, be more accurate and consistent, and deliver this in real-time.

Through our Innovation Lab programme, we have worked extensively with FIDO Tech, a start-up, since 2019. Together, we have improved their AI system to detect more leaks, react to them faster (so they ‘run’ for less

time), and with the potential to direct leak repair effort better. We are now able to respond faster to possible leaks, reducing the water lost; their systems reduces the time delay and effort of processing signals from so many different devices.

Using AI from FIDO Tech has increased our daily leak finding rate by more than a third (+34.9 per cent) and almost halved (-49 per cent) its overall leak run time.

Jointly, we have brought new products and services to the market, all tested and co-designed with us, allowing for quicker adoption and first-mover advantage. FIDO Tech now provide services to other water companies around the world using our endorsement with other clients – a truly game-changing global impact.

2.4 Customer service improvements from innovation

2.4.1 Innovations are not just about saving money, but are a significant enabler to delivering stretching improvements in business performance. Customer expectations are increasing, desiring a better, lower cost service, with faster responses when things go wrong – these drive our innovation efforts.

2.4.2 We have used innovation to improve for customer service, for example:

- **Open banking support assessments** – we were the first water company to adopt this capability;
- **A data-led strategy**, revealing insights including how we have improved void property management
- **New DWP data share provisions** to proactively identify customers eligible for social tariffs and WaterSure. Again, we were the first water company to utilise this capability; and
- **A single affordability support application form and process**, which proactively ensures customers are supported via the lowest possible bill and simplifies the application process.

2.4.3 For AMP8, we propose to trial, and then widely roll out, a range of new tariff reforms. We are systematically testing and iteratively developing a new package of household tariffs. These new tariffs seek to support water bill affordability, while also incentivising sustainable customer behaviour. New tariffs currently being developed or improved include:

- Rising block and standing charge reform;
- Expansion of our Lowest Bill Guarantee scheme;
- Water efficiency incentive schemes; and
- Community-based incentive schemes.

2.4.4 Below are some more detailed examples.

Reducing water demand including non-household

2.4.5 We work hard to reduce water demand and target water efficiency interventions using household income, occupancy and consumption data. We utilise continuous flow alerts to identify instances of high consumption/leaks at lower income properties to help lower water and energy costs. We include water efficiency messaging on envelopes and collection letters signposting our new Get Water Fit platform.

2.4.6 For customers with affordability challenges, we offer specialist home visits, helping resolve supply issues and recommending water efficiency devices. We partnered with Cenergist in 2019 and have completed over 20,000 home visits to undertake a water audit in their homes and provide advice to reduce water demand. The insight gathered from these visits indicated that many customers have leaky toilets; in response, we now provide targeted messaging to customers to tell them if they have a leak, likely from their toilet, and provide leaky loo strips to confirm this, alongside helpful tips to resolve this problem.

2.4.7 Water efficiency is a key part of our affordability conversations and is included in our customer communications as an option for how customers can reduce their bill, along with the promotion of the

benefits of a water meter for customers who we believe, through targeted interventions, could save money on their water bill.

- 2.4.8 We actively engage with developers and self-lay providers and encourage positive and constructive feedback to feed into continuous improvements across all aspects of developer services, including customer experience and charges. We are making improvements to our environmental incentive scheme. Since 2018, we have an innovative charging mechanism to encourage developers to build more water-efficient homes and deal with surface water from their site more sustainably. We have made scheme improvements and are running a pilot to understand how we can further influence developer behaviours to build more sustainable homes. We understand, from our engagement, that the main incentives that would drive behavioural change would be neutral cost to developers, maintenance cost for their customers and recognition.
- 2.4.9 In AMP8, we will continue our focus to reduce North West demand, including co-creation with customers, local community groups and customer representation groups, alongside national programmes. This is why we are excited by the potential of the new AMP8 Ofwat innovation fund focused on water efficiency. Our strong track record of winning additional external funding puts us in a stronger position to continue driving down water demand to meet AMP8 targets.

Data-led innovation – using systems and data to support financially vulnerable customers, whatever their circumstances

- 2.4.10 We will improve accessibility of support through the implementation of new functionality for our mobile app and online account services. We aim to provide a fully digitalised end-to-end affordability journey, incorporating open banking capabilities, to enable customers in need of support to apply and receive an instant decision regarding their application. Improving our self-service options will allow customers to apply for help at a time that suits them best.
- 2.4.11 Through development of new data share arrangements with local authorities/social housing providers, we will work together to identify customers in vulnerable circumstances, proactively supporting low-income customers struggling to pay their bill. Through trusted partner arrangements, customers will be placed on the lower tariffs they qualify for without having to apply.
- 2.4.12 We will introduce Community Champions, who will help digitally excluded customers access the help they need. Community Champions will look to attend key local events in person, and thereby increase customer and organisational awareness of the support that we have available. Through our internal volunteering programme, our employees will be able to support local community partnerships, building relationships within those communities and increase awareness of the support available to customers in vulnerable circumstances.

Case study 5: Open banking data improves customer service

We are leading efforts to ensure that, when eligible customers reach out to us, they can access support as soon as possible, minimising administrative or bureaucratic hurdles. Conventionally, customers applying for affordability support had to manually collate their income and expenditure information, including evidence of benefit receipt, in preparation for their telephone affordability assessment.

Our open innovation model encourages the use of Open Data, which now forms a key part of one of our most sensitive customer journeys. During AMP7, in addition to launching a single online application form for all support schemes (replacing individual scheme application forms and consolidating all of our affordability information into a single support booklet), we are the first water company to implement an open banking solution, offering customers the option to provide their financial information in a quick and easy way that allows us to verify customers' income in real-time to improve the accuracy and efficiency of our customer affordability assessments.

We have streamlined the process to a few simple steps – gaining agreement to use open banking data for the affordability assessment via an online consent portal and receiving a summarised view of a customer's income directly from their bank account evidencing benefit payments. Open banking reduces the amount of time taken and customer effort considerably, with the added benefit of increased accuracy. This innovation also improves first-time completion rate meaning customers are given a decision on tariff eligibility immediately and a sustainable payment plan can be agreed, resulting in an all-round better customer experience.

Customer feedback was sought and is impressive:

- 40% of customers offered the option to use open banking agreed; and
- Of these, 100 per cent told us it was easy to use, with 80 per cent saying they will use it again.

In AMP8, we will optimise this idea, meaning it will be seamless rather than a stand-alone process as it is today.

Case study 6: A data-led strategy on void management using gamification

In early AMP7, we had 225,000 void properties and have successfully reduced this by over half to just 104,000, by taking a radical innovative approach.

A void account means we do not know if the property listed is occupied, as the occupiers have not proactively informed us or responded to any of our correspondence. Reducing the number of void properties (occupied but not billed) means fairer charges between customers and lower bills for customers already paying.

To address this, we have introduced a new void management strategy, which included the enhanced use of data and analytics, and a suite of innovative solutions that have delivered a step change in terms of the accuracy and timeliness of occupier identification.

A data-led void strategy (leveraging data from multiple sources on the status of the property and likely occupiers) has helped us to quickly and proactively monitor all of our empty properties, react swiftly to change occupier status, and it is a more efficient and effective way to manage void properties compared to in-person property visits.

We have always used Credit Reference Agency and Land Registry data to highlight customers who have been a resident in a property and communicate with them about their obligations to pay; however, using third parties to identify void properties is costly.

To improve this, we saw an opportunity to use a digital solution – and used our in-house application development team – to develop a void app used by our employees use to identify potentially occupied properties. The app captures occupier information or verification of void status including the ability to upload photographs and provide additional evidence of status, as shown in the Figure 4 and Figure 5 below.

Our employees were eager to be involved – they live locally alongside customers and could report back frequently, with low disruption and better local knowledge.

We have 1,400 active users of the app; and to date, feedback on 33,000 properties, with 9,000 of these identifying properties that are occupied and needed billing.

Figure 4: App void reporting

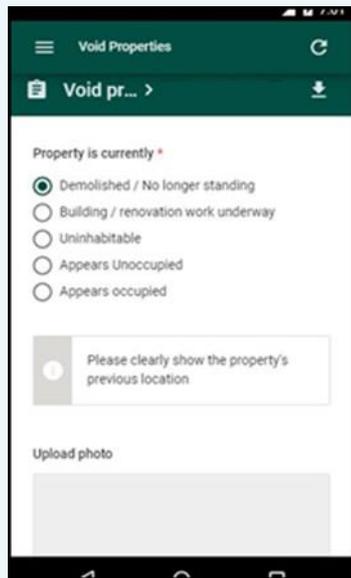
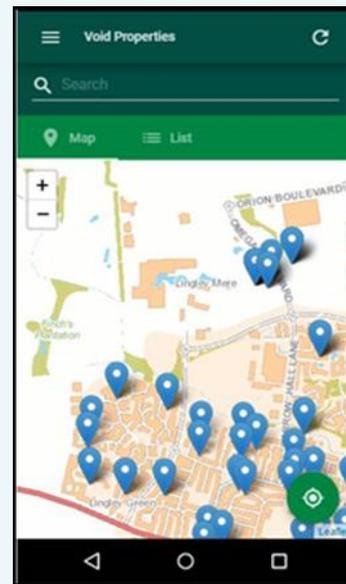


Figure 5: App void graphical interface



The app uses gamification techniques to drive engagement with employees, sharing league tables of performance, linking recognition and reward through prize draws and incentive schemes. The void app project took four months from conception to delivery, is fully embraced and now plays a key role in reducing the number of void properties, adding another layer to the existing void reporting capability.

Case study 7: Using data to offer more innovative charging that supports more customers

Our business plan commits us to providing leading levels of affordability support for customers struggling to pay their water bill. We recognise this requires real-term bill increases when levels of deprivation and general financial stresses are high in our region – and we want to ensure that affordability of future bills is secured for as many customers as possible.

We have, therefore, developed comprehensive and wide-reaching support that caters for people in many different circumstances, designing support schemes to help as many customers as possible who need extra financial help. In AMP8, to balance investment needs with affordability and water efficiency, we've developed innovative charging and financial support schemes to deliver targeted and effective support – our largest ever package of financial support.

We will improve accessibility of support through the implementation of new functionality into the UUApp/MyAccount services. Providing a fully digitalised end-to-end affordability journey, incorporating open banking, will enable customers who need support to apply and receive an instant decision regarding their application. See case study 5 for more information

Our domestic customers on a water meter are currently billed twice a year; this is typical for the water industry where the majority of meters are analogue and require manual readings. We've launched a quarterly billing offering and have already moved 135,000 customers onto this frequency, along with those with an automated meter reader (AMR) meter.

More frequent billing puts customers in control of their bill by giving them early insight into their consumption and allowing them to change their behaviour to reduce water usage. Wider benefits range from avoidance of bill shock, help with budgeting, improved debt collection as customers get more frequent views of their usage and earlier indications of non-payment, particularly for tenanted properties where customers often leave a property before their first bill being produced. The pilot will be extended to other customer groups once the costs/benefit analysis is understood by customer segment.

Case study 8: Delivering for communities through the Hardship Hub

We have used innovative new ways of working and collaborating with partners in recent years to improve the affordability and vulnerability support that is available across the region.

Debt advisers in the North West, who provide financial schemes to help individuals and families struggling with debt, lacked a central resource to easily find and share knowledge about available support schemes. Working in partnership with the Citizens Advice Bureau, we co-created a digital Hardship Hub, which provides advisers with a one-stop shop for debt support schemes. It has been dubbed the *TripAdvisor* for financial advice. Advisers can use it to search for available help in their local area and can rate schemes and recommend them to colleagues.

The Hardship Hub website was launched in January 2019 to support those organisations throughout the North West who provide expert advice to individuals struggling with debt. The website contains information on the financial support schemes offered by suppliers across a wide range of sectors including gas, electricity, water, telecoms, housing associations, councils and local charities. The site contains information on 500 schemes from 300 organisations, and we continue to add to this.

This innovative approach was given special recognition at the Prolific North Tech Awards, receiving High Commended award in the *Technology for Good* category.

2.5 Environmental improvements from innovation

- 2.5.1 Through innovation, we deliver value to the environment and society, as described in *Chapter 6 – Delivering greater social and environmental value*.
- 2.5.2 We are proud to have retained our leading position among water utilities as measured in the Dow Jones Sustainability Index (DJSI) – where our innovation management score has been assessed as 100 per cent every year for the last five years. Each year, we demonstrate to the assessors that we invest in innovation and that we have a diversity of adopted ideas that is making an impact.
- 2.5.3 We have a balanced innovation investment portfolio that will continually source, test and adopt new ideas, de-risking them for scale up and roll out, which includes projects focused primarily on environmental benefit. Innovation is embedded in our environmental plans and we have a portfolio of environmentally focused innovations that are either adopted (fully proven and delivering benefit), being optimised (getting ready for adoption) or in trial (not yet proven).
- 2.5.4 Case study examples are as follows, and are all UK firsts:
- **Adopted** – low carbon reactive media treatment and flexible permitting (wetland and Petteril catchment – Case study 9);
 - **Optimising** – reducing flooding through innovative rainwater storage systems (blue-green roof – Case study 11) and connecting customers to water quality information (CastCo – Case study 18); and
 - **In trial** – creating new products including hydrogen and graphene (LOOP – Case study 20), nature-based solutions ([] – Case study 12) or lower carbon technologies such as FujiClean (Case study 13.)

Case study 9: UK's first wetland creates additional natural capital

Background and conventional solution

The Environment Agency (EA) and water industry are working together to utilise wetlands for wastewater treatment, with the aim of achieving water quality objectives and obtaining additional benefits associated with NBSs, such as increasing biodiversity and improving natural capital. Currently, using wetlands to achieve permit limits comes with a risk, due to the lack of evidence of treatment capability that can be achieved.

We have been continually accelerating the development and adoption of nature-based treatment solutions for many years, including wetlands. From AMP6 into AMP7, we have moved from lab-scale and demonstration projects to implementing full-scale solutions at a number of sites.

One AMP7 example is at Southwaite WwTW (Wastewater Treatment Works), which treats the sewage from a population of 140 people, plus the users of the service station on the M6. Once treated, the water is returned to the water course, making its way into the River Petteril to deliver a 'good' watercourse status. The final effluent quality of the WwTW needed to achieve a 5mg/l phosphorus limit on an annual average basis, in combination with catchment interventions upstream of the WwTW.

To meet these targets for the River Petteril, the site and catchment interventions were required to reduce the level of nutrients downstream of the site by 50 per cent. The dry weather flow treated at Southwaite WwTW receives a 25-fold increase at peak flows – a significant challenge to conventional biological secondary treatment processes.

The conventional 'grey' solutions have a number of drawbacks including high carbon footprint, high maintenance and running costs and cost risks from deep shaft construction.

Innovative solution

Wetlands offer a chance to improve water quality in the way nature intended. The plants and animals that make the wetlands their home are in abundance, and providing a habitat for this wildlife is undoubtedly one of the biggest benefits. As well as improving the watercourse, the wetland has enhanced biodiversity, reduced nutrient pollution, sequestered carbon and helped drive efficiencies through maintenance and operation, while considering what is best for the environment.

A series of solution designs were assessed and compared to traditional 'grey' solutions, which led to the recommendation of a new solution – horizontal treatment media wetland – calculated as the lowest financial cost solution for the site. This solution can aid with the treatment of storm water surges and avoids the need for storm overflows. With open access to the public, it achieves significant natural capital benefits for the region.

Results – comparison to conventional solution

- This nature-based solution delivers an increased £1.7 million of natural capital;
- This is a ten-fold increase in natural capital with 75 per cent less carbon; and
- It is a first of its kind for England and Wales.



The wetland is open to all, thus enabling customers to access our achievement and learn more about how our wetland is benefitting the environment, while enjoying the health and wellbeing benefits the wildlife brings. It harnesses the nature-based solutions approach for storm water treatment and *has wide-reaching sector benefit*.

In this case, the EA has agreed that it can be operated under an Operating Techniques Agreement (OTA), as a flexible approach to utilise wetland technology to achieve WINEP targets. It qualified due to its unique

innovative hybrid nature, being able to polish and treat the flow through the works. The three-year flexible

arrangement is welcomed and will enable us to understand the levels of treatment that this type of solution can achieve, ultimately being shared with the industry to improve the understanding wetlands have as treatment solutions, informing future WINEPs.

Next steps

We hope that, through demonstration of the performance of this solution in its first use case, the industry can more widely adopt this as a standard approach for the future.

Developments in our understanding of what can be expected from the wetlands treatment capability will enable an industry-wide understanding of the types of problems this solution can resolve.

Valuable information to be gained includes performance data, maintenance and operation requirements, rate of

naturalisation and public amenity and recreation engagement. The collection of this data will help demonstrate the potential of these wetlands and support regulators to deliver the change needed to facilitate greater scale-up across the UK.

While it will be several years before we understand the extent that the wetland design operates from monitoring and sample results, the environment is already benefitting. Bringing all this learning together, our sector-leading Mainstreaming Nature-Based Solutions Project (see Section 3 and Case Study 19) will aggregate all trials and learning in time for future WINEPs.



Southwaite Wetland
March 2023

Case study 10: Innovative permitting with greener solutions delivers better environmental outcomes

Background

The River Petteril is a tributary of the River Eden, located in Cumbria. The Petteril is impacted from nutrient inputs, which cause a failure to meet the Water Framework Directive (WFD) good ecological status. There are a range of phosphorus inputs into the river including wastewater discharges, and a significant amount of agricultural load.

To address the phosphorus issue in the River Petteril, we worked alongside the EA, the Eden Rivers Trust and local stakeholders to carry out a 17-week catchment-wide monitoring survey. The survey revealed that, to positively impact the amount of phosphorus in the River Petteril, we needed to look at our own processes and work alongside partners and fellow contributors to transform the ecological status of the river through a catchment-wide approach.

We engaged with a wide range of partners in the catchment. Eden Rivers Trust, Carlisle City Council, Cumbria County Council, Lancaster University, Natural England's Catchment Sensitive Farming, The National Farmers Union, the Environment Agency, 3Keel, Nestle and First Milk Ltd were all involved, making joint decisions through co-creation and co-delivery of interventions.

Innovative solutions

Based on the evidence collected, and with input from our partners, we understood that we had to tackle the problem in a new way. Considering the dynamic nature of the catchment, how pollution into the River Petteril is driven by multiple sources and how it is exacerbated by storm and flooding events, a new collaborative approach was born.

- Catchment Nutrient Balancing (CNB) was initiated at Calthwaite WwTW in 2019. CNB provides an opportunity for water companies to offset some, or all, of their obligations at a WwTW by helping another sector to deliver beyond their own obligations – a natural capital approach using partnerships.
- In conjunction, we adopted the use of a low carbon nature-based solution using Polonite instead of conventional solution of chemical dosing. Polonite is a reactive calcium silicate with unique features such as the ability to adsorb phosphorus from treated sewage water. When Polonite is used in sewage treatment, the calcium on the filter media adsorbs the phosphorus in the wastewater and, therefore, removing the phosphorus. This was the first time this media had been used at full-scale in small treatment works.

Results and next steps

Together, these trials aimed to achieve a phosphorus reduction through integrated catchment and treatment works solutions. The three-year trial was successful and evidences the enhanced benefit that can be achieved with the integrated catchment approach. We worked with other sectors, such as agriculture, businesses, and environmental NGOs to deliver greater value for customers, communities and the environment beyond regulatory obligations.

- **Over 60 per cent phosphorus reduction beyond the target and circa £6.5 million cost efficiencies.**
- **Lower trial cost from additional £355,000 contribution through match funding (farmer contribution plus countryside stewardship funding) and £350,000 though Nestle.**
- **Additional natural capital benefits and further ecological benefits though the reduction of nitrate, sediments, nitrous oxide and bacterial load.**
- **Awarded the Water Industry Forum Environmental Innovation award at their 2022 awards, in recognition of the environmental impact delivered.**

Primarily, the act of engaging with and supporting agriculture is likely to yield improved agricultural performance and better compliance and water quality benefit. In addition to the phosphorus reductions benefit, these farm interventions will deliver significant additional ecological benefits though reduction of nitrate, sediments, nitrous oxide, and faecal indicator organisms, delivering wider biodiversity benefit and overall soil quality enhancement.

Spurred on by this, we have expanded the CNB flexible permitting trial into a further three WwTW in the Petteril catchment (Greystoke WwTW, Motherby WwTW and Southwaite WwTW) targeting to reduce the phosphorus load by a total of 566kg per annum by September 2024, where 98kg of this reduction is achieved through farm interventions. We have completed the associated farm interventions across nine farms in the catchment such as the fencing on farmland to reduce banking erosions as seen in Figure 6 below.

We will continue to monitor the key benefits to determine the overall effectiveness of this approach, which will feed into our future plans. We are also looking to expand the CNB flexible permitting approach across the Eden catchment through the Green Recovery to further improve overall catchment ecology and river water quality.

Figure 6: Fencing and silt pond reduces bankside erosion and slows the flow during heavy rain



Building on our learning from delivering the first catchment flexible permit and our use of CNB we identified significant complexities in how to put this into action and as this is new to the water industry we have developed this knowledge into a CNB delivery guide, which is being reviewed with the Environment Agency and we will jointly publish in 2023.

Innovative approaches: Rainwater management

- 2.5.5 As climate change is becoming an ever more pressing issue, we continue to see an increase in surface water run-off. All water companies have a challenge to reduce surface water entering our network to achieve targets for Wastewater Network performance where more sustainable infrastructure is needed. The wastewater network is constrained by limited storage facilities. With storms causing increasing stress, we need to be innovative with our sustainable urban drainage systems (SuDs) to become more resilient to rainfall.
- 2.5.6 Our business plan includes our rainwater management strategy, which relies on innovation. Our plan includes 177 blue/green and hybrid solutions rather than conventional high carbon grey solutions, including the scale-up of blue/green roof technologies.

Case study 11: Innovative blue/green roof reduces flooding risk

Background and conventional solution

On average, it rains 133 days a year in the UK and 184 days a year here in the North West, amounting to 810mm. Roads and pavements in our towns and cities mean that the natural flow of water drainage is reduced. We're looking to transform these built-up areas to help water flow in a more natural way, mimicking natural drainage to help us transport water sustainably.

For this reason, we have explored options in collaboration with partners such as the EA, Lead Local Flood Authority, and developers to manage the flow of water that interacts with our sewers and drains.

Grey infrastructure solutions, such as dams, pipes and treatment works, are what has been used for many years. While they're not a wrong option, we are exploring other options that are more environmentally friendly and with more natural, resilient and sustainable solutions to the management of water.

Blue/green infrastructure is the most sustainable way to create resilience for the future, providing additional benefits to the landscape, health and wellbeing, meaning a strategically planned network of natural and semi-natural areas and environmental features designed to deliver and support an ecosystem.

Blue/green infrastructure can replace or enhance grey infrastructure solutions. It improves our drainage capacity by taking water out of the combined sewer network where possible, reducing spills of storm sewage to the environment. By delivering blue/green infrastructure, we are reducing flood volume and making our catchments more sustainable through operating and maintaining more efficient networks, which contain less rainfall that are more resilient to extreme weather.

Innovative solution

The blue/green roof is a smart sustainable drainage system, which reduces the demand on our wastewater network from surface water run-off by safely storing and reusing the water. The technology is considered 'smart' as it can be adjusted to change its operation in real-time, depending on the capacity of downstream rainwater storage. This allows for rainfall to be collected and stored under the roof in a tank. The roof is also able to release water from the tank through outlets built into the roof in preparation for a storm, relieving stress on the network. The roof also helps to return nature and wildlife to the area by providing a habitat and a source of food for pollinators such as bees and butterflies. Returning more nature and wildlife to cities will have a positive impact on the mental health of employees, and also the general aesthetic of the city.

This release of water leaves the roof under saturated, so that during the storm it can absorb large proportions of the storm water. The tank data, along with weather data, provides information on how much water should be in the tank at any given time.

As part of Bloc, a £50 million pioneer investment programme seeking to develop the most innovative workspace in our cities, we have partnered with four organisations to build a blue/green roof¹ in Manchester. The roof was built in central Manchester with the aim to reduce the impact on the network in the busy city centre, picture in the Figure 7 below. This would be achieved by capturing and reusing rainfall and limiting discharges into the public sewer.

The testing consisted of monitoring how well the roof absorbed water from storms and recording how long this water is retained in the roof's storage. An analysis of the corresponding rainfall events and outflows spanned over one year, 1 January to 31 December 2022, to determine the benefits the technology could provide.

¹ unitedutilities.com/corporate/responsibility/stakeholders/catchment-systems-thinking/beyond-water-series-alt/blue-green-infrastructure/

Figure 7: The retrofit blue/green roof on Bruntwood Bloc in Manchester



Results

An average of 57 per cent reduction in discharge to sewer throughout the year was achieved.

There were 36 rainfall events during this time, of which:

- 25 per cent of the time, almost all the rainfall was captured within the smart blue/green roof – an 80–100 per cent reduction in outflows to the public sewer;
- 50 per cent of the time, averaged a capture rate of 60 per cent, and, therefore, allowing only 40 per cent to the receiving sewer; and
- 25 per cent of the time, only small amounts of water captured and retained within the roof, i.e. less than 20 per cent of the volume generated by the roof was retained within the roof.

Our learning: The system worked well but the physical tank did not drain as quickly as we would like. As a retrofit solution, the system design has to be in harmony with existing on-roof assets. A small barrier from the existing infrastructure made it hard for water to quickly access the drain. The tank still works well in comparison to other designs and, in the future, a series of tanks would be connected, allowing a quicker reaction to changing weather conditions. Although the results from the trial were positive, there can be problems with a lack of water available during periods of extreme heat and little rain, meaning that human intervention may be required to water the plants and stabilise the ecology.

Benefits and next steps

The blue/green roof provides multi-functional benefits such as biodiversity in our cities, climate change resilience, energy performance and being healthier for our communities by having more green spaces available. A major benefit of this technology is the ability to balance peak demands and low supply in the catchment. If significant rain is expected, it is pertinent to know how much water to release before a storm. This release of water is important as overflow from the roof during times of storms will increase stress on the network. Conversely, the ability to hold water back helps maintain an environment and ecology that wasn't previously able to thrive in a built-up urban environment.

We are underway with plans to optimise this promising solution for AMP8:

- Improve tank intelligence – we can improve the tank performance to store or discharge using triggers from our network and system data.
- DNM system – there is the potential to link the blue/green roof data to our DNM system, opening up potential evaluation of roof outflows and sewer levels via pre-existing sensors.

As the only retrofitted smart blue/green roof installation in the UK, this has been an industry-leading project winning the 'Regeneration and retrofit – small scale' award at the SuDS Awards 2022²

² susdrain.org/community/SuDSAwards2022/SudsWinners22

As a result of the success of the trial, smart blue/green roofs can be considered a proven concept, providing the wider industry with the evidence and confidence to implement this solution in spaces where ground space is limited and at a premium. We have started to share our results across the sector.

There is good potential for adoption in further locations – we are currently considering a potential pilot for a Phase 2 project with the optimisation aspects as trial criteria.

Reducing costs/improving performance – innovation in our WINEP

2.5.7 We were the first UK Company to tap into the potential of the wastewater treatment process, Nereda®, a biological phosphorus removal process utilising the innovation of aerobic granules, applied at five sites during AMP6. Further, three of those sites (Kendal, Blackburn and Failsworth) needed to meet even more stringent permits in AMP7 as a result of drivers in the WINEP.

2.5.8 Our experience of partnering with the Nereda supplier, and history of testing and trialling gave us confidence that we could optimise Nereda to meet these AMP7 needs. At two sites, we optimised the process to meet the new permit, with a trial at Failsworth WwTW proving another novel approach to further reduce phosphorus levels, while still providing mainly biological nutrient removal. This optimisation strategy has lessened our reliance on fossil fuel chemicals and has lowered our carbon impact through reduced or no builds.

Our early adoption of Nereda technology has saved over £33 million in AMP7

2.5.9 To be able to offer the nature-based blue/green solutions and financial efficiencies in our AMP8 plan, we have applied our learning to designing and optimising WINEP solutions using the best innovations where relevant. After agreeing the common problems, we gathered a long list of market-ready and emerging technologies that satisfied demands around key factors including treatment compliance and carbon – this list is freely available to our supply chain partners so they can utilise our learning and increase adoption.

2.5.10 Our teams have been designing proposed solutions for the WINEP, and have worked hard to integrate innovative solutions that are compliant, lower carbon and can be delivered safely and on time. Our WINEP includes a high proportion of environmentally beneficial nature-based solutions including:

- 155 nature-based solutions including an innovative software solution to find optimal sites for SuDS and intelligent water butts, and solutions that are aimed at small treatment works, often in remote areas of our region, where conventional solutions will not be affordable or desired;
- 36 vertical aerated reed beds – our early testing will optimise designs for AMP8;
- 5 enhanced biological phosphorus removal solutions save £70 million;
- 1 algal bioreactor – another UK first; and
- 1 phosphorus recovery plant.

Case study 12: Example of greener solutions for AMP8 - [REDACTED]

Background

We are required to increase the treatment capacity of our works to meet more stringent permits. Additionally, as population growth and impacts of climate change increase, flow and loads to our works increase. As a result, sites frequently have insufficient space for the footprints required to accommodate conventional solutions.

There is a rising concern over micro plastics entering water courses and process emissions, but conventional solutions Activated Sludge Process (ASP) intensification technologies include plastic media or require the addition of chemicals; the UK water industry is increasingly turning towards Enhanced Biological Phosphorus Removal (EBPR).

Innovative solution

[REDACTED]

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[REDACTED]

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Case study 13: Trialling a lower cost, greener solution to meet WINEP drivers on septic tanks

Background

Our Windermere region has many parties that contribute phosphorus to the catchment.

Conventional treatment solutions are to install secondary treatment packages and chemical dosing, which is high in cost and carbon impact, as well as impacting our neighbours through chemical deliveries. We have estimated the 80 sites to cost £100 million to build with ongoing running costs of £3 million per year.

We have a strong innovation portfolio linked to the needs of our capital programme. Recognising the WINEP drivers around improving effluent quality from septic tanks and habitats drivers for phosphorus removal on some septic tanks sites, we actively sought to embrace new solutions.

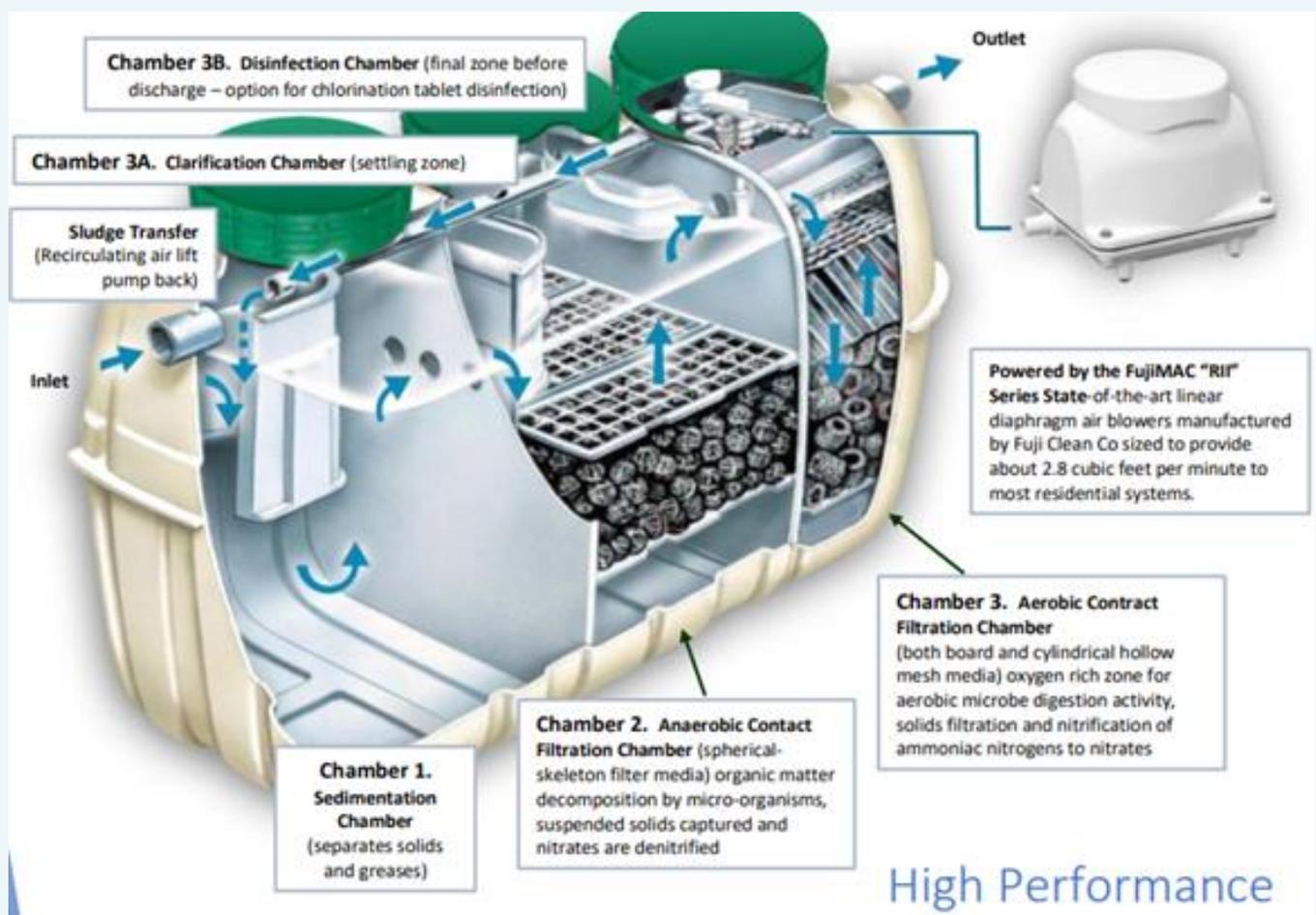
Innovative solution

Our global scouting showed us that combining electrocoagulation with a Japanese-supplied FujiClean unit could help us to achieve phosphorus removal at septic tank sites without the need for chemicals, with a lower whole-life cost and carbon impact.

FujiClean CRX is a containerised, contact filtration wastewater treatment technology, comprising of a tank split into three separate chambers, through which wastewater flows in a circuitous train. BOD, solids, ammonia and phosphorus removal is achievable via treatment across three stages – as shown in the Figure 8 below:

- Sedimentation and phosphorus removal – via electrodes at the front end of the unit;
- Anaerobic treatment – via direct contact with proprietary fixed film media; and
- Aeration.

Figure 8: FujiClean CRX



However, this technology is unproven in the types of application we have in the UK, and the operational and maintenance costs of running these units was unclear. To remove this uncertainty, we have funded two UK-first adoptions to test if FujiClean solutions could be the optimal solution. One adoption is a full-scale solution at Calver Hall Prees Road, and the second is for trialling and ongoing optimisation.

Our first unit is installed at Calver Hall Prees Road where the current solution at this site requires desludging every week, which has an impact on our operational costs and our relationship with nearby customers due to the traffic and noise. Our trial will test the Fujiclean unit – with potential to only need desludging every three years, a significant reduction in traffic, noise and operational intervention.

In addition, the power requirements for the unit are very small (40W) so there could be opportunities to increase the use of onsite renewable energy sources such as solar and/or wind and, therefore, negate the requirement for expensive electrical infrastructure to be laid.

Next steps

In collaboration with FujiClean, we want to push the system boundaries to increase the flow throughput to drive further opportunity sites for this small-scale unit. For larger sites, we have installed another unit at Glazebury where we can complete more thorough testing across a range of parameters without adversely affecting the site operations.

We have identified five sites in AMP8 that could have potential to move away from conventional solutions to using a proven FujiClean – our trials will test whether the system is effective and the optimal solution

- **We have an ambition to save £6 million and over 2,000 tonnes of carbon in AMP8.**

Case study 14: Eyes in the sky, nose to the ground – from satellites to sniffer dogs for leakage detection and environmental protection

At the start of AMP7, we had an ambitious innovation trial underway to use satellite imagery for leak detection using a ground-penetrating radar from Japanese satellite, ALOS 2, to detect water just below the ground. Taken from satellite-mounted sensors, the raw imagery is then overlaid on GIS systems and processed by unique algorithms to generate points of interest that are used to direct our leakage teams.

In areas where loggers are not suitable, satellite data allows us to survey a large geography and plot areas of interest. We hoped to then dramatically improve the efficiency of our leakage technicians by directing them to specific locations where there is a high probability of finding a leak. We knew satellite sweeps would be faster, but we needed to know if it was as accurate as conventional methods.

We ran a series of trials but this technology was not advanced enough for us to displace or supplement existing detection techniques. The AMP7 trial and concept was not successful, and we have moved away from this idea during AMP7.

Our learning: When we explored this idea, the solution was not ready and needed significant development time, which was not optimal use for our resources. Combining forces with other water companies might allow this idea to become more affordable and efficient. For AMP8, we have a ‘fast follower’ strategy and will review this approach again once the satellite detection accuracy improves.

We co-created a trial and new business process with Cape Specialist Pest Control (Cape SPC) to see whether their sniffer dogs could find water leaks in our water network pipes in the same way as other canine detection targets such as explosives, drugs and bedbugs. At the start of AMP7, we were still in exploration phases; we have now fully proven and adopted this method for long cross-country and rural water mains where leakage detection has, traditionally, been difficult because there are few fittings to listen from for the sound of leaks.

Our dog teams have proven to be very successful in detecting leaks (their day job) and has earned them ‘celebrity status,’ showing customers that we work hard to find better solutions for them and the environment. Figure 9 shows Denzel, a valuable member of our detection team. The dog teams regularly appear at customer roadshow events and have been featured on BBC News³.

“Most water leaks never show above ground so we have to go looking for them. It’s very difficult for our engineers to use their traditional ‘listening’ techniques out in the countryside because there are very few fittings or valves for them to access the pipework. It’s like looking for a needle in a haystack. The dogs can cover large distances quickly and, if they find a point of interest, then we send in our human teams to double check. It’s a terrific partnership.” – UUW Leakage Manager

Figure 9: Denzel one of the UK's first water leak sniffer dogs



Using our learning on the effectiveness of sniffer dogs, we have now started to leveraget this idea into a new solution to deliver environmental protection.

Background and conventional solution

Domestic properties have two types of discharge pipes: one for surface water (e.g. rain) and one for waste (e.g. toilets, washing machine etc.). Sometimes, the surface water and waste are served by a combined sewer network. Additionally, dedicated surface water networks receive water from public areas such as roads, taking significant volumes of rain water, which have dedicated networks that capture this to put back into the environment.

There are, however, networks that have foul and/or combined flows connected erroneously – known as misconnections. Though potentially innocent mistakes, such misconnections to the network from third parties (e.g. commercial, residential and retail developers) have a significant impact on the local catchments and increase environmental risk.

The conventional solution is carrying out property surveys to identify misconnections. The process is inevitably disruptive to customers as it involves entry to property, driveways and gardens – and are inefficient due to multiple visits as customers are not initially at home. We estimate this typically takes over four months and £150,000 to survey 1,000 properties. We have trialled alternative innovative ideas such as aerial surveys and portable fluorimeters to avoid disruption but they did not outperform the conventional methods, especially on affordability.

Innovative solution

Building on the success of using sniffer dogs to detect water leaks in AMP7, we wanted to explore what other problems the dogs could tackle where above-ground sensing was crucial and today’s manual processes were in need of improvement. A natural extension was identifying sewer misconnections, which lead to river pollution. We knew that dogs highly trained in clean water leak detection could not simply transfer to other applications that needed different training. So we formulated new trials with the advantage of the water experience and learning.

³ [bbc.co.uk/news/av/uk-england-cumbria-54734117](https://www.bbc.com/news/av/uk-england-cumbria-54734117)

We set out to prove whether new sniffer dogs could be trained to help and Figure 10 shows a training event. Working in collaboration with the EA, our specialist network teams and Cape SPC (our dog detection supplier) we designed a trial to:

- detect common misconnections – washing machines, showers, sinks;
- pinpoint the specific property – when many properties feed the same manhole; and,
- Spot any misconnection – when the flow may not be happening at time of investigation.

The EA guided us on which catchments to focus on for training using known contaminated sites. The first trial was in Frankly Ditch, Wirral, then moving to Pow Beck, Cumbria for the scale-up and to design appropriate business processes to adopt this innovation. During training, moving the dog to new and varied locations is key so that the dog does not simply remember locations and misconnections from last time.

Our first water leaks were invaluable and we applied that learning to this new application – reducing trialling time by over 18 months and therefore moved faster into adoption. The key lesson was improving the feedback loop so the dogs could be retrained faster.

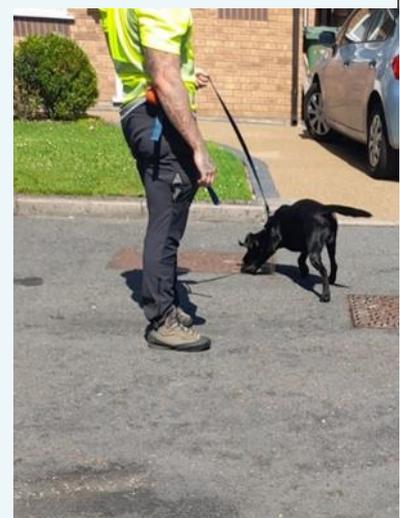
Results and next steps

- **Dogs can detect misconnections >80 per cent of the time faster than conventional methods**
- **Transferring our learning reduced trialling time by and saved £135,000 cost.**
- **This innovative approach has high potential and we are optimising by end of AMP7.**
- **For AMP8, we have an ambition for £2.5 million saving, with reduced environmental risk.**

We are building an adoption plan that will see us optimising in AMP7 and finalising in time for AMP8.

Like our water leak detection dog teams, customers enjoy seeing this innovation in action where they can personally engage by expressing interest and curiosity about our dog-based innovation efforts. We will continue to optimise and launch in AMP8, and explore other opportunities such as above ground fat, oils and greases (FOG) detection.

Figure 10: Training the dog to detect misconnections



3. We routinely collaborate – continuing in AMP8

3.1 Introduction

3.1.1 We have a strong track record of using innovation to deliver value. We know that we cannot achieve our ambition alone and that other parties play a significant role.

3.1.2 Our innovation portfolio now sees us collaborating and partnering more than ever:

- Collaborating across UK water – SPRING and STREAM to increase sector capacity and capability;
- Collaborating globally – through our water sector connections and out of sector innovation forums;
- Closer working with our regulators and direct with customers;
- Collaborating with academia – working with the next generation of innovators; and
- Increasing leveraged funding and strengthening partnerships to lower the total cost of innovation.

3.2 UK collaboration

Water sector

3.2.1 We have collaborated with water companies for many years and continue to do so for AMP8. We are a member of UKWIR (UK Water Industry Research) and are involved in collaborative industry research projects helping to address agreed challenges. The 5 year, £3.5 million UKWIR framework has delivered strategically important research initiatives and we have been partners for all these. We have collaborated with water companies for many years and continue to do so for AMP8. We are a member of UKWIR (UK Water Industry Research) and are involved in collaborative industry research projects helping to address agreed challenges. The 5 year, £3.5 million UKWIR framework has delivered strategically important research initiatives and we have been partners for all these, leading on ten projects including:-

- **Urban runoffs and atmospheric deposition:** This project reviewed existing data and knowledge of chemicals of emerging concern in urban run-off (including highways) and atmospheric deposition and assessed the potential for this data to be used within our systems. Whilst all UKWIR projects benefit the sector – for us, it highlighted knowledge gaps, guided us to prioritise how we update our systems and increased our awareness of possible approaches to reducing the risks associated with urban runoffs.
- **Land Carbon Sequestration Tool Development:** The key aim of this work is to develop a user-friendly, best practice tool that becomes the UK water industry standard to support strategic carbon sequestration management. We believe this is a vital step forward in the sector reaching Net Zero ambitions. We now have an industry standard tool for calculating net carbon sequestration across our land holding and better understanding of how we impact third party land. We have taken this learning into the project scope of our catchment partnership projects, CastCo and Mainstreaming Nature-based Solutions and it is informing our Land Management strategy.

3.2.2 We also supported the development of the Water Sector Innovation Strategy ‘Water 2050’ and led as the first chair for all-company innovation lead meetings and workshops, using our innovation, legal and commercial expertise to propose a sector-wide collaboration contract aligned to the fund and competition design, which is now accepted as the working template contract when bidding for all future Ofwat fund rounds. We will use this template when bidding as lead partner.

Supporting SPRING

3.2.3 We are a member of the SPRING Development Group – one of five organisations guiding the centre of excellence development and setting the strategy for others to endorse. We shared ways to harmonise best practice, creating the processes for SPRING to act as a first receiver of new ideas (on behalf of all

water companies), sharing our technical guidance from our Innovation Labs to remain compliant with procurement guidelines and providing subject matter expert judges for running challenge-led sourcing.

- 3.2.4 We provided funding, advice and support to the creation of SPRING – the UK water sector centre of innovation excellence – welcoming the agreement of their new strategy, which opens the door for more innovation across the sector and reduces duplication. We have publicly committed to the continued development of SPRING to help make it effective and more self-sustaining.
- 3.2.5 Building on our Innovation Lab experience, we are supporting their challenge-led Accelerator processes and are already leading one work stream for the joint venture work with Microsoft Ventures to find new start-ups to disrupt conventional processes.
- 3.2.6 For the projects we are leading from the Ofwat Fund, we have named SPRING as our knowledge partner for co-ordinating how we make the most impact and reach the right people with our results sharing. We will share the results of the AI for sewers project in September 2023 and use SPRING to store the Open Dataset. We have already shared our Industrial Symbiosis results in 2022, including our innovative approach to measuring and improving collaboration behaviour in our leading projects, sharing our experience with the sector in June 2023 via a SPRING showcase.
- 3.2.7 We look forward to continuing to support SPRING to provide a better centralised service to companies and innovators. Alongside the water companies' greater collaboration, there are now many relevant parties in the UK water sector innovation ecosystem. We will work collaboratively with SPRING and will use their Development Group to adopt these improvements.

Using Open Data via STREAM

- 3.2.8 A further water sector collaboration is with STREAM, the Open Data platform and adviser. STREAM's vision is to unlock the potential of water sector data to benefit customers, society and the environment. We are a strong contributor to the group, and are taking the opportunity to use STREAM to support and accelerate our own open data strategy and plans.
- 3.2.9 This includes using STREAM as the final repository for our Ofwat Fund project, AI in sewers, where we are publishing an Open Dataset for CCTV defect types in sewers. Until STREAM is fully established, we have agreed a temporary host with SPRING.

Using Open Data and innovation in our partnerships – Greater Manchester

- 3.2.10 We have worked with Greater Manchester Combined Authority, alongside the EA, for the last four years, to drive forward the environmental, development and infrastructure priorities across Greater Manchester. The key aims of the partnership are to reduce flood risk, improve water quality and efficiency, enhance natural assets, and ultimately create more liveable, healthy places and developments; we will continue to use innovation to support and accelerate these goals.
- 3.2.11 The partnership will also inform and support our investment planning in Greater Manchester by working with partners and catchment stakeholders. This will continue into AMP8, and actively engaging with the future developments of the partnership, such as the development of an integrated water management plan for Greater Manchester, which will formalise the application of knowledge sharing and shared innovation portfolio.
- 3.2.12 In addition to our work in Greater Manchester, across the North West, we will actively seek out opportunities to work in partnerships to develop solutions that reduce flooding and pollution. The types of schemes we will pursue include nature-based solutions, such as natural flood management, sustainable drainage, developing community resilience and engaging with wider communities to help them understand their impact and how they can influence their local environment.
- 3.2.13 As part of our Open Data strategy, we developed the U UW collaboration portal⁴, which is an interactive external platform where we host updates regarding key schemes happening across the business, such as

⁴ collab-uu.co.uk/

our catchment systems thinking approach, our DWMP and water resources. This online collaboration tool provides a space for engagement with key stakeholders and partners, making engagement and contribution easier and faster. We use the collaboration portal as an online consultation space to evolve our plans and approaches.

- 3.2.14 We recently sought input from key stakeholders regarding proposed WINEP schemes across each catchment using maps on the portal. We will continue to use this portal in AMP8 to seek out further opportunities to update and strengthen the portal to enable more innovative approaches for engagement and initiating potential partnerships.

3.3 Global water collaboration

- 3.3.1 We also collaborate outside the UK, as founding members of global sector groups such as the Technology Approval Group, Water Action Platform and the World Water Innovation Forum. Collectively, these groups allow us to pool knowledge, share findings and results. By learning from others, we can minimise our own bespoke trialling.
- 3.3.2 We were one of the founding sponsors of the Trial Reservoir⁵ – the innovative trial funding scheme that is increasingly successful. It connects trial results with adoption and has led to over 200 globally sourced technologies being reviewed for innovation funding, with seven completed trials. We have learned from others about the merits of innovative technologies without incurring our own costs.
- 3.3.3 We have proactively scouted for ideas globally using our established networks such as Export Development Canada, a Canadian joint government organisation that enables us to tap into breakthrough innovators and ideas. Since late 2022, we have set problem-challenges with them every three months and they supply a pipeline of introductions to Canadian-based companies that have potential to help. We have similar arrangements with others in Israel, Australia and Asia and have reviewed over 200 suppliers outside the UK, many of whom have applied to our Innovation Lab programmes.

⁵ isleutilities.com/services/trial-reservoir

Case study 15: Example of learning from others – trialling and adopting Smartvalve

Background

Customers expect us to provide clean water every day, and a stable and calm network provides this. We agreed an improved performance in AMP7 and AMP8, and have made great strides to reduce problems such as leakage, outages and pressure changes that lead to a change in supply.

One reason why such changes in supply occur is when valves are operated on the water network. The valve turning method has remained the same for years; while some valves have become automated, the majority remain manually operated, and rely on operators and third parties. Opening or closing a valve too fast causes stress to the network, which can cause additional leakage, discolouration or change of supply.

Each valve has its own turning regime; that is, how many times to turn and at what speed. Given the different approaches by valve location and type, this is prone to error and operators do not get any feedback from the system to know if they have turned the valve correctly.

Innovative solution

Through the collaboration with World Water Innovation Forum (WWIF) – a knowledge sharing forum⁶ – we became aware of SmartValve, an innovative way to turn valves in a more controlled way, resulting to a calm network. Their system includes a mobile app that is attached to the valve, and provides the operator with real-time guidance on which valve to turn and at what speed to meet the calm network standard, and reduces any pressures surges. They get instant feedback on turning performance as all turning profiles are recorded.

In reviewing this new idea, we could access the trial results from other WWIF companies, which provided confidence that the system worked. While we could see the obvious benefits of this idea, it could not simply be adopted immediately, as we have over 100 water network employees and many third-party operators. The business process relies on people using it in the correct manner and as intended, so we designed a trialling and training programme to deliver the desired outcomes.

Our trial criteria and results are shown in Table 3 below:

Table 3: Results of trial

Trial criteria	Result and implication
Can the app be used on the majority of our valves?	Yes – although some are niche and the app needs updating in future version updates.
Would a sufficient number of employees use the app for the first time, and then every time?	Yes for first use, operators were curious to try. No for every time – operators reverted to traditional approach. See <i>our learning</i> below.
Is the operator experience acceptable?	Yes – no changes needed.
Was the system used as intended by operators?	Yes – no misuse.
Can the system record the valve operation with enough accuracy?	Yes – although full integration with our systems is the vision subject to confirming the business investment case.
Is the app effective at supporting a calm network?	Yes – we had reduced taste, smell and appearance events.
Summary	Successful: proceed to scale up.

Our learning: We were grateful to others in recommending this idea to us – and they gave us invaluable insight into how we should approach any trialling and supplier interaction. During the trial, it was apparent that earlier and more sustained end-user involvement is key. We discovered many operators reverted back to the manual method after the trial had finished due to a lack of feedback and local reinforcement to use the best processes.

⁶ worldwaterinnovationforum.com

For our full scale adoption, we will share operator performance and have started to train local champions. For all future innovation trials, we will copy this approach of engaging earlier with end-user operators.

- **By learning from others, we accelerated our trialling and adoption by nine months.**
- [✂]

3.4 Out of sector collaboration

- 3.4.1 Searching for inspiration and new ideas only within the UK water sector supply chain gives limited results – it creates an echo chamber. We need fresh eyes, so search outside the conventional water sector supply chain.
- 3.4.2 We have supported many suppliers outside the UK water sector to pitch their ideas to us, and we have run trials to test their products and services. One example is how we adopted a solution from the marine sector, Clearwater Sensors, to support our environmental obligations and ambitions.

Case Study 16: Clearwater Sensors – from oceans to rivers

Background

High phosphate concentrations are a major concern for rivers, streams and other freshwater bodies in the North West. Too much phosphate causes excessive growth of algae (algal blooms), which leads to a major reduction in water quality, potentially harming fish and other organisms in the river. It is important that we understand how phosphate concentrations vary and what the main sources are, allowing mitigation measures to be targeted in the best way possible.

High resolution automated monitoring is fundamental to understanding the problem and deciding how to deal with it, which is a key aspect of our Better Rivers, Better North West environmental investment programme. The traditional approach consists of manual sampling and laboratory analysis of discrete samples, which can be slow and expensive. The best alternative technology for on-site phosphate analysis relies on large mini-labs, lots of chemicals and very skilled technicians. These constraints inhibit pervasive environmental monitoring of this important parameter, a prerequisite for gaining meaningful wide-area data.

Innovative solution

We discovered Clearwater Sensors in the UK marine sector. Their idea is a deployable phosphate sensor based on cutting-edge lab-on-chip technology. It automatically records highly accurate and reliable phosphate measurements, and can self-calibrate using on-board calibration solutions to maintain accuracy when deployed.

Successfully applying to our Innovation Lab 4 programme in 2022, a six-month trial tested their sensor by submerging in rivers and streams, deploying it at treatment works and in almost every other situation where automated high-resolution phosphate measurements are required. It operates with very little to no infrastructure so can be deployed in remote locations away from mains power – a significant improvement over conventional solutions.

The Clearwater Sensors phosphate sensors provide key data that will be used to make informed management decisions and ultimately lead to improved water quality in rivers and lakes. Building on the trial, we have shared the findings with some of our regional key collaborators and we are in the process of investing in, and supporting, follow-on trials with partnerships including Academia, the EA and local authorities, enabling this innovative solution to provide data to wider audiences. We are using a local university to verify our results and help unearth other applications.

Next steps

We will continue trialling in AMP7, aiming for AMP8 deployment alongside exploring how this marine technology can possibly solve problems in other areas, such as specifically targeting catchments areas. It is one of our innovations in our investment portfolio focusing on better river health.

Collaborating out of sector to deliver business growth and social value

- 3.4.3 We are active in knowledge innovation forums with other utilities, infrastructure clients such as Sellafield and HS2 and organisations like BMW, AO and Alder Hey Children’s Hospital innovation centre. Our formal partnerships include out of water sector partners, which is always a stimulating environment to join capabilities and tackle wider problems together.
- 3.4.4 Often, our innovation efforts also **stimulate new social value** with supporting the creation of new jobs and people development. Our Innovation Lab alumni have been able to create 35 new jobs, with many of them in the North West, and we have supported internships, placements and apprenticeships in some projects connected to emerging trends.
- 3.4.5 We also take opportunities of additional funding to accelerate social value benefits alongside idea development. Our leading efforts with hydrogen and graphene generation (LOOP – Case study 20), our Ofwat WBC3 project, Biopolymers in Circular Economy, and our continued collaboration with Changemaker 3D, all have offers of internships, work placements and recruitment to increase social mobility – connecting young people to the skills shortages of construction, and generating new interest in the water sector and emerging digital and construction trends, such as 3D printing.
- 3.4.6 Sometimes, we cannot afford to support a supplier on our own especially where their idea has cross-sector appeal, needs help from a more diverse client base and requires significant investment. We had worked with Changemaker 3D to produce a **world-first 3D printed low carbon** concrete distribution chamber. See case study 22 for more details.
- 3.4.7 We could see the potential of low carbon 3D printing for our capital programme, but we were unable to fund this fledgling start-up to fully penetrate the water sector, so we introduced them to other large infrastructure clients and we endorsed their products and company. They now have contracts with Sellafield and HS2, and are also receiving support from our construction supply chain partners. We have also created a wider partnership, including Costain and HS2, to harness learning from the rail industry.
- 3.4.8 Encouraged by this cross-sector support, we have led a multi-partner team to win and project manage a £1.7 million bid to the Ofwat innovation fund in the Catalyst stream of the Ofwat Innovation Competition ‘Water Breakthrough Challenge 3’. This project will deliver operational demonstrations of concrete and plastic 3D printing of structures and mechanics to increase our construction and maintenance efficiency. The guiding project partners are ChangeMaker3D, Manchester Metropolitan University and Scottish Water and we are the lead partner and programme manager⁷.

3.5 Working and collaborating with regulators and customers

- 3.5.1 We have collaborated with the EA to adopt our wastewater network sniffer dog trials, our agreed approach catchment management, increased acceptance of green, nature-based solutions and flexible permitting – a key aspect of our WINEP submission.
- 3.5.2 We have used innovation to support our transformative outcomes with the DWI through effective delivery of our Water Quality First transformation programme, including site visits and showcases of innovative water quality sampling methods. Our trials of flying drones to take water quality samples is reaching full maturity and is now accredited by United Kingdom Accreditation Service and is another UK first. This is a major step forward in adopting a new process for water quality sampling; we have shared our results at the Drinking Water Quality Conference, September 2023.

Using the opportunity of the Ofwat Innovation Fund

- 3.5.3 Ofwat established a £200 million Innovation Fund as part of PR19, with the goal of supporting the sector to better meet the needs of, and create long-term value for, customers, society and the environment through innovation. Through a series of innovation competitions, the Fund aims to achieve this objective by driving impact in three key areas: Accelerating the creation and roll out of innovative

⁷ unitedutilities.com/corporate/newsroom/latest-news/water-sector-heralds-uk-first-in-major-success-for-greener-printinfrastructure/

products, services and concepts; Growing capacity and capability of the sector to innovate; and Embedding a culture that values, encourages and supports innovation.

- 3.5.4 We fully support the Fund's ambitions as it is benefitting the sector and has helped to transform our innovation portfolio to include more sector-changing innovation projects through more formal water company collaboration and information sharing. From the first designs of this fund, we have been actively supporting the competition's development through constructive feedback that benefits the whole sector.
- 3.5.5 We provided feedback to Ofwat and competition support partners through consultation, quarterly project progress reports and other informal feedback routes, and we have been pleased with the openness and transparency of this process. We welcomed the lowering of intellectual property barriers in later funding rounds, which had previously hindered our bidding.
- 3.5.6 In AMP7, we have used the fund opportunity to build on our leading innovation capability, co-operate, collaborate and partner to strengthen and prioritise innovation efforts. We will continue to do so throughout AMP8, using our experience gained and the increased funding available. We have been able to unlock investment for ideas that may have been viewed as unaffordable, either on our own or part-funded in partnership with others. Even unsuccessful bidding has led to innovation portfolio improvements due to the feedback received, steering us to re-submit, guiding us to self-fund or to postpone ideas until resources are available.
- 3.5.7 We are one of the few water companies to have fully completed an Ofwat funded project (case study 17, Industrial Symbiosis) giving us experience of the entire end-to-end process: bidding, delivering, closing out a project and sharing results, including impact assessments, through the Ofwat review panel quarterly and final reporting process. Since the Fund was launched, we have continued to manage more leveraged fund projects alongside our own innovation portfolio. This has required us to improve our capability and bring in additional resources to create the capacity to participate, allowing us to:
- influence competition designs, bidding and fund administration;
 - co-ordinate idea generation and triage for external funding potential;
 - submit bids, execute contracts including project management and financial administration;
 - create new internal governance and bidding business processes; and
 - Promote the fund around the world through our extensive network, supply chain, idea scouts and far-reaching Innovation Lab programmes.
- 3.5.8 We have been instrumental in removing barriers for others to participate in the Fund, including support of the Discovery competition where we sponsor a specific challenge or mentor an innovator. We feel well suited to Discovery support as we have success with early stage innovators, knowing how to take successful bidders, develop their concepts and identify routes to adoption.
- 3.5.9 We understand the practical challenges working with early stage ideas and innovators:
- **For the water company** – the energy and time needed to provide constructive feedback and support is intense and time consuming, amplified for those from outside sector and academic spin-offs or start-ups;
 - **For the idea development** – releasing resources to provide feedback from diverse sources including scientific, engineering, operational, IT and project delivery, and early stage developments that are unlikely to deliver a return 'in AMP' need particular nurturing to avoid being overlooked;
 - **For those outside sector** – introduction to the regulated water sector and industry standards; and
 - **For all new innovators** – helping them understand the real problems (not perceived), giving access to key decision makers, business development support, and company growth advice and funding to move from concept to commercially available product or service. We see the emerging role of SPRING being useful here and will continue to support its development.

- 3.5.10 We welcome Ofwat's early signals of the continuation and expansion of the fund for AMP8. The segregated water efficiency fund is novel and positive for customers and the sector. We will ensure that our innovation efforts include supporting and capitalising on this, contributing to all consultations and feedback opportunities.
- 3.5.11 We are underway with generating and gathering ideas suitable for AMP8 fund application; our current Innovation Lab programme closes in summer 2024 and includes a focus specifically on water efficiency, so we will open our programme to other water companies to share with the sector. Our track record of tapping into the strength of others and working in partnership will continue for AMP8.

3.6 Working with academia

- 3.6.1 Working with academia provides us with access to specialists and world leaders in their fields, opening up access to specialist subject matter expertise in the form of consultation, facilitated industrial collaboration and the undertaking of novel research to address gaps in the water sector's knowledge. Collaborating in this way is useful to challenge our thinking, expands our capabilities and brings new perspectives to us and the wider industry, and helps us to develop intervention strategies to emerging circumstances and promote efficient services.
- 3.6.2 We work with academia and research organisations in several different ways to help inform, test and implement the latest thinking, expertise and new approaches.

Facilitated industrial collaboration

- 3.6.3 We are members of several facilitated collaboration groups. Often led by research institutes, the groups work with industrial partners to understand specific issues and build a body of research. This enables companies to pool resources and leverage academic research funding. These collaborations include funding of academic research and sponsorship of MSc and PHD students. An example of this type of collaboration includes:
- **PODDS** (The Prediction and management Of Discolouration in Distribution Systems) – Collaboration with the University of Sheffield who led a research project with water industry partners, with the approach to manage drinking water quality using innovative hydraulic strategies. Spanning many years and phases, we have consistently taken the results from this research and adopted it to make changes to our water network strategy over successive AMPs.
 - **Managing discolouration risk** – a project to understand the particle behaviours in the water network, and how they move and settle, so we can proactively manage discolouration risk, reducing customer contacts and reportable events. This project is working towards helping us target our mains flushing and cleaning programmes and mains replacement; longer term, we are exploring whether this can influence the design layouts of water networks.

Sponsored academic collaboration

- 3.6.4 We have a history, and continued engagement, in sponsoring both doctoral and post-doctoral research. Over AMP7, we funded 19 students and we work directly with other industrial sponsors to design research requirements. Co-funding and providing data and access to company subject matter experts is a key aspect of this sponsorship, and the outcomes of this research often lead directly to developments in our business plan and strategies.
- 3.6.5 Examples include working with:
- **Stream IDC** (The Industrial Doctorate Centre for the Water sector) – we sponsor research projects where PhD researchers cover a wide range of water industry-related topics with our Head of Innovation as Industrial Steering board representative.
 - **WIRe CDT** (Water Infrastructure and Resilience Centre for Doctoral Training) – co-creating research projects for PhD students to collaborate on projects tackling critical issues associated with the water

infrastructure, in association with Cranfield University, University of Sheffield and Newcastle University.

- **C-DICE** (the Centre for Postdoctoral Development in Infrastructure Cities and Energy) – C-DICE is a world-class postdoctoral development programme, which leverages the capability of 18 leading research-intensive UK universities. C-DICE aims to build and sustain the advanced skills base required to create a pipeline of world-class talent for the Infrastructure, Cities and Energy (IC&E) sectors, and accelerate progress towards a net zero society by 2050. C-DICE brings together the collective expertise of the UKCRIC universities with the partners of the Energy Research Accelerator, working alongside research associations, institutes and many leading industrial partners.

Leveraged funding and academia

3.6.6 We have partnered with universities including:

- WBC 3 Water Industry Printrastructure – Manchester Metropolitan University, supporting use of new materials as alternatives to fossil-fuel and high carbon products - and social value impact;
- WBC3 Biopolymers in Circular Economy – Glasgow Caledonian and University of Manchester, supporting market sizing for recovered resources; and
- Levidian LOOP generating hydrogen and graphene – Liverpool John Moores, supporting the integration of trial results with Liverpool Region’s hydrogen commercialisation strategy.

3.7 Working with others to reduce innovation costs – leveraged funding

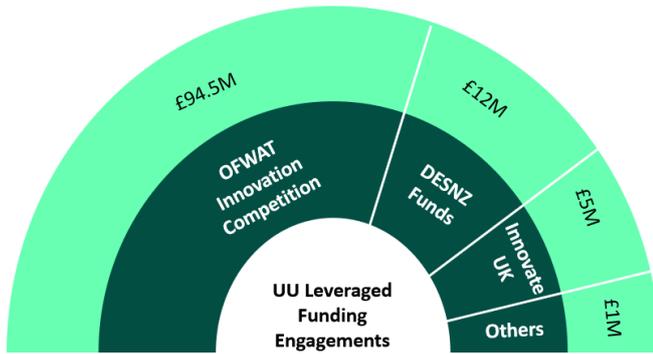
3.7.1 We embrace the opportunity of leveraged funding to benefit from pooled knowledge, consolidation and sharing between peers, which avoids duplication of ideas and wasted trialling. This enables better utilisation of funds and resources to drive value to customers.

3.7.2 Bringing in external funding through collaborative innovation partnerships has helped us to rapidly develop new products and services that deliver value to customers, shareholders and the global water sector. Our partnerships share the risk and financial investment associated with complex, multi-layered and transformational innovation. Sharing the risk with partners has enabled us to confidently drive disruptive innovations that address common and fundamental water sector challenges.

3.7.3 Capitalising on these funding opportunities brings outside perspective into the water community – but these funding sources have their challenges. Many opportunities are denied to us as a large regulated company in the water sector. In addition, the reporting, speed of reaching agreement, issues around intellectual property and cost recovery and deciding who leads, who manages and who supports is time consuming. Therefore, choosing the best leveraged funding routes is a key part of our strategy and we have prioritised the Ofwat Innovation Fund, Department for Energy Security and Net Zero (DESNZ) and Innovate UK competitions. These new leveraged fund projects are part of our overall innovation portfolio, which includes collaborations with other partners and our own in-house and individual projects.

3.7.4 In AMP6, we had less than ten per cent of spend benefitting from leveraged funding such as working with other water companies in joint research such as UKWIR. During AMP7, we have targeted more leveraged funding opportunities to lower the total cost of innovation and increase partnership working – and with good success. Now, **over 50 per cent of our innovation portfolio is connected to external funding** – and we can deliver “more for less”, as shown in the Figure 11 below.

Figure 11: UUW connection to leveraged funding has significantly increased



Ofwat Innovation Fund: Regulatory funded innovation competition where UU are leading 7 projects and supporting 26 projects across various themes such as: water efficiencies, circular economy, nature based solutions etc.

DESNZ: Levidian Loop Phase 1 & 2 – Graphene and Hydrogen Recovery from Methane at our wastewater treatment sites

Innovate UK: eHGV Charging Infrastructure Installation – Part of a consortium to implement 140 electric 40 - 44t eHGV charging points across various strategic routes and assets. 12 to be installed on our sites

Other: Non-household customer research (Waterwise Fund) project to drive water stewardship across big manufacturing industries in the North West AND Ephyra – a bioresources technology to reduce sludge

% of our innovation investment connected to leveraged funds (£ value):

AMP 6 <10% AMP 7 (to date) >50%

3.7.5 We have incurred extra cost to win this additional funding:

- Additional £65,000 to recover a project that was at risk due to a partner withdrawing at short notice;
- Allocated additional £2 million from shareholder funds for speculative bidding;
- Created two new roles to support bid co-ordination, project management and payments; and
- Supported the Discovery competition by providing a judge and two mentors for four finalists.

3.7.6 We are investing to secure even more funding – leading to extra capacity and capability:

- Investing in new software to help us co-ordinate the vast amount of new partnerships and relationships as a result of extra funding and increased innovation portfolio – even those where we are not lead or partner;
- Using in-house commercial, legal and finance resources to support co-ordination and ensure we are aware of contractual and funding risks;
- Participating in all water company workshops to develop bids and to agree lead/support roles;
- Designing new governance processes to confirm bidding strategy, participation and funding;
- Creating a new six-step bidding process, to gather the best intelligence on possible ideas, share with others in a consistent way, ensure alignment to the leveraged fund provider’s ambition and focus to ensure we put compelling bids together;
- Adopting a new method of measuring and improving collaboration behaviour, using a survey-based approach that has proven to be effective and shared widely in June 2023 via a SPRING showcase. We also tested this approach in the Industrial Symbiosis Ofwat funded project in 2022 and it is now an accepted tool that we intend to use on approximately one-third of our entire portfolio, whether a leveraged fund one or not; and
- Agreeing to use SPRING as our knowledge partner on all leading projects, including ones outside the Ofwat Fund portfolio – we want to support their growth and stability.

3.7.7 We have access to a grant searching system ‘Grantfinder’, which allows us to search all opportunities and narrow down to those where we qualify, where we have an innovation focus or need, and where we can add value.

Activity and results – leveraged funding for innovation

3.7.8 Utilising leveraged funding, we created a new idea pipeline and increased our innovation portfolio by collating over 100 ideas across our three leveraged fund targets.

- Our Ofwat-bid for Non-Household Water Efficiency was submitted originally to Ofwat Fund but was rejected. We reviewed the feedback provided and used this to improve our bid, which we subsequently submitted to Waterwise (Water Efficiency Collaboration Fund) – and was successful.
- Submitted three bids, winning two projects (over £600,000) including converting **waste carbon to hydrogen and graphene** to Innovate UK and DESNZ funding rounds.

3.7.9 Other sources: **we have won £18 million** of additional funding. Examples include our sector-leading circular economy work to create new sources of graphene (LOOP) and accelerating our transport fleet decarbonisation (eHGV Charging infrastructure).

Ofwat innovation fund – results

3.7.10 We have embraced the opportunity of the Ofwat Innovation Fund with good success. These results are hard won; from over 200 new ideas reviewed, 74 bids were submitted, leading seven and influencing a further 19 projects, as shown in Figure 12 below.

Figure 12: UUW Ofwat fund activity as of August 2023



3.7.11 For the Ofwat innovation fund, we are making sure that our financial contribution is being spent wisely and making an impact for both customers and on a national scale. Our combined investment is connected to more than 90 per cent of the total awarded fund, leading on one quarter of projects, co-ordinating over 100 partnerships. These are all managed by our dedicated Ofwat project delivery team, with inputs from experts, steering boards and support teams.

- Ofwat Innovation Fund – we are leading circa £30 million of investment on seven sector-wide projects, **influencing over £90 million in total across 34 projects.**
- Ofwat’s 2023 Innovation Fund Annual Report confirms we have submitted the joint highest number of bids and are leading almost 25 per cent of the awarded funds – the highest allocation to a single water company.

3.7.12 Many of our 19 supporting partner projects are still in trialling or mobilisation phases; however, of our seven leading projects, we have substantially completed two projects already:

- Industrial Symbiosis – circular economy sector blueprint (Case study 17 - detailed below); and
- AI in sewers – an Open Dataset provided to five partners converting 190,000 CCTV images of sewer defects to 27,000 useable, categorised and approved images across 72 defect codes, fully compliant with UK standards. This is to be published and promoted widely with SPRING in September 2023.

Case study 17: Creating a sector blueprint for circular economy – Industrial Symbiosis

We care about the circular economy; keeping materials in useful life for longer makes environmental and economic sense. We led the Industrial Symbiosis bid in the first Ofwat competition with four established partners and one new entrant to test if barriers to circular economy principles could be overcome in the water sector. For this collaborative project, we set out to prove the new circular economy concepts within our capital programme.

We proposed 24,000 tonnes of material available for resource matching, 60 ‘hidden’ opportunities, converting 20 of these – realising over £55,000 financial saving and saving 200 tonnes of carbon.

We are working hard to make this successful and have not stopped since the end of the Ofwat funded project. We have delivered even more savings, and are on target to deliver a further £100,000 saving and 500 tonnes carbon by the end of AMP7. We have shared our results with all UK water companies as we believe this has wide reaching implications for reducing AMP8 costs and carbon. In selecting our AMP8 supply chain partners, we have made circular economy opportunities easier to realise by including specific reference to symbiosis in our contracts. Any successful supplier will have to demonstrate their track record and commitment.

Case study 18 – Connecting customers - Catchment Systems Thinking Co-operative (CaSTCo)

Background

The water environment is facing growing pressures from pollution, weather extremes exacerbated by climate change, population growth and ageing assets. These challenges are interconnected and addressing them requires us to work in new ways, to think of assets and the water catchments they operate in as integrated systems, and to leverage the power of collective action to deliver more resilience in those catchment systems. Further, we depend on reliable data that can tell us how catchment systems are performing, if we are to understand the impact of these growing pressures on river health.

The ability to monitor the environment in a more integrated way, to easily share large amounts of information, and combine observations from different sources, can provide greater information and insights into the state of our rivers and our understanding of where to prioritise appropriate responses and reduce risk, to make our rivers stronger, greener and healthier for everyone.

In responses, we formed a strategic partnership with the Rivers Trust to create long-term collaboration and mutual benefits, collaborating to solve the most pressing water challenges (too much, too little, too dirty), accelerating change and influencing system transformation, and deliver societal, environmental and financial benefits.

This collaboration includes a UUW senior leader working part-time for the Rivers Trust; this openness is welcome and bearing fruit. Together, we believe nature-based solutions, and the multiple benefits they can deliver, are going to be key in mitigating climate change, but we need evidence that shows their value and effectiveness.

Innovative solution

A key aspect of our partnership is to drive an improved and more integrated approach around data and evidence to build a better picture of the state of our rivers, and a shared understanding of what is causing impact, so that we can do something about it. We submitted a joint bid to the Ofwat innovation Fund and were successful to deliver a three-year project, the Catchment systems thinking Cooperative project (CaSTCo) to create a radical step change in how Citizen Science and integrated monitoring and data management can enhance the UK's rivers and catchments.

All 30 partners are collaborating to trial ideas and solutions, originally at eight sites, but we have expanded to 11 river catchments, which are working as demonstrators across the country. In the North West trial, the Mersey Rivers Trust, supported by the Ribble and Lune Rivers Trusts, are leading the way, engaging with us and dozens of other organisations, working with 130 Citizen Scientist volunteers and anglers, water sampling kits and measuring biodiversity metrics on fish captures.

The partnership project has also been keeping the community engaged through the 'Big River Watch' (a national programme of citizen engagement linked to river water quality), with a large event planned in September 2023.

Catchment systems thinking Cooperative

CaSTCo is a £7.1 million Ofwat innovation fund partnership led by UUW between the Rivers Trust, 12 water and sewerage companies, and academia and environmental charities, bringing together over 30 partners, aims to revolutionise the way crucial data about England and Wales' water catchments is gathered and shared, in particular on the health of the nation's rivers. The objective is to build the first standardised monitoring and data management framework which is:

- Independent and robust;
- Easily accessible and widely shared;
- Open and transparent; and,
- Collaborative in its approach.

This project aims to empower local communities to collaborate with decision makers, customers and other stakeholders around catchment monitoring and data sharing, to enable evidence-based catchment management decisions. The project will be developing a national framework of standardised 'kite-marked' methods, tools and training, which can allow this citizen-led approach to be adopted at scale.

Benefits to be achieved:

- **Over 15,000 hours of volunteering monitoring time per year;**
- **Over 1000km² of catchment area assessed per year (across ten catchments in England and Wales);**
- **A dynamic, cost-effective monitoring and data management framework that becomes widely adopted nationally as a single source of trusted information; and**
- **Creating the first list of proven techniques to overcome regulatory hurdles.**

This important information will be used by the water industry, authorities and communities to better understand the health of our rivers and deliver targeted actions. We are building this together through co-creation, testing and innovation application and we held the first in-person event at UUW offices in July 2023 with delegates from all catchments attending to create a cohesive, collaborative team, as shown in the Figure 13 below.

Figure 13: CastCo project teams working together at UUW Offices: July 2023



Case study 19: Accelerating adoption of nature-based solutions – a multi-sectorial collaboration

Building on the Rivers Trust partnership, we have also been successful in securing further funding through the Ofwat Innovation fund.

Background

While there are still uncertainties about emerging nature-based solution capability, regulatory and permitting hurdles, we are committed to pushing boundaries with ambitious plans to expand this in AMP8.

Our blend of conventional, proven technologies is coupled with the adoption of emerging novel greener solutions, and we see a trend of these nature-based solutions ideas becoming more market ready. Market intelligence on these is not centralised and there are still regulatory and financial barriers to adoption, which inspired us to lead the national scale project 'Mainstreaming Nature-Based Solutions', with key drivers and outcomes summarised in Figure 14 below.

We are the lead water company and project manager – looking to remove barriers to nature-based solutions to deliver greater resilience and multiple benefits, while attracting investment at scale. This £8.9 million programme brings together diverse technical expertise from regulators (including the EA and Ofwat) to policymakers, water sector, eNGOs, academics and finance sector.

A multi-sectorial collaboration led by UUW, between the Rivers Trust, other water and sewerage companies, as well as regulators, policymakers, finance sector, supply chain partners, infrastructure and local authority representatives, academia and environmental charities, aiming to:

- Enable adoption and transition of NBS into business-as-usual;
- Drive a multi-million pound investment pipeline;
- Create a common total value framework for assessing NBS;
- Accelerate change through policy and regulation;
- Standardise tools and processes to facilitate implementation at scale; and
- Provide a better deal for customers, society and the environment.



Figure 14: Mainstream NBS project – key drivers and desired outcomes

Recognising the high potential of these solutions, we have agreed to accelerate this complex project to be able to share results in time for influencing PR29 WINEP efforts.

Benefits to be achieved:

- **National cross-sectorial collaboration with over 20 multi-disciplinary partners;**
- **Real-life programmes across the country;**
- **Building on existing (global) successes;**
- **£8.9 million, of which £8.1 million secured through Ofwat Innovation Fund and £900,000 through partner and philanthropic investor contribution; and**
- **Five-year programme (2023–28) with recommendations in time for AMP8 business planning.**

Case study 20: Creating new material supply - graphene from wastewater – Levidian LOOP

The path from breakthrough discovery to transformational industry applications can be a long, circuitous one. Often, the first rush of possibility is followed by many years of development, refinement and experimentation. Even then, there are no guarantees, so close management of an innovation investment portfolio is vital to balancing both short and long-term needs.

Through our well-established horizon scanning and trend watching capability, we identified the potential of the circular economy and new materials. Leveraging our strong relationship with academic partnerships, scouting networks and supply chain partners, we reviewed a number of opportunities; by prioritising these, we now have a watching brief on many future potential innovation projects.

- There is potential to explore circular economy opportunities and our efforts are showing progress.
- An exciting project is exploring how **graphene can fast track** our decarbonisation journey.

Background and innovative solution

Nanotechnology is the manipulation and exploitation of materials and technology at an atomic and molecular scale (i.e. one billionth of a metre in scale). Graphene comprises just a single atomic layer of graphite, being a one-atom thick sheet of carbon atoms arranged in a honeycomb-like pattern and was the first two-dimensional material discovered. Graphene is one of the strongest materials known, with an ultimate tensile strength of 130GPa, which is 300 times stronger than steel. It is also flexible, transparent, highly conductive and seemingly impermeable to most gases and liquids. Its key properties include high electrical conductivity, high strength, low density, high light transparency, high flexibility, high sensitivity for chemical detection, high thermal conductivity and a high barrier material (impermeable if defect-free).

Graphene has the greatest potential of many new materials and is attractive to a number of markets, as it is considered to be the worlds thinnest, strongest and most electrically and thermally conductive material. It is a commercial product typically referenced in two broad material forms: a bulk material (either as a powder, solution or paste) or a continuous thin film.

These properties make graphene suitable for multiple applications across electronics, materials, optics, chemical and biosensors, heat and energy storage, and energy generation. As a result, there are many potential applications to utilise graphene within the water sector including new materials for heavy screens equipment, affordable membrane technology, fuel cells, components in new sensors and super-light storage tanks. Converting this potential to reality is not straightforward with many significant technical and funding hurdles to overcome.

Despite predictions of huge growth over the next decade, current markets for graphene-enhanced products are nascent in their maturity. Either products are still being developed in experimental or trial settings or, where commercial products do exist, they are typically priced far higher than more established alternatives. We expect this commercial picture to change dramatically as graphene production scales, and graphene-enhanced manufacturing processes become more commercialised.

We have partnered with Levidian, a start-up with a novel technology called LOOP, to decarbonise the sludge treatment process. Together, we submitted a proposal for leveraged funding through DESNZ funding route. Our proposal was successful and we have received a total of £5 million to support innovation in hydrogen BECCS (bioenergy with carbon capture and storage) technologies.

The Phase 1 LOOP project was commissioned to investigate the conversion of methane to graphene and hydrogen using a fully sustainable biogas feed source from a UUW sludge treatment and a summary is shown in Figure 15 below.

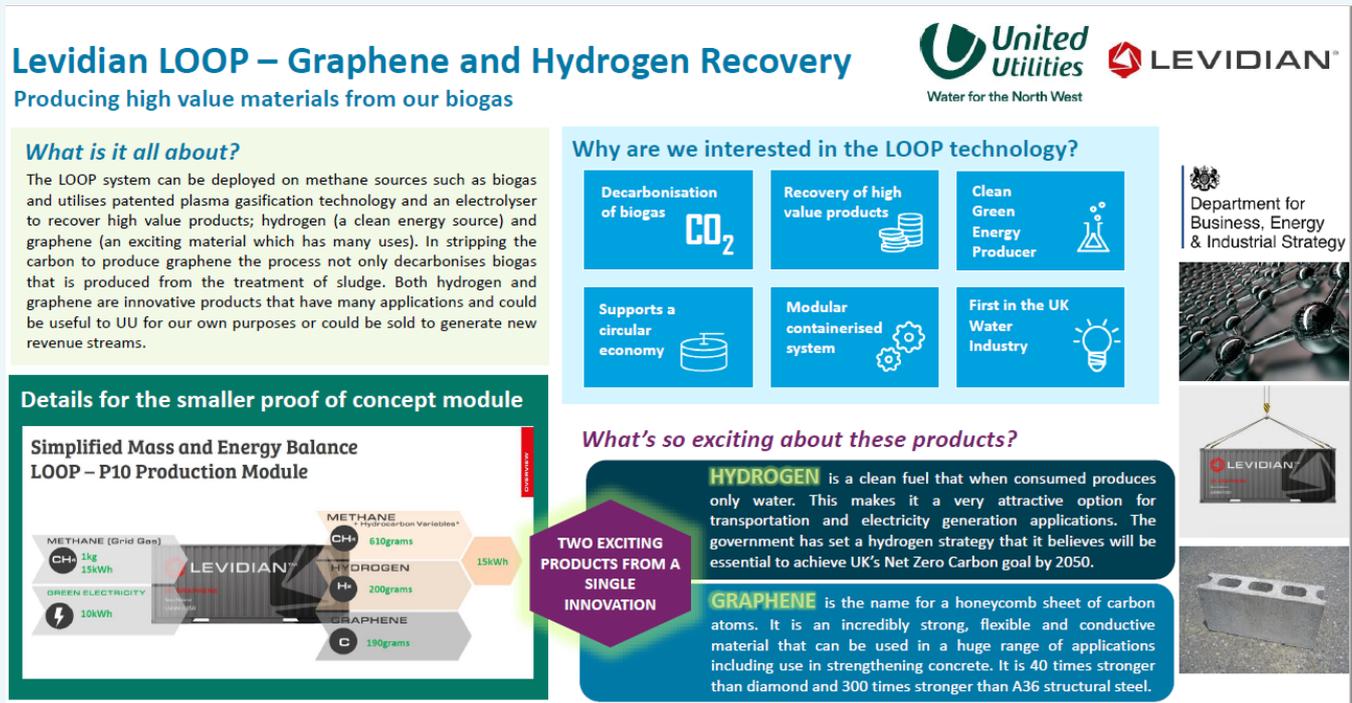
Results and next steps

We have demonstrated at laboratory scale the ability to use a fully sustainable feed substrate. This early testing allows us to move to larger scale and we have identified a suitable location for upscaling and testing of the upgraded LOOP technology. This will broaden our understanding of processing capabilities and the markets we

can enter with both graphene and hydrogen. Carbon lifecycle analysis has confirmed that LOOP can be expected to produce hydrogen with a carbon intensity below the UK Low Carbon standard.

We have achieved both carbon capture (graphene) and hydrogen outputs from biogas (65 per cent methane).

Figure 15: Graphic showing summary of Levidian Loop – graphene and hydrogen recovery



From the graphene produced from our processes, Levidian will target supply towards key markets: construction, energy storage, coatings and polymer composites. We have identified a number of commercial options available and are testing them during this trial – with an outcome guiding how UUW can use graphene within our own capital programmes as alternative materials and additives to conventional concrete, reducing the carbon content.

Using the LOOP system, over 95 per cent of the biogenic carbon in biogas is transformed into products that are not classed as direct greenhouse gases, principally hydrogen and graphene, both of which have strong emerging markets and routes for added value.

The North West is one of the two fast-tracked industrial clusters nationally developing hydrogen generation, storage and distribution networks. The UK water industry produces 490 million cubic metres of biogas each year, typically used to produce heat and power for on-site operational use or injecting this gas into the local gas distribution network. Our analysis gives us a view of the total potential market size for LOOP in UUW and the wider UK water sector, suggesting up to 50 LOOP units just for UUW, a further 500 in the UK water sector and thousands more for the global market.

This innovation is exciting and its potential is clear, but the affordability and certainty is not. We have much more testing to do and need to find alternative funding arrangements to enable us to scale this up in future AMPs. It may be suitable for future leveraged funding and we anticipate that other water companies will want to learn more at the right time. While we need to protect our intellectual property of this novel invention, we will share our results for the benefit of the sector as a whole.

One extra dimension to this project, like many of our innovation projects, is to increase social value – this forms one of our work streams on this exciting technology development. In this case, we have agreed to tackle economic inequality by offering paid internships to students from disadvantaged backgrounds, provide employability partners, and support green skills training and access for future contracts for local small to medium enterprises. We have started this work stream, identifying apprenticeship and intern opportunities to increase social mobility of young people.

Case study 21: Accelerating our green transport fleet using leveraged funding

Background

We know that ‘greening’ our transport fleet is a vital part in our net zero decarbonisation ambitions, but there are many obstacles to this:

- The availability and affordability of Electric Heavy Goods Vehicles (eHGV), which are more expensive and require a greater upfront investment and a longer payback;
- The lack of fast charging stations required for longer journeys and in employee’s homes;
- The lack of reliable real-life information regarding duty cycles, battery life, vehicle range and total cost of ownership; and
- The expensive disposal routes for existing petrol and diesel vehicles.

Innovative solution

We are excited to be part of an innovation project that will attempt to reduce these current blockers.

Our demonstration will be a full-scale nationwide one, working implementation of 140 electric 40-44T eHGV across several truck fleets operating on real business routes across a variety of use cases, including national long haul routes along core motorway networks, regional distribution across multiple sites and local multi-shift goods movements on site.

- **The 20 consortium partners include HGV fleet operators and hauliers like ourselves, automotive OEMs and vehicle leasing companies, landowners and electric charging infrastructure providers.**
- **Together, ‘Project Electric Freightway’ project has secured £63 million of external funding from their ‘Zero emission road freight battery electric truck demonstration’ fund.**

We will see benefits for UUW in this project being successful. It de-risks current blockers and provides an opportunity to piggyback on the advantageous purchasing power of our partners (including Amazon, Royal Mail Group and Sainsbury’s Supermarkets). Amazon’s involvement is unique – this project will allow access to their Amazon Freight Partnership programme, where Amazon will buy the truck and make them available to other operators, significantly lowering the barriers to purchasing.

For more efficiency and environmental benefit, there is potential to export our renewable generated energy to power the fleet. This seven-year project will be completed in 2030 and we will share the results publicly, with special focus on fellow water companies.

Our plans to continue collaboration and partnership in AMP8

- 3.7.13 Our AMP8 plan is to continue collaboration and partnerships where they align with Ofwat’s critical challenge statements and the sector’s innovation strategy (Water 2050). We will retain cross-industry and cross-sector collaboration, strategic research, academic and industrial partnerships as they complement our open innovation model.
- 3.7.14 We will aim to share information, expertise and latest innovations to our wider ecosystem. Our strong relationship with scouts and trend-watchers such as L Marks (global disruption of start-ups), Isle Utilities (water sector focus) and Frost & Sullivan (emerging trends) enables us to identify incremental and radical innovations at an early stage.
- 3.7.15 We will continue to access more innovative leveraged funds by working with our partners inside and outside the water sector. We intend to go further on leveraged funding and will bid to the AMP8 funds when opened for application, starting with providing feedback through consultations.

4. We have improved our innovation capability

4.1 Introduction

4.1.1 During AMP7, we have placed great emphasis on improving our approach to innovation management – that is, our collective company-wide capability to innovate.

4.1.2 This section explains our capability improvements so far and future plans in AMP8, including:

- How we have increased our capability around systems thinking;
- How we balance risk and reward through our innovation portfolio management;
- How we keep track of and capitalise on emerging technology trends;
- How we have matured our differentiating Innovation Lab accelerator programme with sector-leading results;
- How we have introduced a greater focus on exploiting the power of Open Data; and
- How we have invested in new testing facilities and created a new research centre at Worthington.

Our systems thinking capability is increasing

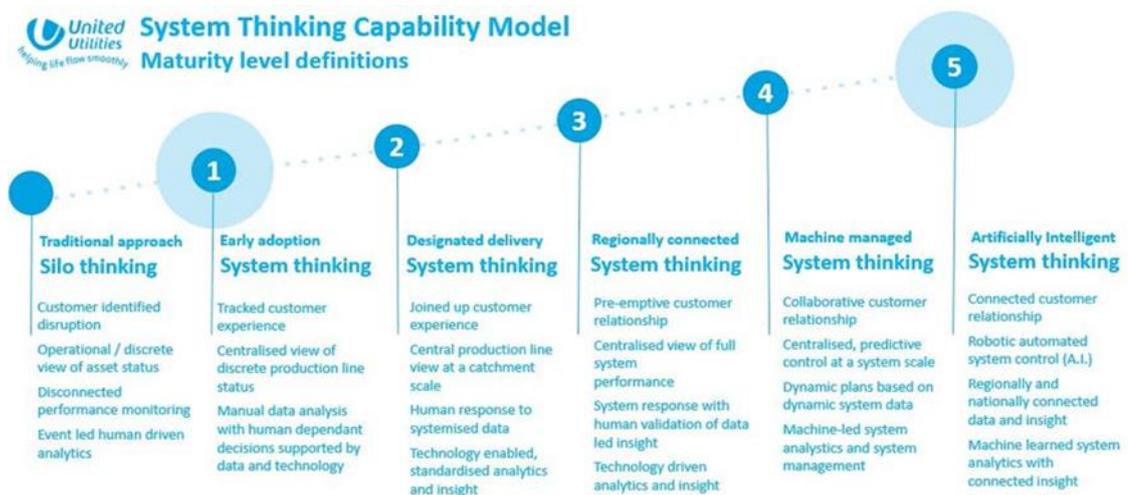
4.1.3 As described in section 2, whole system thinking is a rich source of innovation for us.

4.1.4 We have actively sought challenge from outside our organisation and worked with Accenture to independently assess our organisational capability to deliver value from systems thinking. This capability maturity model measures our progress in establishing the critical enablers from which we can accelerate value from innovations in areas such as dynamic network and dynamic catchment management.

4.1.5 Capability maturity is an internationally recognised practice and a set of structured levels that describe how well the behaviours, practices and processes of an organisation can reliably and sustainably produce required outcomes.

4.1.6 The maturity model, as demonstrated in the Figure 16 below, has five Levels, with the highest maturity (level 5) being a notional ideal state, and the lowest maturity (level 1) is when very few aspects of the businesses required outcomes are produced sustainably. The application of the maturity model framework to systems thinking is summarised in the following diagram, with the five levels of systems thinking described.

Figure 16: System thinking capability model



- 4.1.7 Over time, the highest maturity level must be re-assessed as more innovation developments and emerging trends shape the sector so we will adapt this maturity model in AMP8 where needed.
- 4.1.8 Accenture complete an annual assessment of UUW’s systems thinking maturity and publish a report that details the outcomes. This report output provides their independent view of our maturity level against eight capabilities, compares any change in maturity over time, and gives a rationale for the maturity scores, including highlighting any opportunities in less mature areas from which we develop action plans to improve our maturity to the desired level
- 4.1.9 During AMP7, Accenture have confirmed that we have increased our maturity against all eight capabilities, as shown in Figure 17 below:

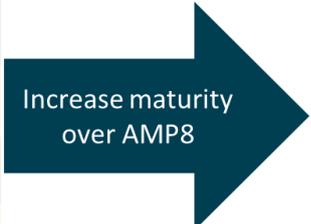
- From 2020 – seven capabilities assessed as level 1 and only one at level 2.
- To 2023 – five capabilities validated at level 2 and three, more advanced, at level 3.

4.1.10 The assessment concludes that:

“UUW has maintained an overall ‘level 2’ maturity in the capabilities required to embed systems thinking.”

Figure 17: Independent assurance of UUW systems thinking capability: March 2023

Capability	2020	2021	2022	2023
Operational Monitoring	Level 1	Level 1	Level 2	Level 2
Operational Control	Level 1	Level 1	Level 2	Level 2
Asset Lifecycle Management	Level 1	Level 2	Level 3	Level 3
Planning & Optimisation	Level 1	Level 1	Level 2	Level 2
Scheduling	Level 2	Level 2	Level 2	Level 3
Process Excellence	Level 1	Level 2	Level 2	Level 2
Data & Information Management	Level 1	Level 1	Level 2	Level 2
Customer Experience	Level 2	Level 2	Level 3	Level 3



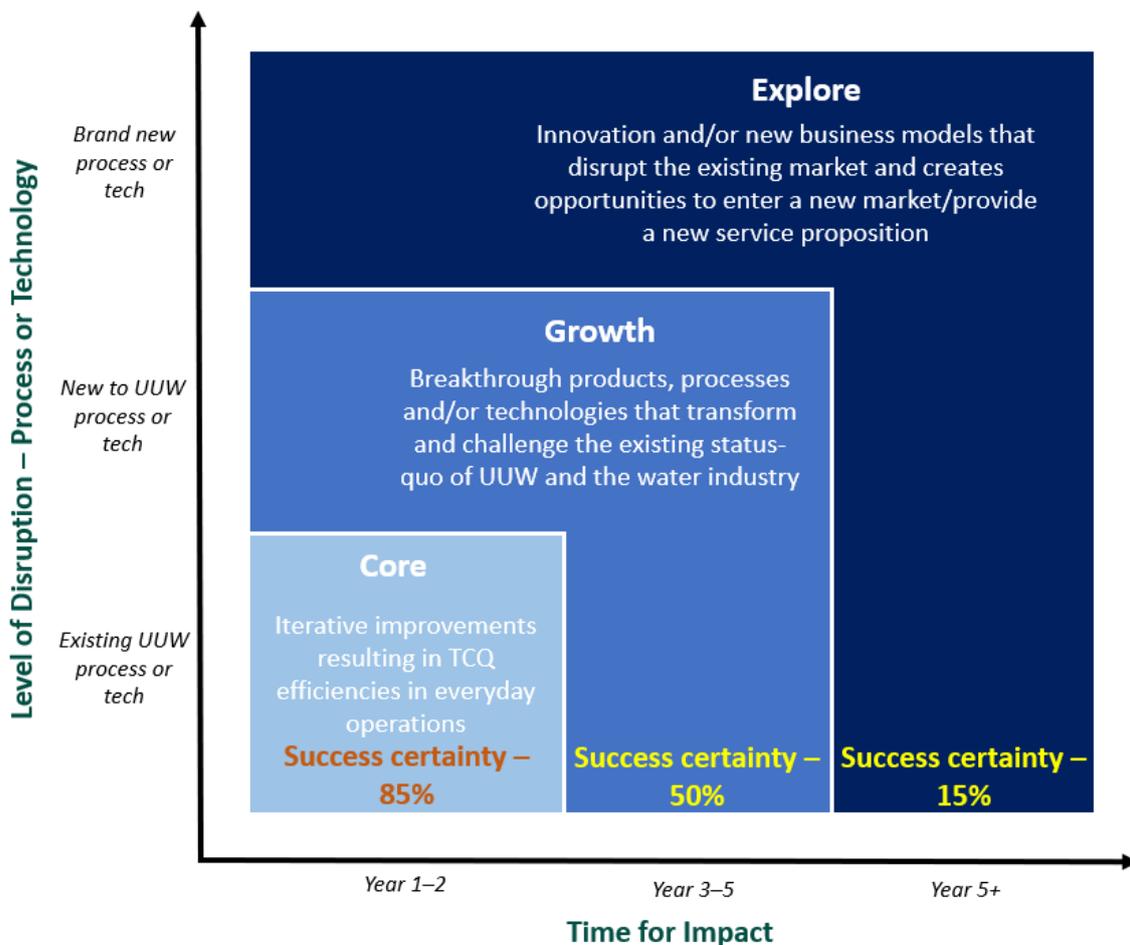
4.2 Innovation Portfolio Management

- 4.2.1 For an organisation with the scale, complexity and breadth of UUW, deciding where to focus and prioritise innovation investment is not straightforward. With our connections to global scouts (in and out of sector) and our employee suggestions, we have a high volume of ideas to co-ordinate. To address this challenge, and stimulate greater cross-functional collaboration, we have put capability road mapping at the heart of innovation management.
- 4.2.2 Capability roadmaps are a crucial part of our innovation approach in identifying and targeting the key areas of horizon scanning, emerging trends, market-ready ideas and in-house technologies and capabilities to check they can deliver our current and future business plans. This portfolio approach balances the need for short-term delivery and longer-term explorations by spreading the risks and providing consistent, quantifiable results for the business.
- 4.2.3 We now have in-house capability to provide a visual, systematic and repeatable way to spot areas of duplication and deficiency, and have an agile approach to guide how we deliver our current commitments and pursue new opportunities. This investment portfolio approach is vital in balancing

resources and risks. With careful management, we can prove concepts, assess where ideas can be adopted, prepare for adoption and then scale up the idea and integrate, allowing us to progress similar, competing ideas to be funded and explored so that we have choices to make when winners emerge.

- 4.2.4 Each idea is treated as a project with a sponsor, defined scope, dedicated resources, trial success criteria and potential routes for adoption. We have achieved success through learning from previous projects and bringing the adoption end-user teams into innovation projects at early stages to make sure ideas are developed with adoption in mind. All projects contribute to individual, team and company learning.
- 4.2.5 We have improved how we track and visualise our innovation portfolio with investment in dedicated idea-management software and internal resources. We can visualise and manage explorations, those in trial design, those being trialled, those ready for scale-up adoption and those we have adopted. We also learn from our abandoned projects, those that failed to prove concepts, cannot be scaled up, or are too early in their evolution and need reconsidering later.
- 4.2.6 We can display our portfolio using various metrics of time, disruption level, department, customer priority (our innovation themes) and by funding level and route. We can also show ideas with levels of potential and when they will be ready for adoption (i.e. which AMP cycle is being targeted) linked to the metrics. We regularly review and adjust our innovation roadmaps with leaders across the business, as well as with the emergence of new solution trends – all of which inform decisions about future research and development effort. Figure 18 below shows the approach we use.

Figure 18: UUW innovation portfolio management - model



4.2.7 Each theme has the individual innovation projects classified as a CORE, GROWTH or EXPLORE project, as shown in Table 4 below:

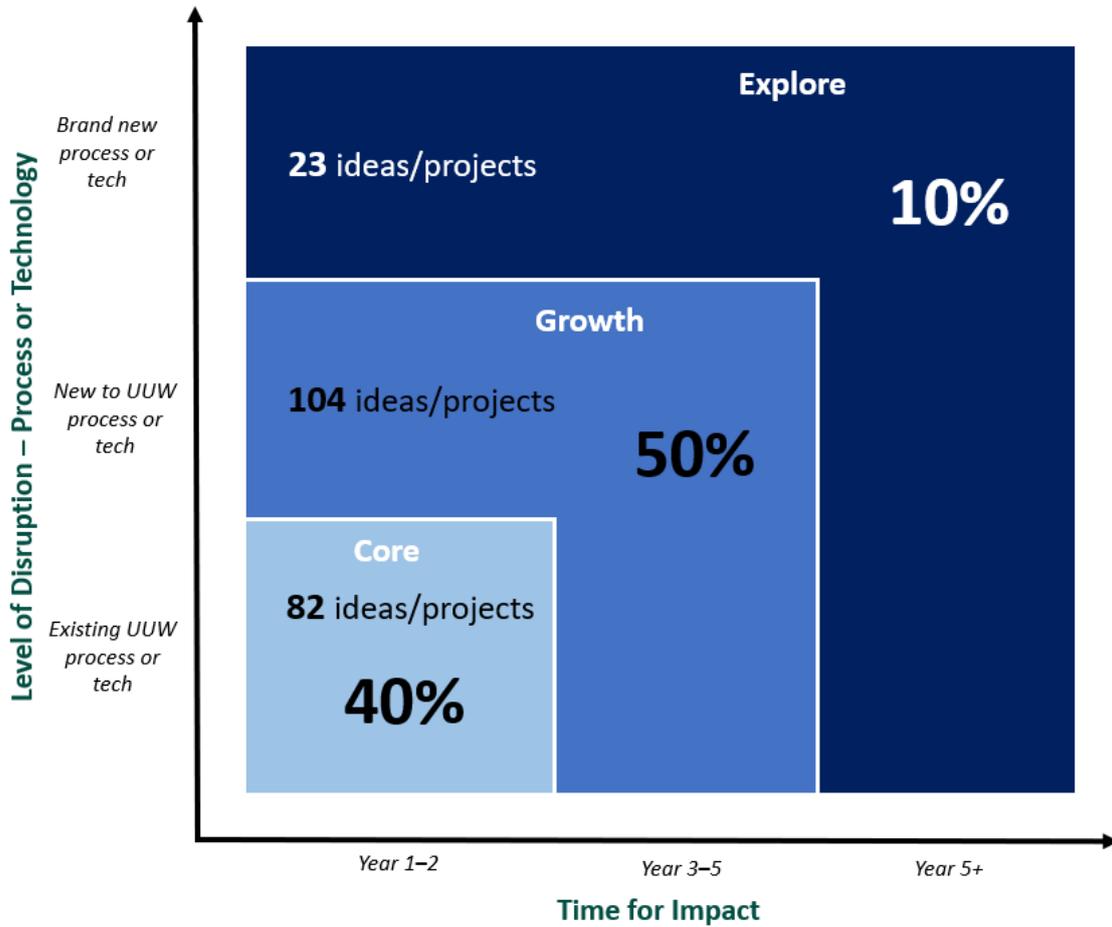
Table 4: Innovation Projects

Project classification	
Core horizon	<ul style="list-style-type: none"> Focuses on developing incremental innovations that result in efficiencies in our everyday operations and enable continuous process improvements. This is a low risk profile part of our portfolio, which has the highest certainty of delivery success with measurable efficiency. Typically, these are market-ready ideas where we can adopt best practices from others, or simply transfer knowledge from one area to another. This is one example of our core innovation horizon, which resulted in immediate incremental impact. Our increased water sector collaboration and knowledge sharing, and our in-house Operational Excellence efforts are examples here (see Section 5).
Growth horizon	<ul style="list-style-type: none"> Focuses on breakthrough innovations that can transform and challenges our status quo. This is a medium risk profile part of the portfolio, which has around a 50 per cent certainty of delivering success due to the potential disruption and ambiguity. Our recent mainstreaming nature-based solutions project and how we are using AI from sewer pipe condition assessment are some examples of innovations that arose from our growth horizon.
Explore horizon	<ul style="list-style-type: none"> These are very long-term explorations such as academic research and trend watching efforts to ensure that we have good visibility on innovations and/or new business models that disrupt the existing market and create opportunities to enter new market or provide a new service proposition. This is a high risk profile part of the portfolio, which has about a 15 per cent certainty of delivering success due to the futuristic nature of the idea and lack of maturity. Using drones for water quality sampling and converting excess carbon to graphene are some examples of ideas in this horizon. This drives strategic questions and where we increase or decrease innovation effort: <ul style="list-style-type: none"> How much resource does each theme receive? What is the current ratio of projects between disruption and time? Is that balanced? What is the optimum ratio needed to achieve the stated theme ambitions?

4.2.8 This portfolio approach has enabled us to focus our resources, balance risks and ensure our projects stay on track to deliver great value to the sector and our customers.

4.2.9 Figure 19 below shows the count of projects across our portfolio including percentage allocation, correct in August 2023.

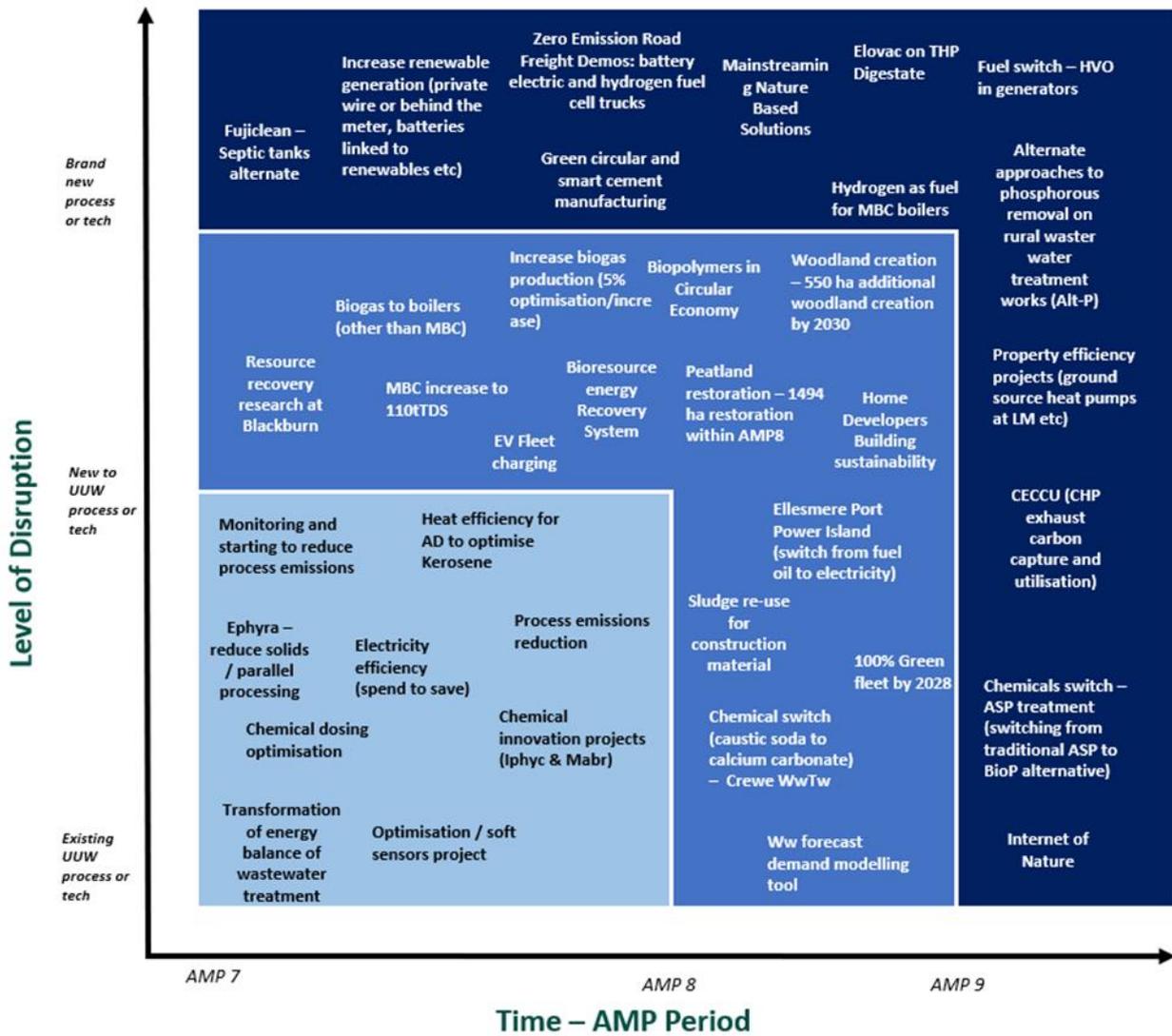
Figure 19: UUW innovation portfolio management – allocation – August 2023



Managing a carbon innovation portfolio

- 4.2.10 We know that decarbonising our operations will take time and significant investment, as many of today’s solutions are not fit for purpose. We were one of the first water companies to introduce Science-Based Targets for carbon, relying on co-ordinated innovation effort to find workable and affordable solutions. We use the roadmap tool but, this time, with a carbon lens.
- 4.2.11 Figure 20 below shows our portfolio at August 2023 for projects connected to reducing carbon.

Figure 20: UUW innovation portfolio management – carbon portfolio



4.2.12 We track the carbon footprints of relevant innovation projects accounting for all types of emissions from our own operations, to our bought in energy and the carbon emissions of our supply chain.

- Our core horizon efforts include a focus on energy efficiency, which leads to carbon reduction in Scope 1 typically, which we can transfer across all our operational processes throughout the water lifecycle. Our employee graduate teams have been active here over the years and many of their ideas are being shared and adopted widely within the company.
- Growth for carbon includes two transformational programmes – biopolymers in the circular economy and water efficient smart homes. Both projects focus on resource recovery, and our strong relationships with others has enabled us to start pilots for full cyclic circular economy approach.
- Within the EXPLORE horizon, we are actively exploring future trends within the net zero carbon drivers and have incorporated alternate carbon friendly methods to remove phosphorous during our wastewater treatment process. While we will deliver results in AMP8, our ‘Alternative approaches to phosphorus removal’ is aiming for AMP9 scale-up. This project involves trialling four new techniques to remove phosphorous using electrolysis and chemical alternates, instead of fossil fuel and increasingly scarce chemicals. These (as yet unproven) technologies need time to be proven and time to consider scale up. See case studies 11 and 12 for more information.

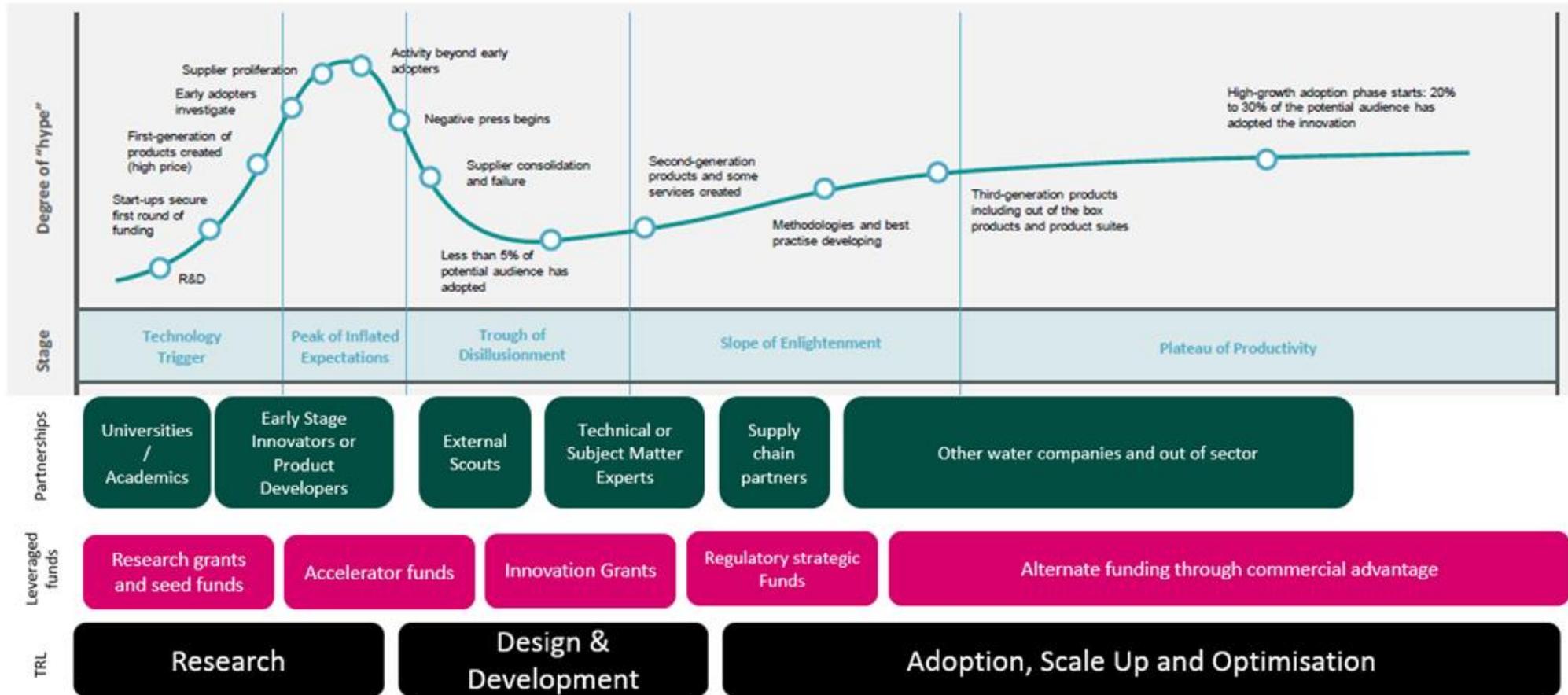
4.3 Trends – keeping track of fast-moving development in/out of sector

- 4.3.1 For PR19, we shared our thoughts on 11 digital trends as set out in our PR19 document S5009: Innovation Technology Trends case study. Since then, we have made significant progress embracing and advancing several innovation and technology trends. We applied an increased focus during AMP7, guided by partnerships with trend consultancies and idea scouts, both inside and outside the water sector. This helps us stay on top of emerging trends, test them in our innovation portfolio and adopt them at the right time. Our newly developed horizon scanning process has helped significantly.
- 4.3.2 As covered earlier in this section, **horizon scanning** is how we monitor emerging threats and opportunities presented by new innovations and technologies in and out of sector. This process involves engaging with our business functions to map current operations and future business against time to impact enablers and restrictors of strategic technologies. Examples include possible regulatory changes and macro factors such as political, environmental and societal.
- 4.3.3 We also consider technology – and our technology scanning team collates and distributes information on future technology trends, which, in turn, allows for better informed strategic decisions. We now have an enhanced ability to mitigate risk and exploit benefits in the future. We maintain a view of established and emerging technologies in and out of sector, and filter to those relevant with a longer-term view of trends and technologies that may affect our services.
- 4.3.4 Our information sources include reviewing the original PR19 trends and other known digital disruptors, the Government’s Industrial Strategy including Catapult Centres, academic literature, industry forums, research centre relationships, and discussions with partners, subject matter experts and academia. The scanning describes the opportunity, savings, value and target where UUW can leverage the early adopters.
- 4.3.5 We co-ordinate trends that we see opportunities in investing time and effort – that is, those that:
- Attract attention (trending stories);
 - Put existing scenarios under pressure, potentially disruptive to conventional wisdom;
 - Show a trajectory of evolving existing trends, technologies and services; and
 - Give insight from other sectors and give new applications for existing technology and ideas.
- 4.3.6 Combining horizon scanning with our innovation road mapping enables us to generate more exploration opportunities. We combine water sector problems with external trends and can test hypotheses. Our innovation portfolio has new trials to answer questions such as:
- How effective are drones to take water quality samples in areas that are hard to reach?
 - How might we unlock new sources of water supply by using mobile water treatment technologies?
 - How can we exploit technology that detects water on other planets to detect water leaks on earth?
 - How could the circular economy impact the water sector – can we create a sector blueprint?

Using trends to inform technology scenarios and adaptive plans

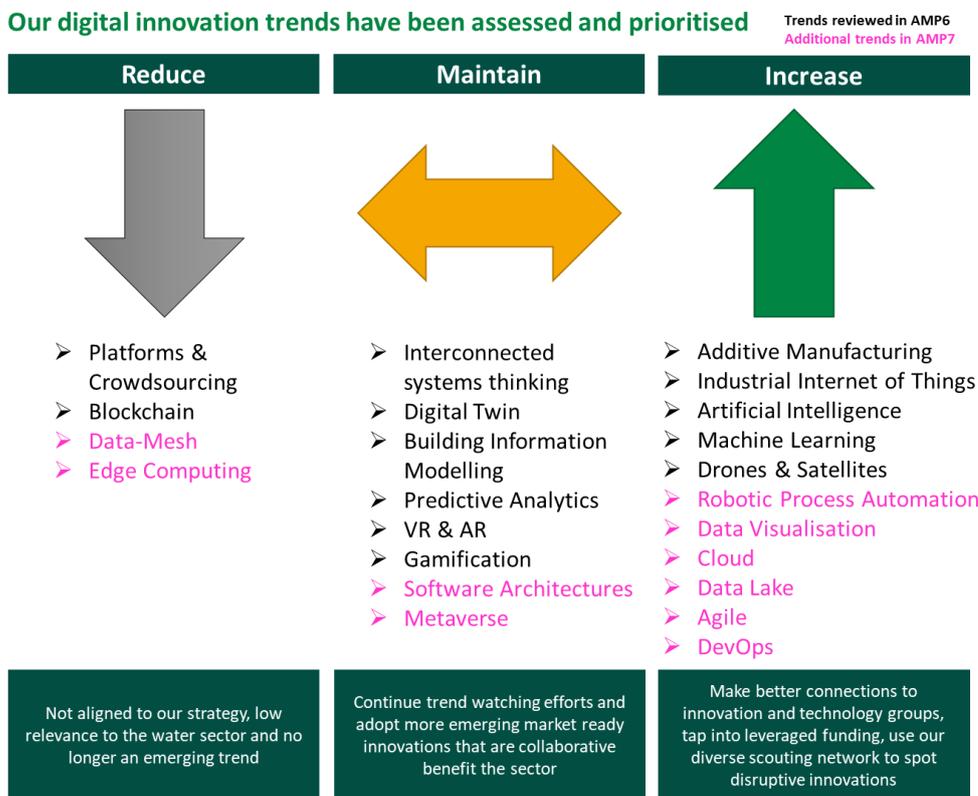
- 4.3.7 We use trend-watching models such as Gartner’s Innovation Hype Cycle – Figure 21 below - to determine the critical points across the lifecycle of a trend and how to leverage our supply chain and partners to get value from the trend. Strategic collaboration with universities, academia, research organisations, early stage innovators, external scouts and supply chain partners help us realise changes to emerging trends at any given point across the below cycle.

Figure 21: UUW trend-watching – assessing trend maturity and how we can fund the exploration



- 4.3.8 As seen in Figure 21 above, this provides a graphic representation of the maturity and adoption of innovation and applications, and how they are potentially relevant to solving real business problems and exploiting new opportunities. They enable us to develop a holistic view of how an emerging trend will evolve over time, providing insight to manage its deployment within the context of our specific business goals.
- 4.3.9 We listed 11 key focus trends for UUW in our S5009 document from PR19, and have made significant progress across each of these PR19 trends. We measure the importance of each trend to us and our level of knowledge. Compared to the start of AMP7, we have significantly improved our activity of exploration and our knowledge maturity.
- 4.3.10 Notable examples include:
 - Additive Manufacturing – Our ground-breaking work with Changemaker 3D accelerates our learning of using 3D printed materials to save time and reduce safety risk;
 - Gamification, Platforms and Crowdsourcing – Our use of Planview SPIGIT (crowdsourcing software adopted in AMP6), our voids app and CEO Challenge competitions are described in this document;
 - Predictive analysis, machine learning and AI – Many examples including DNM, VAPAR and FIDO Tech, helping our operational teams to focus on areas they can add most value; and
 - Drones and satellites – Not just for photographic/video tools but taking water quality samples and possible leak location.
- 4.3.11 Alongside the other technologies listed in the Ofwat’s Long-term delivery strategy and common reference scenarios document⁸, we have gathered intelligence on emerging technology trends and suitable focus in AMP8. For each, we know our priority based on our capability and relevance to the sector. Figure 22 below shows our decision for each trend, showing effort we will allocate.

Figure 22: Outcomes from our digital trend-watching review for AMP7 and AMP8



⁸ ofwat.gov.uk/wp-content/uploads/2021/11/PR24-and-beyond-Long-term-delivery-strategies-and-common-reference-scenarios.pdf

- 4.3.12 We plan to stay at least one AMP ahead of market-ready trends (as described in our approach to technology scenarios in *UUW12 – Long Term Delivery Strategy*). We are already investing in the AMP8 trends, with some being explored and some already matured. For example: our adoption of Robotic Process Automation (RPA) is focusing on taking manual, repetitive tasks from humans and running them on their behalf.
- 4.3.13 We are convinced that our wide adoption of RPA, which epitomises our approach to innovation, will be a contributing factor to a more efficient delivery of our services through AMP8. Embedding digital workers in teams has delivered time saving benefits and efficiencies from reduced rework, higher accuracy and consistency. Further information can be found here⁹.
- 4.3.14 In a controlled environment, we provided test data to the open market and have partnered with Blue Prism, a supplier specialising in RPA expert. They allowed us access to their technology so we could develop our own robotic processes to test concepts and identify associated benefits. We have an in-house development team, an internal RPA Centre of Excellence, using this technology to increase our innovation capability and co-ordinating our current and future efforts.

RPA – streamlining affordability processes

- 4.3.15 We introduced RPA into our customer services operations and our new RPA-enabled affordability processes are improving the efficiency of our operational teams by automating high volume, low complex tasks that were previously processed by our people.
- 4.3.16 A programme was agreed with our in-house RPA team to design and implement solutions that would enable our agents to focus more on value-add activities. As a result, we have automated all third-party deduction processes, and the process deals with the outcomes from our doorstep affordability visits.
- 4.3.17 The software robots, or digital workers, focus on non-intelligent tasks, freeing up colleagues to complete higher skilled tasks, including how to spot and correct exceptions to the model that robots cannot. Employee engagement is greatly increased when mundane tasks can be passed on to the digital workers, so they can focus on more interesting, value-adding tasks. In addition, by allowing our digital workers to take on tasks outside of working hours, preparing for the day ahead and performing the repetitive tasks, enriches the employee work experience.

The RPA solution has reduced processing time, manual errors and delivered a ten per cent increase in successful applications, resulting in a £150,000 per year saving.

- 4.3.18 With the success of the initial RPA pilots, the programme has been expanded across our income teams, as well as identifying several other opportunities to drive efficiencies for delivery across the remainder of AMP7 and into AMP8. It is another example of monitoring a digital trend, taking action and delivering value to customers.

4.4 Innovation Lab – a sector differentiator

- 4.4.1 Our Innovation Lab is unique to the UK water sector. It sets out some intentionally broad customer and environmental challenges, seeking the submissions of potential solutions globally and across all types of organisations. The process enables the selection of the most promising ideas and uniquely creates a collaborative approach where, over an initial 15-week sprint, we offer the innovators mentorship from our senior management, as well as live operational environments to learn and develop their ideas. We also provide access to a network of external mentors from diverse sectors and the opportunity of a long-term commercial relationship with us, continually optimising original ideas and developing new ones together.
- 4.4.2 We developed the process with our long-term Innovation Lab partner, L Marks, in 2017. At that time, there were very few new suppliers coming into the UK water sector and we recognised the need for fresh outside thinking. Traditional industries are notoriously hard to get a ‘foot in the door’, a challenge

⁹ unitedutilities.com/corporate/newsroom/latest-news/united-utilities-revolutionises-services-with-robots/

made harder to potential suppliers as we are a highly regulated company with complex procurement rules.

- 4.4.3 We recognise the possible power imbalance that can exist between large companies and smaller early-stage innovators. We create open and transparent channels of communication, alongside L Marks, acting as broker and coach to smaller companies, speaking up on their behalf to us as client.
- 4.4.4 This is where the UUW Innovation Lab¹⁰ was born and it seeks to solve the sector-wide innovation dilemma: how can a water company find, test and adopt new innovations at scale, when new entrants are stifled from barriers such as unknown demand and complex procurement regulations and we don't know all the solutions that exist to consider?
- 4.4.5 Without early client engagement and feedback, innovators run the expensive risk of building a product before they found out that they were wrong in their most central assumption: that someone was interested in that product in the first place. Our Innovation Lab significantly reduces this risk as evidenced by our results in attracting new entrants, and giving them and start-ups the confidence they need to co-create their product and service, and grow their business.
- 4.4.6 In return for access to our experience, technical feedback, and product/service endorsements, we gain first-mover advantage onto a range of new ideas before others and at the lowest price. This means customers benefit early and the supplier gets to refine and fine-tune their concepts before approaching other potential clients.
- 4.4.7 Our programme finds good ideas and those supplier teams worth continually inspiring to bring new ideas to our table. We designed an innovation development contract so that, together, we bring the smart suppliers even closer to our challenges. Their 'fresh eyes, can do' attitude means they continuously improve the original adopted idea. This long-term partnership is unique in that we routinely co-create new ideas on a regular basis.

How the Innovation Lab works

Category ID:

- 4.4.8 At the start of each Lab, we set diverse problems (categories) for innovators to respond to; this involves using our community cohort of innovation champions and directors to agree four or five problems that need innovation effort. We provide more detail on each problem to innovators so they can see the scale of the problem and possible opportunities to tailor their offer; new market entrants tell us this is particularly helpful as they do not understand the water sector challenges. We design the criteria to select winning suppliers and agree programme management responsibility, securing internal leadership support with problem sponsors, business leads and others.

Scouting and scoring:

- 4.4.9 This is where we open the Lab and invite applications. We use the strengths of organisations within the water sector such as British Water, global innovation scouts and water publications and social media. As we are often targeting new market entrants, we advertise and promote widely elsewhere in innovation zones such as Singapore, Australia, Israel, Canada and US, and to the innovation ecosystems such as Innovate UK, Federation of Small Businesses, Startacus and others. We reject suppliers who cannot meet our minimum trading conditions such as financial standing, attitude to Modern Slavery and access to relevant intellectual property. We use our community cohort to filter ideas, categorise them and provide the initial score and shortlist.

Pitch day:

- 4.4.10 A shortlist of up to 25 suppliers join us in person to 'pitch' to a wider audience of scorers and people interested in seeing the ideas of the future. All suppliers are given help to prepare and rehearse their pitch. The key output of this stage is six to eight suppliers who we believe we can help over an initial 15 weeks. We facilitate networking sessions with our directors for each supplier and wider scorers to refine

¹⁰ unitedutilities.com/corporate/about-us/innovation/innovation-lab/

our original scores. Over the first week, we scrutinise the applications of each shortlisted suppliers and choose the best paths for each. We often find good ideas from new market entrant suppliers but they are not ready for an intense 15-week sprint, so we offer feedback and follow-up sessions for those not taken forward in the process, but encourage them to stay in touch for refined feedback over time to develop their idea into something we can use. All suppliers get our feedback on their application, pitch and meeting performance.

On boarding:

- 4.4.11 It can be daunting for a supplier to be selected to work with a large company like ours; we take time to induct the supplier into the water sector and how our company operates alongside agreeing the initial scope of the innovation trial. We form core teams of UUW and supplier representatives, with a dedicated project manager to drive the team, agree timelines, report expectations, locations and funding. We also pay for any legal support that suppliers may need to take part.

Lab Live:

- 4.4.12 This is where the suppliers work with us over 15 weeks with frequent feedback and idea development, amending the trial scope as we go, as ideas develop. We trial their idea and explore how we can adopt, creating many opportunities to showcase their idea and how it is progressing. Throughout this process, we complete market validation, a rigorous assessment of the supplier's commercial viability, and continuous idea refinement to align with our specific business needs and those of the UK water sector. In addition to working with suppliers individually, we create a Lab community, bringing all suppliers together to celebrate our diversity, engage with mental health, safety and personal development discussions and offering access to our company training portfolio.

Agree relationship:

- 4.4.13 Not all ideas come to fruition and not every supplier wants to proceed. For those that do, we establish next steps, which might be more trialling to a new scope or progress to early roll out and adoption. We always have lessons gathering and sharing sessions for mutual improvement, and we promote and celebrate success.

Figure 23: UUW Innovation Lab process – in partnership with L Marks



4.4.14 Figure 23 above shows a summary of each stage of the Innovation Lab process.

Innovation Lab – setting the right challenges

4.4.15 Our Innovation Lab is a proven way for us to explore ideas in a de-risked approach; taking ideas from concept to market-ready in an accelerated timescale. We have created a reputation for simplicity, fast decision making and taking calculated risks to adopt new ideas.

4.4.16 Key to that is striking the balance between specifying a solution versus being open to any, and all, ideas. To help us, we set diverse and open problem challenges that are derived from customer research and emerging trends:

- Lab 1 – Connecting customers to the world of water, Being proactive for customers, Predicting asset condition, Helping our employees to be safe and well;
- Lab 2 – Getting the right information to the right people at the right time, Empowering colleagues, Improving customer service;
- Lab 3 – Systems thinking, Circular economy opportunities, Creating the future of the water sector;
- Lab 4 – Digitising our business, Being more energy efficient, Delivering net zero and increasing nature-based solutions; and

- Lab 5 – Digital networks, Low carbon construction, Reducing water demand, Better river quality.
- 4.4.17 In addition these challenges, we always include a wildcard category to encourage more ideas that don't fit neatly to one of the specific categories. We have found this to be a lucrative source of market intelligence, spotting where technology disruption is emerging around the world.
- 4.4.18 Our four Innovation Lab results:
- Advertised worldwide to 8,500 potential suppliers with a target of outside sector and fledgling businesses.
 - Reviewed 420 applications and shortlisted 96 supplier ideas for further review.
 - Selected 35 suppliers to trial, with two-thirds being new market entrants.
 - Proved 30 concepts via trialling including 12 world firsts such as AI to detect leaks and prioritise leak repair.
 - Adopted eight ideas delivering a collective £35 million saving for AMP7 and AMP8.
 - With five innovation development contracts for ongoing idea development.
 - Created 45 new jobs – 90 per cent based in the North West.
 - Our successful suppliers have secured more than £30 million of external investment – the financial stability they need meet our demand and offer their services globally.
- 4.4.19 We have been pleased to see supplier ideas being adopted in every year of the programme, and they have gone on to develop and disrupt the sector. Some examples are in the case study below.

Case study 22: Examples of Innovation Lab alumni successes – ideas and business development

Datatecnics from Lab 1 – developed a way to assess pipe condition by attaching sensors to the outside of pipes, creating a ‘Fitbit for pipes’. These on-pipe sensors spot pipe movement and condition using pioneering AI models for predicting pipe failure. This is a valuable tool for our asset management and planning, as we can assess pipe condition before any failure and defer capital investment. As well as securing equity investment, they have won a place on the prestigious Imagine H2O Accelerator programme following our endorsement. Since then, they have developed refinements to the AI model and helped us assess the health of our critical pipes.

FIDO Tech from Lab 2 – developed AI to detect water leaks and leak size in real-time with more than 92 per cent accuracy, and can predict the size of leak – a key aspect of leak repair work planning. They are fully integrated into our leakage operations with over a £2 million benefit to date. As their idea development partner, we have co-created eight new products, with five of these still in trial and aiming for adoption in AMP8. Since working with us through the Innovation Lab, they have grown their business significantly with 35 new jobs created, mostly in the North West, as well as developing a global presence. In a first for a water sector idea, they won the Private Enterprise Tech Innovator award in 2022.

VAPAR from Lab 2 – VAPAR are fully integrated in our operations, helping with analysis of CCTV video footage analysis in our wastewater network area, forecasted to save £8 million for AMP7 and AMP8 for our wastewater network business. In addition, they have analysed 20,000 images to help us prioritise the AMP8 capital programme, and will be optimising their solution with new data as a result of UUW completing the sector-wide project ‘AI in sewers’ from October 2023 onwards.

ChangeMaker 3D¹¹ from Lab 3 – completed the world-first 3D printed low carbon concrete distribution chamber, achieving a 25 per cent carbon reduction with 20 per cent cost saving and 55 per cent reduction in labour compared to traditional methods. It was printed in under four hours – a significant reduction in normal time frames.

Low carbon construction: 3D Concrete Printing with Changemaker 3D – a world first

Distribution chambers are used as part of our wastewater process. They're usually constructed on site by pouring concrete in situ which takes up to 6 days to produce. There are risks to colleagues as they have to climb into the chambers to be able to complete them.

There can be implications on our environment when making chambers as concrete is a carbon intensive material. Using sustainable methods of working is key to help support the world we live in today, and in the future.

Changemaker 3D (CM3D) was selected for the Sustainability Category in Innovation Lab 3 to explore how we can use low carbon material alternatives. This solution would support UU's vision of net carbon zero by 2030.

Who are Changemaker 3D?
Changemaker 3D are from the UK and were founded in 2017. Their team consists of 3D concrete printing designers, consultants and manufacturers – AND social value experts (helping people into work.) They use mobile robotics machinery to 3D print bespoke low carbon concrete items. They can innovate across the whole design and build process. They call it "Print-Infrastructure".
This 3d printed wastewater chamber makes us the first water company to showcase a low carbon "at scale" 3D printed design.

Benefits of using 3D concrete printing
Benefits (compared to traditional design):
55% Labour Reduction
50% Time Reduction
25% Carbon Reduction (000e kg): 5625 vs 4324
20% Cost Reduction (£LL362 vs £942)
Safety Enhancement
Social Value for UU Customers

Proving the Concept
The chamber was printed in 3.5 hours onsite in Netherlands and transported to our Weaverham WwTW site. This is a temporary location whilst we are testing the concept. This first print has been full of great lessons of how to improve the printing process and we now monitor the performance of the tank. Accelerating this exciting trend: With the Ofwat funded project – we can accelerate bringing this printing capabilities to the North West and collaborate with other sectors to de-risk and learn together.

Sustainability Benefits of the Technology:
Reduce waste by printing on demand
Print with less material
Rapid and flexible printing enables on-site
Quick drying mortar which does not use portland cement
Potential to reduce steel reinforcement within structures
Local supply chain that supports the reduction of the overall carbon footprint

Our project is a water sector world first.
Look out for our shortlisting for the 2023 Building Innovation Awards to be decided in October 2023

Now known as ‘Printrastructure’, they have gone on to develop this original idea further with backing from the Ofwat Innovation Fund. This partnership takes us away from water sector to include experience from the rail industry and learnings from academia, and converts these to actionable, operational demonstrations for the industry, and we will share a toolbox of options to realise a more sustainable future with infrastructure assets.

¹¹ 3D chamber printing video - youtube.com/watch?v=sFbTitZqmFl

We are creating a North West Construction Hub and training local people to use these new emerging digital tools, offering new apprenticeships and jobs for increased social value.

Altitude Thinking¹² from Lab 4 – developed remotely operated vehicles to help sample hard to reach water bodies and are on their way to full accreditation – a UK first. They have supported us on important projects such as ‘The Big Windermere project’, which connects local residents to local water quality measurement and information.

- Both FIDO Tech and Altitude Thinking are co-located with us.
- All Lab alumni companies have long-term commercial contracts with us and the opportunity to continue to develop innovative solutions with us.

Innovation Lab learning and next steps

- 4.4.20 The successes and learnings from each Lab are always applied to the next Lab. For example: in our early Lab programmes, we failed to reach agreement at trial stage for some suppliers and some proven concepts were not adopted because of contractual difficulties. These risks are mitigated in future Lab designs and, as a result, we are more ready for new ideas and all selected suppliers get to trial.
- 4.4.21 During AMP7, a number of similar Lab programmes have emerged – from the American Imagine H2O programme, Isle’s Italian Living Lab and the emergence of SPRING accelerators (which we have helped to co-design). Therefore, we will look to learn from these initiatives to assess whether our Lab programme is still fit for purpose and will be effective to deliver our stated ambitions.
- 4.4.22 Our current Innovation Lab 5 is now closed for applications. We have received 140 ideas, of which >75 per cent are new to us and >65 per cent are new to the global water sector; therefore, we are optimistic to find and adopt more ‘firsts’ for the sector. Our Lab 5 programme will reach conclusion in 2024.

¹² watermagazine.co.uk/2023/01/02/drone-lends-support-to-big-windermere-survey/

4.5 Improving our capability with Open Data

- 4.5.1 Open Data is defined as data that is available to everyone to access, use and share. We recognise that the data we hold is a valuable asset that can be put to wider use.
- 4.5.2 We have invested over AMP7 in improving our in-house capability on Open Data and partnerships with others. We know that a key part of any innovation work is ensuring internal support and insight to maintain relevance. We created an internal working group from key departments, experts in their own fields, supplemented with Open Data expertise. Chaired by our Head of Data and Analytics, a key objective of the group is to develop processes and ways of working to support the identification, sharing and maintenance of Open Data sets and to identify, prioritise and deliver a programme of Open Data release.
- 4.5.3 Our new capability has made huge strides to create our Open Data vision, develop our strategy and progress our delivery plan; all developed in conjunction with the experts, Open Data Institute. Our Open Data strategy is endorsed by our executive team and will be published by December 2023.
- 4.5.4 We welcomed Ofwat's June 2023 review of Open Data capability in water companies, and feel this is a fair reflection of our Open Data maturity at the time of the assessment. Our original Open Data delivery programme has been amended to address the improvement areas identified.

Working with others to create our Open Data vision and improve in-house capability

- 4.5.5 STREAM is a collaboration of water companies and partners with a vision to unlock the potential of water data to benefit customers, society and the environment through open and shared data. We are an active partner in the group, using these new connections to collect and test learning for our own vision, strategy and delivery programme.
- 4.5.6 The Open Data Institute are recognised experts and their mission is to work with companies and governments to build an open, trustworthy data ecosystem. We have commissioned them to work with us to guide our vision, strategy and delivery programme. Our collaborative work is publicised and has resulted in:
- **Leadership:** Engagement with senior leadership at an executive level through a facilitated workshop to set the strategic direction for the role of Open Data and connection to support delivery of our organisational objectives; a new vision, strategy and delivery plans have been approved alongside risk-based approaches to the challenges and concerns of Open Data. Support to embed an Open Data culture.
 - **Benchmarking:** A facilitated Open Data maturity assessment to improve understanding of our readiness for taking a more open approach to data and acting as advisers and 'critical friends' to challenge us to go further.
 - **Potential:** Improved understanding of the needs of current and potential users of Open Data through an external stakeholder workshop and a follow-up survey to help inform priority actions, and support the development of use cases.
- 4.5.7 Our AMP7 capability improvement has seen us:
- Plan investment in the human and digital infrastructure needed to develop our Open Data vision;
 - Publish our first Open Dataset under Open Data license (with Natural England);
 - Create a prioritised delivery plan to publish more data in candidate areas such as regulator-defined reports (e.g. Annual Performance Reporting), household consumption, water quality, live CSO activations and detailed carbon emissions to encourage innovation and collaboration;
 - Run our first hackathons with our supply chain to test Open Data capability and reveal new insights; and
 - Started two sector-leading innovation projects on Open Data:

- AI in sewers – see case study 3 for more details; and
- CaSTCo – see case study 18 for more details.

Our Open Data vision and strategy

- 4.5.8 We have set out our vision to become a data-driven and Open Data Company. That means using Open Data and publishing it with a purpose, led by what our stakeholders and customers need. We know that doing this will generate value for UUW, the wider water sector, customers and beyond, by continually improving capability. We see the value of Open Data as an agent to drive innovation and economic value by releasing a series of high-value datasets, and facilitating collaboration on what we share through the programme. We will also develop an Open Data culture with our colleagues and stakeholders, including commercial, research and public organisations, together with the public.
- 4.5.9 We will leverage data sharing via innovation challenges with external stakeholders and partners to unlock new insights and drive innovation. We want to use shared and Open Data to drive situational awareness of the water ecosystem and encourage data-driven decision making. Through implementation of our strategy, we have started to deliver a well-governed and efficient Open Data framework that enables innovators, both within and outside UUW, to help address key water sector challenges
- 4.5.10 Our first deliverables in the programme have included engagement with the Open Data Institute (ODI), mobilisation of an internal Open Data working group and publication of our first dataset under Open Data licence. We have continued our active partnership with the STREAM collaboration project and our Open Data strategy is compliant with the STREAM ambitions and objectives.
- 4.5.11 The work for the Open Data Institute delivered tangible capability improvement and our first Open Dataset published with an open licence. We delivered short and medium-term value awareness and understanding of Open Data, while progressing towards the longer-term goal of firmly establishing the culture and practices of Open Data within UUW. The work helped us understand current and potential Open Data user needs and our current Open Data maturity using their Open Data maturity model¹³.
- 4.5.12 Through the practical application and use of the ODI templates and tools, we were able to develop practical, agile processes to support the identification, governance and secure publication of Open Data. These processes enabled us to appropriately identify, navigate and manage the organisational challenges, as well as the legal, commercial and reputational risks, which can be associated to publishing Open Data.

Data infrastructure and protecting data integrity and sensitivity

- 4.5.13 We care about protecting data integrity and sensitivity. It is important that some data within the water sector remains closed and not shared outside of the organisation. This is to protect privacy, commercial interests or national security where relevant. However, even if the raw data itself remains closed, aggregated or anonymised versions of it can potentially still be shared or made open, and our Open Data strategy caters for that.
- 4.5.14 Further, we ensure that data is fully scrutinised before publication. We use the Open Data Institute's risk assessment process, which is proving very useful as it is structured and surfaces detailed discussions between the data owners and subject matter experts, mandating investigation of the potential implications of openly releasing data. This process ensures we consider security, legal and regulatory compliance, as well as the value of the data to our communities, wider society and the environment.
- 4.5.15 Prior to releasing any Open Data on any external platform:
- Each dataset will be risk assessed, which involves the data owners and appropriate internal stakeholders. Any risks identified must be satisfactorily mitigated and the mitigation documented.

¹³ theodi.org/article/open-data-maturity-model-2/

The risk assessment is based on a template developed by the Open Data Institute and was utilised prior to the release of our first data set, Bowland Peat Depth;

- Metadata is identified and published to clearly explain the lineage, quality and meaning of the data items;
- An Open Data license such as those provided by Creative Commons is used and clearly displayed with the data;
- Approval will be gained from a relevant subset of our executive team; and
- We have a number of data sets we have risk assessed using the risk assessment process and these will be considered for release in the future.

4.5.16 Data licensing: Sharing Open Data requires the application of a suitable license. A range of open source licenses are available, including those developed by the Creative Commons organisation. We have worked with the working group to establish the most appropriate open licence to use when publishing our initial and future candidate datasets.

4.5.17 Data platform: The choice of a data platform for Open Data sharing will be dependent on the use case under consideration. In the longer term, the company's analytics and visualisation platform is expected to be the interface with consumers and other Open Data resources. Our initial publication was on our website, and this is likely to be used again for specific types of Open Data.

- For early use cases, our intention is to use a cost effective readily available, purpose-built platform. We are currently investigating utilising Data Mill North, which is a collaborative, free to use website, originally set up by Leeds City Council to help facilitate Open Data publication.
- For our datasets from sector-collaboration projects, CastCo and AI for sewers, we will initially use our website or those of other water companies, migrating to STREAM when available.

Case study 23: Working with others using Open Data

Our first published dataset – working with Natural England

As part of the Bowland WINEP, our catchment team undertook an estate-wide moorland vegetation survey to assess the condition of the Site of Special Scientific Interest (SSSI).

Through ongoing collaboration with Natural England (NE), we wanted to support their ongoing project investigating and collecting information on all aspects of peat quality, quantity and connectivity across the uplands and lowlands of England. One of the deliverables is a Peat Map of England, which UUW has contributed to. Our first Open Data use case was released in December 2022 and provides surveyed peat depths across the Bowland catchment.

While the collection of the peat depth information was not integral to the WINEP vegetation survey, our catchment team felt the information would be useful to both the NE project and for us to more accurately assess our potential carbon resource. As a result, the survey, conducted over the last two winters, was extended to measure the peat depth on every hectare of Bowland moorland (approximately 6,000 data points) with our contribution welcomed by NE.

Publication of the dataset has proved very valuable to NE. The data was published on our UUW website under best practice Open Data guidelines¹⁴.

“I think it’s a great website and a great example of Open Data, and I’m hoping others will look at it and be inspired.”

Tom Hunt, Natural England, February 2023

Data sharing with Electricity North West

One of the most effective ways of identifying customers eligible for Priority Services is through sharing information with other organisations that maintain similar registers.

To enable learning and immediate collaboration between the water and energy sectors, and to act as a ‘proof of concept’ for the industry to follow, we completed a ground-breaking cross-sector pilot with Electricity North West (ENW), rapidly trialling and testing new approaches to data sharing.

Issues, such as customer consent, requires codes and aligned communications have all been addressed in the trial. Since its start in 2018, data sharing has become business-as-usual for both organisations and we have jointly shared over 100,000 pieces of customer vulnerability data, equating to over 15 per cent of UUW Priority Services registrations.

Being the first in the industry to transfer data in this way has enabled us to share our learnings, with most water companies now sharing data through their own regional agreements. We have shared our learning with the UK Regulators Network.

We continue to innovate. UUW and ENW have now developed a prototype online Priority Services Registration portal, allowing customers and third-party organisations to register those in need of Priority Services from water, electricity and gas suppliers in a single transaction. A pilot ran in 2022 with Citizens Advice Manchester, ultimately enabling customer information to be sent directly to water and energy network businesses at the time of a customer’s Priority Services registration.

Development data sharing to support vulnerable customers

We are working with the Cabinet Office, Defra, CCW and a small group of other water companies to clarify legislative changes, permitted under the Digital Economies Act, to encourage data sharing of vulnerable customers by government bodies.

Through partnerships with the Department of Work and Pensions and other holders of relevant data, we will use advanced data sharing arrangements and analytic capabilities to proactively identify vulnerable customer groups. We will enhance our existing customer vulnerability data model to overlay with both geographical and

¹⁴ unitedutilities.com/bowland-winep

demographic data. This will highlight areas and communities that contain the hardest to reach customers. Rural isolation, cultural factors and high deprivation can be barriers to engaging with vulnerable customers. We will target these groups, collaborating with trusted charities and organisations.

We are also seeking two-way sharing of vulnerable customer data with local councils and all six North West fire support services. This data sharing agreement will be built on the existing online registration portal, designed as a one-stop shop for Priority Services registrations for utilities. It will become a secure data sharing platform, accessible to all fire support services in the North West.

Our Open Data capability will improve again for AMP8

4.5.18 We will continue with our Open Data delivery programme, embedding guidance from Open Data in the water industry making the change¹⁵, and:

- Collaborating actively with the rest of the industry to create a shared Open Data roadmap;
- Accelerate our Open Dataset release and further develop our technical architecture and standards to incorporate best practice and ensure our publication adheres to FAIR (Findable, Accessible, Interoperable, Reusable) principles;
- Continue to develop and mature our Open Data culture and data literacy generally, through the engagement of external experts to design and deliver focused, best practice training and ensure that upskilling is available to all sections of the UW workforce;
- Continue and expand active industry-wide collaboration through membership of STREAM and creation and participation in Open Data innovation hackathons and challenges, to help identify and solve common challenges through knowledge sharing and development of common standards;
- Engage regularly with data consumers and stakeholders to both identify the datasets, which will deliver the most benefit and value, as well as establish a clear and consistent feedback loop within our publishing process to continuously improve the quality of the data we release; and
- Develop and mature our approach to data ethics. This is critical to ensuring a trustworthy data ecosystem. We will begin developing a standard approach to assessing the ethics of publishing, collecting and using data and advanced analytic such as AI.

4.5.19 In time for AMP8, we will have fully embedded our vision with increased in-house resources, published more datasets and harnessed the power of Open Data as another strand of our digital capability.

4.6 Trialling capacity and capability

4.6.1 We know that innovators can only progress their ideas by giving us confidence in the product/service capabilities, which is why we trial. Our AMP8 ambition is to continue to make it easy for innovators to work with us and have consistency of where their products are tested.

4.6.2 We have added new capacity in AMP7 to provide access to dedicated testing and research facilities to create better collaborative interactions with our dynamic, agile and non-traditional innovation ecosystem, allowing us to rigorously assess ideas before their integration into live networks.

Worthington Lakes Innovation Centre

4.6.3 We have a dedicated innovation building and our ambition is to use this space to fast-track innovation pilots in AMP8 and provide the necessary data-based evidence to stimulate new innovation and accelerate adoption, for both customers and the water industry.

4.6.4 The Centre exists to stimulate new ideas from collaboration and rigorous testing. It hosts accommodation for meetings, office work, workshop facilities, three connected reservoirs and pipe

¹⁵ ofwat.gov.uk/publication/open-data-in-the-water-industry-making-the-change/

testing rig capability. We have offered these facilities widely and they are well used, especially with our internal innovation community, our apprentice and graduate teams, Ofwat Fund teams such as CaSTCo and Mainstreaming Nature-Based Solutions, and Innovation Lab alumni such as Altitude Thinking and FIDO Tech. We are collaborating with SPRING to raise awareness of our facilities for the national testing map.

- 4.6.5 The pipe testing rig has several key components designed to facilitate comprehensive testing and analysis. It houses a series of connected pipes and valves, which allows us to simulate our live network. Two access chambers are incorporated into the design to facilitate easy access for maintenance and monitoring purposes, and a mock-up of a customer driveway and meter box area, specifically to test customer-side network issues – a growing area of AMP8 focus.

Other in-house trialling facilities

- 4.6.6 We make full use of dedicated innovation facilities and for ad-hoc testing in other locations that are strategically located in our geography.
- For non-potable water testing, we use a raw water facility near Chester that has helped us progress our academic research into discolouration with UKWIR and others.
 - We also have four trial zones for wastewater and bio resources testing:
 - Ellesmere Port and Preston network trial area, situated in close proximity to traders;
 - Our operational and large Davyhulme WWTW; and,
 - Our Cheshire Catchment pilot encompasses Weaverham WwTW, facilitating small-scale testing, 3D at-scale printing trials and evaluations of nature-based solutions including how we can influence farmers.

National Leakage Research and Test Centre

- 4.6.7 We are pleased to be a supporting partner to develop the National Leakage Research and Test Centre for the advancement of innovations to reduce leakage. It is complementary to our in-house pipe testing rig as it has additional capability and operates at a bigger national scale. An integral facet of the centre's mandate is the certification scheme, offering innovators a 'seal of approval' and providing us with the confidence we need to adopt without our own bespoke trialling. We are already on the project Steering Group and will promote this facility to new innovators.

5. We nurture an effective innovative culture

5.1 Introduction

- 5.1.1 We recognise that innovation frequently involves technology, systems, governance and business processes. However, it is more crucial that our colleagues know that innovation is expected, welcomed and valued. We have developed a strong innovation culture: how our people behave every day drives our innovation ambitions and outcomes.
- 5.1.2 At the start of AMP7, Ofwat stated *“United Utilities Water’s business plan is high quality and ambitious, with sufficient and convincing evidence to demonstrate that it has the right culture for innovation”*, awarding us the only ‘A’ rating in the sector.
- 5.1.3 During AMP7, we have built on what we have, which has strengthened our culture by continuing to stimulate, recognise and reward the innovation behaviours we expect, leading to adoption of more ideas across all areas of our business. Our innovation model means we look both externally and internally to source inspirational and adoptable ideas.
- 5.1.4 We encourage our employees and key suppliers to create and adopt new ideas.
- For employees, ‘being innovative’ has been one of our company values since 2010 and remains so for AMP8. This sets the expectation of how employees are expected to behave every day. We create the right environment for innovation to thrive from an employee’s first day, using innovation in our recruitment criteria and providing access to training and development opportunities. All employees are incentivised through annual appraisals and performance-related payments that can drive our succession planning and promotion opportunities.
 - For our supply chain, we set expectations for all suppliers to suggest and adopt innovative ideas. For our key suppliers, we measure their innovation performance and incentivise them through higher contractual spend, promotion to other clients, investors and through our supply chain awards.
- 5.1.5 We know that innovation behaviour is not always easy to display when many of our business processes are dealing with public health or regulatory, legal compliance or safety matters. We have set the right tone, backed by senior leader reinforcement, and our employees and supply chain continue to deliver. This has nurtured a strong innovation culture, which is demonstrated in this section.

5.2 Inspiring our employees

- 5.2.1 We inspire employees through the examples listed below:
- ‘Tell us’ – our company-wide way of enabling immediate feedback on employee suggestions;
 - Departmental awards for innovation – to celebrate local success;
 - Our internal innovation community – to review ideas and champion innovation in their department;
 - Provision of innovation training to employees – so they can have access to the best training including standardising operational processes and sharing best practice;
 - Innovation training programmes for apprentices and graduates – so our early careers employees can learn about innovation; and
 - Crowdsourcing ideas – Gamification of the innovation process to stimulate innovation and recognise the best employee behaviour.

‘Tell us’ – a company-wide approach to connecting problems to possible solutions

- 5.2.2 During AMP7, we have replicated the ‘Tell Me’ initiative and it is now flourishing in many departments. Leaders have encouraged their teams to give them feedback on problems that customers have encountered with our current business processes. This allows our colleagues to suggest possible local

improvements based on their interactions and daily work. Our employees see first-hand the inefficiencies and possible areas of improvement and can be the 'voice of the customer' to their senior leaders.

5.2.3 Our employees routinely suggest workarounds and fixes that prove beneficial. Even reporting the problems is valuable as we can see emerging trends on where our processes could be further improved. Leaders consider each suggestion and respond within 24 hours. In AMP7, we received and reviewed thousands of employee suggestions, many being duplicates, which gives us confidence that there is a real problem to fix.

5.2.4 Our leaders have recognised and rewarded great innovation behaviour; we acknowledge all suggested ideas with local line managers and directors saying a personal 'thanks'.

We have adopted more than 135 original ideas, recognising 55 employees for their high potential ideas with over £10,000 of rewards issued.

5.2.5 It outperforms a simple 'idea suggestion' box as there is a timely feedback loop and the process connects directly to decision makers who can change and influence process design.

Departmental awards – encourages recognition of innovation effort

5.2.6 Another approach we have found useful to connect employees to innovation challenges is departmental awards, celebratory events to recognise great individual and team behaviours and performance, from health, safety and wellbeing to cross-company working to local improvements. Larger departments have introduced innovation awards, specifically to show employees that innovation behaviour is desired and, as such, reward this. Employees are active in making suggestions or improvement, judging panels' vote, and all submissions are acknowledged and winners celebrated.

5.2.7 To date, eight business areas formally celebrate innovation departmental awards and continue to inspire employees by setting the right tone and rewarding great behaviour. For AMP8, we will introduce company-wide awards that will celebrate our environment and culture of innovation.

Our internal innovation community

5.2.8 We want innovation to be embedded in everything we do and in every department and, while we want all employees to 'be innovative', we know that many ideas are highly complex and require technical skills and review. That is why we have created a cohort of 55 subject matter experts – employees within technical disciplines such as water quality, engineering, asset management, carbon measurement and scientific services, who we have been trained in the innovation process and represent their departmental or technical area.

5.2.9 This group supports our innovation portfolio roadmaps, problem definition, idea review, trial design and become idea champions for proven ideas with high potential, paving the way for adoption and scale up. They are frequently brought together to learn about the innovation model and process, to see first-hand emerging trends and get insights into where new disruptions are occurring globally.

5.2.10 This cohort have had external assessments of their innovation 'personality'; that is, what type of innovator are they, ranging from relying more on idea-generation or a preference to run trials and support adoption. This is beneficial in spotting their strengths and areas of development and making them more effective on innovation projects.

5.2.11 This innovation cohort reviews the thousands of applications we receive each year including from our Innovation Lab programme. We will be looking to introduce more dedicated innovation effort especially with the rapid growth of leveraged fund capability and opportunity including the Ofwat Innovation Fund.

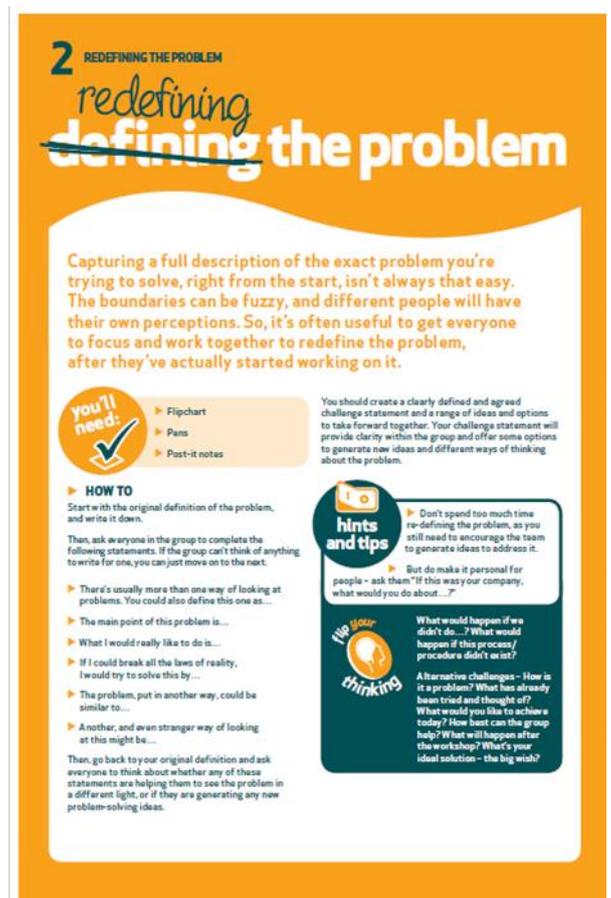
In addition to our Innovation team, we have full-time innovation-focused roles in departments such as commercial, engineering and capital programmes, water/waste treatment, bio resources and scientific services and smart networks.

Provision of innovation training to employees

- 5.2.12 We know that, when ideas are self-generated by local teams, the adoption rate is higher, as there is a better ‘connection’ to the solution and reduced inertia and friction. By encouraging and considering more ideas, we tap into more solutions and accumulate cross-company efficiency, reinforcing that innovation is encouraged, welcomed and valued.
- 5.2.13 We encourage all employees with access to a dedicated SharePoint with ‘self-serve’ innovation training material. Our innovation toolkit is well used by employees and has been effective in unearthing new problems and ideas (see the ‘Tell us’ section above). Figure 24 and Figure 25 below show example extracts for the toolkit.
- 5.2.14 We provide key talent groups each year with bespoke innovation training to raise their innovation behaviour and capability. Our innovation training programmes create safe environments to ‘try and fail’ with coaching on the innovation model, process, resilience and continuous improvement so that they bring sustained benefit to customers. We have found that this behaviour is infectious to colleagues, inspiring more innovation.
- 5.2.15 Over the last four years, we have rolled out existing training to more employee groups and developed new training, including more apprenticeships with innovation projects as part of their curriculum, showcases on emerging trends, knowledge sharing and supporting people managers in inspiring their teams to be more innovative.

Figure 24: Our innovation toolkit available on our all-employee SharePoint

Figure 25: Example of self-serve training for ‘Redefining the problem’ – one of 23 in our toolkit



Source: UUW internal communications

Case study 24: Using Operational Excellence to unlock hidden inefficiencies

We have invested in a new internal team to roll out Operational Excellence training to more than 300 managers, which includes problem-solving methods and ways to use standardisation and repeatable templates to improve the day-to-day running of their teams. We provide ongoing feedback to these managers through recognition and reward schemes.

Operational Excellence, summarised in Figure 26, and means:

- **Alignment of direction** – helping our leadership team to reconcile competing initiatives to ensure we focus on customer outcomes and financial objectives;
- **Targeting our efforts** – process excellence focuses on processes to make them more efficient and effective to deliver customer demands better, faster and at a lower cost. Process excellence is a key enabling element of the systems resilience initiative and capability model;
- **Improving performance** – ensuring the right people, at the right level, are taking action to drive performance. Continuous improvement (CI) provides teams with proven methods to unlock hidden inefficiencies of time, cost and quality of tools and methodology to improve the process; and
- **Leading the change** – ensuring behaviours and decision of leaders reinforce a culture of Operational Excellence and that change impacts are seamlessly.

Figure 26: Our approach to Operational Excellence



We are forecasting savings of £17 million in AMP8 from Operational Excellence.

Innovation programmes for apprentices

- 5.2.16 We provide our apprentices with access to training and learning opportunities; their curriculum includes classroom learning on problem solving and challenges on adopting new innovation. We combine this academic learning with practical experiences 'on the job', and one team has used the innovation training programme to make an improvement in environmental compliance – shown in the case study 25.

Case study 25: Apprentices learning through innovation

UUW impounds and abstracts water for drinking water supply purposes. To keep the watercourses downstream flowing, we need to discharge a minimum flow of water back in to the water course. This is known as a compensation flow. We have licences with the EA that detail what these flows need to be in order to maintain the natural ecology in the water body.

Driven by requirements from the EA, who had recently began to request 15-minute compensation flow data on any of our new or amended licences, we set a challenge to apprentices to understand how we can acquire 15-minute compensation flow data across all of our sites.

This was a difficult task for many reasons. Firstly, the majority of compensation flow sites are in remote parts of the North West, with poor phone signal and no access to a mains power supply. The team also had to understand how to integrate data into our servers in a secure manner, while dealing with challenges caused by the COVID-19 pandemic.

They narrowed their focus (a key aspect of innovation effort) to confirming what ideas and technology works best in different circumstances, with a focus on renewable energy sources where appropriate. They designed and ran trials covering a variety of technologies at many locations, exploring how they could be powered and then send their data back to our Integrated Control Centre (with communication being a major challenge to some remote locations).

In addition, the data for all technologies needed to be integrated into our systems, aligning with our digital requirements and systems thinking strategy. A dashboard was separately created to display this information, and this work has supported the regulatory reporting team to address the requirement for 15-minute compensation flow data. As a result, there is also a reduced likelihood of permit non-compliance, and the improved visibility of data is allowing us to proactively respond to breaches before they occur.

“Great opportunity to do something I would never get to do. I have been accountable for leading, delivering and embedding new initiatives into UUW, which feels great. It has helped bring me out my shell and my confidence has increased because of the programme.”

Steve, a year two apprentice

Innovation programme for graduates – the CEO challenge

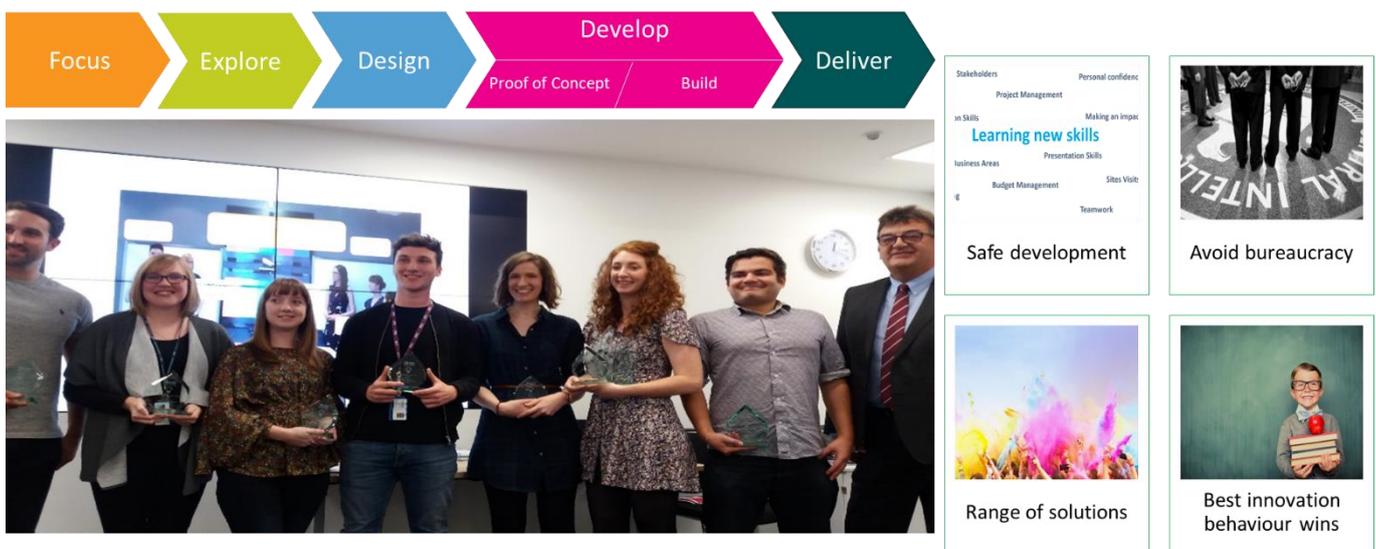
- 5.2.17 Our CEO challenge is an annual initiative that has been running for over a decade. First and second-year graduates from all disciplines are engaged in solving real business challenges to improve service and to lower cost. They follow our structured innovation process and are coached by the innovation team and senior leaders. The programme is sponsored by our CEO, with the challenges agreed and championed by our directors.
- 5.2.18 We believe that giving our graduates the opportunity to work on real business challenges, with the freedom to make decisions, make mistakes and change the way we do things, is very important for their development as future leaders. It accelerates the development of ideas into implemented solutions, taking the teams rapidly through our innovation process. Participants have to understand the problem, identify internal and external stakeholders, and trial and develop solutions that will be implemented should they be successful. They have access to senior leaders in the company for guidance, and funding to support experiments and trials. As well as delivering new innovations, the competition encourages learning – part of the assessment criteria to win the challenge is through demonstrating key innovation behaviours, as shown in the caption below.
- 5.2.19 The programme design has four main components:
- **A safe environment:** graduates are encouraged to push themselves, testing their limits in a way where mistakes are inevitable but tolerated with valuable learning from positive and constructive feedback.

- **Avoid bureaucracy:** we don't require graduates to conform to all our standard business processes for this innovation work; we allow them to go fast by allocating dedicated innovation budget and support resources so that decisions can be made without escalation and by the teams themselves.
- **Range of solutions:** graduates are directed to search out many ideas from a multitude of sources, inside and outside our company, sector and country, and to push for both incremental and radical suggestions that are shortlisted and tested using the innovation process.
- **Best innovation behaviour wins:** the competition winner is not always the team with the best ideas, nor the ones who adopt fastest or make most impact; rather, this programme is for personal development so teams are measured on innovation behaviour throughout the ten months. Figure 28 lists the five criteria.

5.2.20 Participants are given training and exposure to innovation techniques and the innovation process, which is critical to embedding innovative behaviours for their long-term career. Our graduate programme is structured so that they become people leaders quickly. They take the learning from the CEO Challenge process with them to the teams that they subsequently lead, creating an infectious innovation environment around them.

5.2.21 Each year, we announce winners against each of the five criteria, (Acting with speed and agility; Engaging stakeholders; Influencing and persuading; Maximising the opportunity for benefit; and Communicating with impact) with one overall winner, with feedback coming from the innovation team, the business sponsor and a 'Dragons Den' panel including the CEO.

Figure 27: CEO Challenge winning team and main components



The best performers *are accelerated* into leadership positions

CEO challenges in AMP7:

- Scale: we have supported 180 graduates with 50 challenges and 107 work streams.
- Development: 98 per cent of graduates say they have developed as a result of the programme, many describing their increased confidence and innovation learning.
- Promotion: Eight graduates excelled and have been accelerated into leadership positions.
- **Challenges:** We have set challenges around a diverse set of water sector challenges, all focused around customer priorities, mainly energy saving, carbon reduction, water efficiency in homes, water quality, flooding, leakage and customer experience.

- **Our most repeated challenge area is decarbonisation:** asking for fresh ideas on a range of problems and our graduates have inspired us to think further than conventional and market-ready solutions, creating new connections to potential partners and start-up innovators.
 - **Talent:** We know this is an excellent way to spot talent in their early careers, and target them for acceleration into more senior positions or transfer them from one department to another.
- 5.2.22 For the last three years, we have set a carbon/environmental challenge to keep priority focus; a range of diverse solutions have been adopted including:
- Carbon training – the teams developed a new all-employee training course to make stronger connections between everyday operations and carbon.
 - Electric vehicles – kick-starting the first purchase of 16 electric vehicles into our Green Fleet and £30,000 saving per year. This early venture gave us confidence to push on and deliver a more assertive exploration with our multi-sector, multi-partner leveraged fund EV bid (see Case study 21.)
- 5.2.23 Since the start of AMP7, the CEO challenge programme has evolved, matured and delivered significant benefits to UUW and the wider water industry. Over the years, we have continually improved the programme design to involve more departments, more employees and integrated with other innovation programmes. We are not complacent, but as our most mature talent programme, we have found a winning formula and intend to continue the CEO challenge during AMP8.
- 5.2.24 Some examples of graduate achievements, alongside quotations about their personal development, are provided in the following case studies.

Case study 26: CEO challenge: reducing taste, smell, and appearance contacts

One team was set the objective to reduce customer contacts regarding the taste, smell and appearance of our water. When the challenge was set, our performance commitment was to reduce the number of customer contacts due to taste and smell by 20 per cent.

After gathering feedback from customers, the team launched a new website¹⁶, providing better information to customers and allowing them to resolve queries independently. This website initially included information on the potential reasons for bad taste and smell; however, it has since been expanded to include information on the appearance of water.

The team separately identified a way to support, they developed and implemented a new methodology for lab bottle testing and a new chlorine-decay data-based predictive model, giving us valuable information on how chlorine varies across our network.

In addition, a chlorine dashboard was developed, allowing sites to monitor their chlorine levels and compare their performance to other sites in a user-friendly format. It is now fully adopted by UUW teams – a new best practice standard.

“The programme was vital in pushing me out my comfort zone. I knew I was safe to fail in the programme but that extra push really helped me to develop new skills and personal connections that I never would have in my normal placement. I still use all the networks now in my permanent role that I developed during the CEO challenge.”

John, a year three graduate

¹⁶ unitedutilities.com/help-and-support/your-water-supply/your-water/water-quality/

Case study 27: Carbon reduction in secondary wastewater treatment

Another team set out to improve energy efficiency in the secondary wastewater treatment processes; their focus was to reduce the cost of energy in the activated sludge process. This accounts for over 50 per cent of our wastewater energy costs.

Linking to our systems thinking approach, the team benchmarked 65 of our activated sludge plants (ASPs), measuring them on energy consumption and how efficient the sites are. Sites were measured against a number of performance metrics, which allowed us to gain new insights into our operational performance and then focus on:

- Best practice – Working with five high priority target sites revealed by the results of the benchmarking, the team developed training and ‘best practice’ guides to drive the correct site behaviours and support efficiency improvements on ASPs.
- Optimisation – The team undertook technology trials, monitoring and data analysis to understand and monitor the health of ASPs, making local improvements to optimise sites.
- Future capabilities – Development of a feasibility study to accelerate the adoption of our systems thinking approach, providing seven key recommendations to improve energy efficiency.

“For me, the CEO challenge gave me a safe environment to learn about innovation in a large company and to try new things. I still use the innovation learning in my new position, leading our wastewater network teams in the North. I am happy to be a sponsor of new innovation projects and encourage my team to get more involved with innovation locally.”

Samantha, a previous graduate who is now in a senior leadership role

Case study 28: Water efficiency: engaging with customers and communities reduce water demand

Across our catchment, West Cumbria has a higher than average per capita consumption (PCC) of water than other areas, with some negative attitudes to water efficiency and a risk of water scarcity in the area. In addition, three Outcome Delivery Incentives (PCC/Water in the home/CMeX) are challenging us even further to improve behaviour towards water efficiency. This was the challenge set to one team of graduates under the CEO challenge.

The team began by looking at what approaches others were taking to change behaviours. This included other water companies in the UK, other business sectors and the actions taken by countries that were facing water stress.

After looking at a variety of different campaigns and understanding how they worked, they then used behavioural psychology methods to design a place-based campaign in Cockermouth, West Cumbria. This campaign involved:

- Personal messaging – messages to individuals with a community focus;
- Nudge messaging – repeating the same simple messages again and again to drive behaviour;
- Challenges – incorporating a ‘challenge’ aspect to increase take up; and
- Feedback – having a feedback loop to reinforce desired behaviours, and showing residents their progress.

No previous water efficiency campaign had successfully combined all of these aspects before. The team worked with key members of the community including the local mayor, the Cumbria Community Foundation, focus groups and, most importantly, members of the public; the main purpose of this was to understand their concerns and aims, and gauge interest in the campaign.

For the remainder of the challenge, the team worked to implement their campaign through a variety of in-person events, social media campaigns, challenges and direct messages to customers.

Measuring the impact of their campaign was important. The team developed and deployed a tool to visualise PCC, which can be used to gain valuable insights on consumption in any community in our region.

This helped Cockermouth to reduce water demand by 7l per capita, per day.

The team continued to work with others after the challenge, designing a 12-month schedule of events and follow-up media to continue to drive the message of increasing water efficiency now part of our business-as-usual toolkit to reduce water demand.

“I have personally developed my influencing DNC communication skills. As a graduate in a technical programme, I wanted to try and improve some ‘soft’ skills, and the CEO challenge programme has helped me to do this. I have taken the chance to learn from our Communications teams to consider the audience when I want to get my point across. I’m looking forward to applying that in my next placement.”

Harish, a year two graduate

Case study 29: Asset health: better decision making from AI and automation

We believe that the health of our assets is important to the resilience of the company. Therefore, if we allow assets to age without sustaining condition and performance, it threatens our performance and increases risk of asset failure. It could also cause compliance issues and damage our reputation with customers and stakeholders.

Within our wastewater treatment business area, we spend approximately £35 million per year fixing, refurbishing or replacing failed assets. If we had more visibility of the condition of our assets, and performed proactive work to optimise their performance, we would avoid some of this cost. For this reason, we set a team challenge to understand how innovation can enable decision making to consistently consider asset health.

The team collaborated with over 120 colleagues within the company and a further 25 external partners including other water companies, regulatory bodies and universities to find ways to address issues. This led to four work streams:

- **Standardisation and training:** How can we standardise language to facilitate asset health discussions? Differing perceptions of what ‘asset health’ meant acted as a blocker to conversations. To help, the team developed and rolled out a communications package and an e-learning module across the business;
- **Sensors and data:** How can we gather more data about powered assets to make proactive interventions? The team designed a trial of SAM4 sensors from Samotics. Their sensors and machine learning capabilities can remotely predict mechanical and electrical failures up to six months in advance. In addition, Samotics successfully tested their capabilities using data held on small remote sensors monitoring power consumption on individual devices on sites already installed at Stockport WwTW. This created the opportunity for £20,000 annual energy saving from adjusting just one pump valve;
- **Monitoring:** How can we start to monitor the condition of critical civil assets? A trial to monitor the condition of civil assets in four WwTWs, using aeroplane mounted aerial imaging providing high resolution and thermographic imagery was completed. These sites were selected as they had a high volume of existing repair data to validate the accuracy of the aerial imagery; and
- **Data visualisation:** How can we provide centralised data to optimise investment decisions? The team designed and launched an easy-to-use asset health information dashboard to inform decision making. It was used for a two-month trial period – saving £55,000 – before being rolled out to production managers within the wastewater process teams.

The work of this graduate team – alongside other asset health improvements - will save £1 million in AMP8.

Their work is enabling asset health maintenance and investment to be more targeted and is helping to reduce operational expenditure. It is supporting us to optimise the condition and performance of our assets and prevent asset health failure.

“I think the CEO challenge has been a really valuable programme to be involved in as part of the graduate scheme. I've learnt a lot about the whole innovation process, having been stretched and challenged throughout, which has allowed me to develop lots of skills that I will be able to use in my career, and I've built a network of people from all different areas across the business, which I will be able to gain further knowledge from.”

Arron, a year two graduate

Crowdsourcing/gamification of the innovation process

- 5.2.25 We want more ideas from our employees and our supply chain; however, we need to do this in a co-ordinated way. We wanted to focus innovator attention on a key business challenge and create competitions to find and adopt the best ideas. In late AMP6, we selected Planview SPIGIT crowdsourcing software as our idea crowdsourcing platform, with the aim to connect more employees to our key challenges, encouraging participation to gather more ideas and more adoption, and we branded it as ‘The Idea Pool’.
- 5.2.26 To date, we have completed six challenges including one with our broader supply chain, with results summarised in the Figure 28.
- 5.2.27 Using the analytics capabilities of Planview SPIGIT, we tracked those teams and individuals who contributed the most to the process and we formally recognised and rewarded their contribution to encourage a lasting engagement in the programme.
- 5.2.28 The ideas from the six challenges led to us trialling 63 new ways of working, which resulted in us adopting 23 new ideas including:
 - **Helping customers:** better equipment for our frontline teams to get customers back on water supply faster and new pollution testing kits in our wastewater team vehicles;
 - **Employee safety:** daily vehicle checks and introduction of video conferencing;
 - **Better training:** Creation of self-help training videos, available for employees and customers; and
 - **Support employees:** Changing our performance appraisal documentation to make it easier to spot and reward great innovation behaviour.
- 5.2.29 The process is very simple and is shown in Figure 29 below. Challenges are launched through our internal social media, inviting colleagues to respond with ideas. As ideas are submitted, the community of colleagues collaborate and contribute to the ideas. They also vote on the ideas that have the most potential in their opinion, to help us to prioritise. An expert panel reviews the ideas that achieve predefined criteria and get through the first stage. The ideas that get through this review they are pushed back out to the community to vote again, using an engaging approach called ‘Pairwise’, a series of ‘this or that’ choices of all the ideas, forming a ranking of preference from the voters. The shortlisted winners are selected and, depending on the complexity or scale of the idea, they are trialled or implemented.
- 5.2.30 Planview SPIGIT was made available via the colleague’s desktop, laptop or mobile device, and is open to all employees, whether field or office based.

Figure 28: Results of our crowdsourcing in AMP7

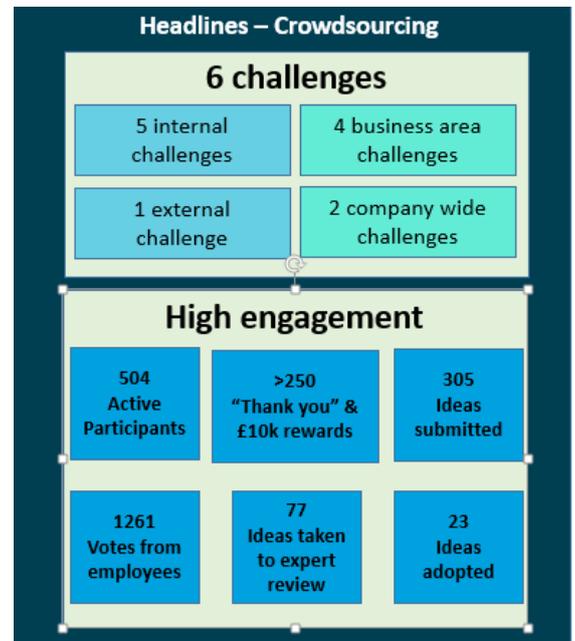
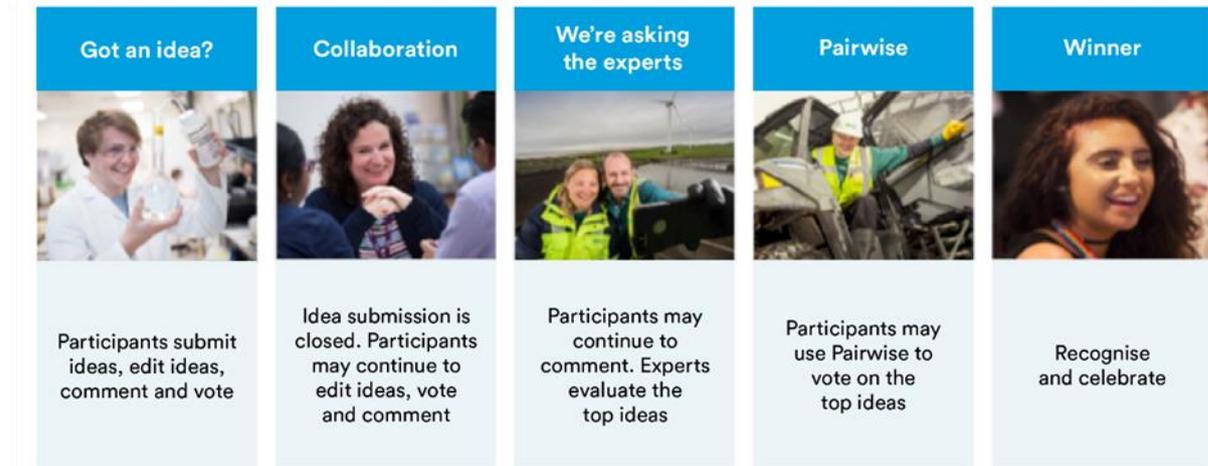


Figure 29: UUW idea pool crowdsourcing process



Our results show that over 200 employees engaged with the process; our senior leaders recognised all these employees and paid out £10,000 in financial rewards for categories such as 'highest voted idea'.

5.2.31 Our learning: We will reduce reliance on this tool. This approach worked but only temporarily; our employees found the process to be impersonal (compared to team problem solving led by their own team, for example) and the tracking aspects were off-putting to some. Some ideas are best suggested locally and privately and not in wide-audience forums. This feedback has shaped where we focus our efforts to source new ideas for AMP8:

- For radical and transformational ideas, we will use our global scouting and challenge-based Innovation Lab programme alongside collaborating externally across the sector;
- To scale up departmental awards and local line manager recognition;
- Seek out more opportunities to engage employees through innovations like our void app that uses frequent feedback and reward (see Section 4); and
- Reducing our reliance on this digital, platform-based approach, and instead, reinforcing the personal touch and strengthening the connection through the organisation hierarchy through our Operational Excellence programmes, innovation development programmes such as CEO challenge and the all-company 'Tell us' scheme.

5.3 Inspiring suppliers

5.3.1 We rely on our supply chain. For innovation, we have incentivised our suppliers and, like our employees, we have set ambition and expectations for how we want them to behave. We believe a good client is a role model for innovation and we have shared our innovation model, portfolio and training programme with key suppliers.

By pooling our knowledge like this, we have reduced total cost of new innovation trialling by more than £2 million.

Our supply chain routinely join forces with us on bid applications for leveraged funding.

5.3.2 We are able to strengthen our relationships with suppliers to better collaborate to deliver key environmental and social value. We have held several market engagement sessions with potential suppliers for AMP8, ensuring that innovation is hard-wired into their ways of working. We have shown them how we can help by using our innovation model and in-house capability to find, test and adopt more ideas with their help. We have also shared examples of the types of solutions we are trialling now, for potential AMP8 consideration.

Figure 30: Track record of innovating with suppliers



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5.3.3 Rewarding fresh ideas: During the tender stage when suppliers are bidding for our contracts, we encourage innovative ideas to deliver the stated specification we need and to suggest alternatives. We know that suppliers need time and reimbursement for innovative ideas and that only winning suppliers get to recover their costs.

Case study 30: Supply chain innovation - a new pipe cleaning idea

Occasionally, the supplier selected at the end of the tender process is not the supplier with the best idea. We copied a procurement strategy from outside our sector (Crossrail procurement) and for our Vyrnwy Modernisation capital project, we paid the supplier with the best idea. Even though they did not ultimately gain the contract, their creativity and innovative efforts were recognised and rewarded.

Our Vyrnwy project team and Innovation team gathered key members of the supply chain to stimulate them that we would be open to new ideas for our most pressing priority problem of large diameter pipe cleaning, which traditionally uses huge amounts of cleaning water and vehicle movements. While our existing approach gets the job done, we were looking for better ideas with lower cost and environment impact and looked to our supply chain for help.

Our supply chain partner, Avoxe, suggested a technique called ‘air pigging’, which is well known but it’s the first time it’s ever been used on water pipes this size (42” diameter and 2.6km in length). A ‘pig’ is the device that is pushed and pulled through a pipe to clean it. Figure 31 and Figure 32 below show the “before” and “after” situations.

By using this technique, we are able to clean the steel bitumen lined pipe to remove the iron and manganese deposits that have built over the 100 years or so since it was first installed. This is the first part of the Vyrnwy Aqueduct Modernisation Programme (VAMP), which is due for completion over the next six years.

Figure 31: Before



Figure 31 show the first pig (called George by the team after George Deacon, the engineer who designed the aqueduct) as it’s lowered into the aqueduct

Figure 32: After



Figure 32 is George looking very dirty covered in the iron and manganese picked up from the pipe

The process of air pigging forces the pig through the pipe using compressed air to move it. This is then repeated using pigs with different scouring covers, starting with a rough one, moving to a gentler one at the end – very similar to the scouring sponges used to wash the dishes.

The advantage of this technique is it’s quicker, can clean longer distances and, so far, looks to be more effective than traditional jetting, while using considerably less water.

Our collaborative trial has been a success with significant programme impacts, summarised in Figure 33:

- **Higher productivity – this approach is faster than conventional methods.**
- **Lower environmental and customer disruption – the site set up is significantly smaller in footprint, with a 91 per cent reduction in water used.**

We have de-risked this novel technique, and are considering how to apply it to other mains cleaning projects, taking our AMP7 learning into our AMP8 programme.

Figure 33: Benefits summary – new pigging



Case study 31: Supply chain innovation: customer and environmental benefits

We often need to work in busy streets, villages and towns. Traditionally, informing customers of the reason, nature of the work and likely duration is done with printed notices or labour-intensive stalls manned by our teams. This approach is static (in that messages cannot be changed easily) and means we only publish one message, which can become outdated if works change.

We wanted to promote more customer education as we carried out our work and felt this could be improved. We set an innovation challenge to our supply chain to find a better way. We asked: “How can you help us to notify, educate and engage with customers in a positive way, updating messages more frequently and with more impact?”

Learning from the mobile advertising world, one of our suppliers, Sapphire Utility Solutions, proposed a digital screen attached to the side of their operational vehicles, updated remotely and in real-time. Working together, we adapted this design, and it is now fitted to over 50 vehicles.

A digital design has reduced the time it takes for our messages to reach customers, allowing us to send more relevant messages more frequently, even emergency messages, tailoring each one to the specific local work rather than generic corporate messages. Our messaging is now provided instantaneously rather than taking several days using the conventional approach. Customers are very positive about this new innovation and it promotes us as forward thinking, digital water company.

This digital billboard is now fixed to 11 of Sapphire’s large vehicles and 25 smaller vans. As well as installing these boards onto Sapphire’s own fleet, other suppliers recognise the value of this innovation, and now rent 15 vehicles from Sapphire. For Sapphire, this increases revenue and reduces total cost of ownership from better fleet utilisation and reduced maintenance as they have standardised their fleet.

Sapphire were considering a new design of fleet for other types of work but the investment business case was not effective. Sapphire now has a better return on investment and has bought a new fleet incorporating these digital boards on smaller vehicles. Read more at: sus.co.uk/sapphire-lead-the-way-on-customer-engagement/

This new fleet has strong performance compared to the conventional solution:

- **£90,000 annual fuel saving and £2 million purchase cost saving.**
- **51 per cent carbon reduction – more than 200 tCO₂e.**
- **44 per cent reduction in particulate emissions.**

We are ready to innovate again for AMP8

Introduction

- 6.1.1 We are proud of our multi-AMP track record using innovation to deliver efficiencies, customer and environmental improvements. Section 2 describes the value from being innovative where we evidence and quantify significant return on investment.
- 6.1.2 Our innovation success over the last few years is not from a single, isolated team, but due to a systemic embedded approach:
- We are stimulated by new ideas from internal and external sources – and our strong links to academia and emerging technology trends (including start-ups in global innovation ecosystems);
 - All employees are encouraged to be innovative, with ‘being curious’ and ‘continually improving’ a part of our cultural DNA, starting with recruiting innovative employees and ongoing training, reward and recognition. We help employees with routes to identify problems and then suggest and champion ideas;
 - Our supply chain are stimulated to improve service and reduce cost and carbon in delivery of their products and services – strategic suppliers are incentivised to increase environmental and social value; and
 - We can evidence and quantify a strong return on investment from managing an innovation investment portfolio that balances risk, failure and reward – this gives us the confidence for AMP8 that we will continue to be a role model in the sector.
- 6.1.3 We will focus on our **AMP8 innovation focus areas**, creating an active and managed portfolio of new ideas and concepts that will be fully tested and considered for further adoption – our ‘AMP8 pilots’.
- 6.1.4 We have reviewed our innovation model and portfolio and believe it remains fit for purpose for AMP8. Customers can be assured that we will continue to innovate and realise value from our improved innovation capability. In time for AMP9, we will review our open innovation model and all of our innovation investments and operations, particularly with the emergence of STREAM and SPRING, and access to increased central leveraged funding.
- 6.1.5 This section shows some of our preparations for AMP8 including our approach to directing innovation effort, how we set our innovation focus areas, our AMP8 pilot innovation portfolio and more detail on our innovation model.

6.2 Our approach to directing AMP8 innovation effort

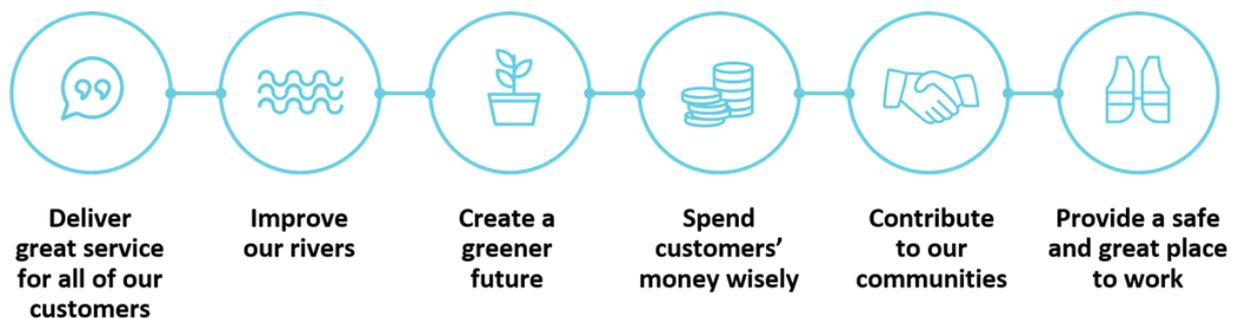
- 6.2.1 Our AMP8 innovation effort is directed by what customers tell us is important. They are aligned to Ofwat’s core innovation themes, the sector’s 2050 Water innovation strategy and other government and regulatory ambitions, and our ambition for a stronger, greener and healthier North West.
- 6.2.2 Our approach is to manage an investment portfolio of incremental and breakthrough disruptive innovations in these areas, which will deliver more value to customers and environment.
- 6.2.3 We govern our innovation portfolio to:
- ensure consistent alignment of strategic innovation across UUW;
 - use our innovation roadmaps to balance short and long-term needs (our Core, Growth and Explore model – see Section 4);
 - maximise external collaborations to support and advance the innovation agenda of the water sector; and
 - Secure available leveraged funding from a variety of sources.

- 6.2.4 We have an active innovation investment portfolio of new concepts and market-ready ideas for AMP8 adoption and we are excited about the potential of new ideas being trialled such as:
- AMP7-adopted ideas are being developed further – such as our sniffer dogs detecting environmental risks in wastewater networks and using drones for water quality sampling and asset health condition assessments.
 - New innovations being tested through our AMP8 pilot portfolio and the outputs for all Ofwat Innovation Fund projects.
- 6.2.5 In addition, we are optimistic of the prospect of finding even more ideas through our future Innovation Lab programmes and other global scouting – our ‘stretch’ based on our innovation strength and capability.

Our AMP8 innovation focus areas

- 6.2.6 Our innovation focus areas align with our company’s strategic priorities (see *Chapter 2 – Provide great water for a stronger, greener healthier North West*) and are set at a high level to ensure that a more diverse set of solutions from within, and outside, the water industry are considered; this will enable in-sector collaboration and bring in additional investment (a core part of the innovation model).
- 6.2.7 We intend to innovate across all our strategic priorities (shown in the Figure 34 below) and this will create the demand for more innovation, all of which needs co-ordinating through our innovation portfolio approach.

Figure 34: Innovation priorities for AMP8 – aligned to Company priorities



AMP8 pilots – ideas being trialled for possible AMP8 adoption

- 6.3.1 To kick-start AMP8, we have started and developed our AMP8 innovation portfolio linked to our innovation focus areas. We used our innovation process to ask customers what they valued most and combined this with our asset management and environmental plans. This gave us a long list of problem areas to explore; having collated and generated many ideas over the years, we were able to select from a wide pool of collected ideas.
- 6.3.2 The world of innovation is continuously evolving, with new ideas and technological advances being developed every day, within multiple industries and across the world, and we want to ensure we are stretching ourselves to find and deploy these to secure improvements to performance and efficiency. Therefore, on top of known innovations, we have included £80 million of ‘stretch’ efficiency in our plan to reflect new innovations that we have not yet identified.
- 6.3.3 Our strong track record gives us confidence that we will be able to find and deploy new opportunities to meet this stretch target. Our PR19 plan included £40 million of innovation stretch for AMP7, and we are on track to meeting this target with ideas that are in test or trial, giving us confidence that we will be able to meet our AMP8 target.

Our AMP8 innovation portfolio will contribute towards our ‘stretch’ efficiency.

AMP7 pilot projects to shape our AMP8 plan

6.3.4 During AMP7, we have implemented a programme of 24 pilot projects testing innovative approaches to key business challenges, such as protecting water resources, improving resilience, water efficiency and reducing consumption. Ultimately, the results of these pilots have helped inform our business plan and supported the implementation of innovative projects for AMP8. In delivering the pilots, we have worked with more than 20 partners ranging from the Department for Education, local authorities, charities and other water companies. We have invested £5.1 million and we leveraged an additional £900,000 of third-party funding from partners.

24 pilot projects
20 partners
UUW contribution: £5.1 million
Partner contribution: £0.9 million

6.3.5 We already have the first results:

- 1 stop – the benefits do not outweigh the cost. We tried a new approach to reduce flooding risk using property level separation, but this was unworkable. There may be an opportunity to revisit this idea for future leveraged funding if we can collaborate with others.
- 5 in trial – we are still trialling a number of ideas; we have not yet reached a conclusion and need more time. Ephyra is an example of an idea in trial – see case study 32.
- 18 explore further – these first pilots were to prove early concepts and this has been successful. We now need to consider all the costs to scale up to achieve adoption. Seven examples of concepts that are initially proven are described below.

Case study 32: AMP8 pilot - in trial: Ephyra®

Background

Wastewater treatment relies on significant electricity supply, generates process emissions and waste that needs disposal (treated sludge). Tighter environmental permits make this more costly and we saw an opportunity for innovation.

We had a strong relationship with Royal HaskoningDHV from our pioneering work introducing Nereda to the UK, leading to four installations and saving over £50 million in AMP6 and AMP7. They had other products in their portfolio and, together, we considered Ephyra as it had potential to support our net zero ambitions.

Innovative solution

The Ephyra technology is a plug flow (tanks in series) anaerobic digestion process using recirculation from the last tank to the first. The plug nature optimises biological efficiency, increasing biogas production and produces more outputs with reduced downstream methane emissions, dewatering and recycling costs. A unique feature is that it enables digestion at a very short sludge retention time of just six to eight days. These short retention times result in increased reactor capacity and a reduced footprint for new build digesters.

In comparison to conventional solutions, it increases throughput by up to 50 per cent, uses less energy and fewer chemicals, while producing more biogas, making it a highly sustainable process.

We led a bid in partnership with Royal HaskoningDHV and successfully secured 40 per cent of the funding through the Carbon Trust's Industrial Energy Efficiency Accelerator (IEEA) programme (Phase 3) leveraged fund. The aim of the £1.7 million project is to test retrofitting Ephyra at Stockport WwTW to see if it can produce operational efficiency and increased resilience for our bio resources assets.

Our trial is aiming to outperform conventional solutions:

- 20 per cent more biogas production – increasing our contribution to the circular economy.
- 11 per cent less sludge that would require dewatering and operational costs to recycle to farmland.
- Reduced process emissions and increased asset resilience.

We will deliver a UK-first full-scale installation and evaluation, sharing results with others.

We are aiming for £1.25 million AMP8 savings and more if we can scale up at other sites.

Explore further – proven concepts we are looking to scale up in AMP8

- 6.3.6 **Rivers: natural flood management with the National Trust** – this pilot aimed to test how far we can develop and work in partnership to address common issues in a geographical location. A strategic partnership was developed with the National Trust, targeting flooding and storm overflow activation reduction in the Quarry Bank Mill amenity area near Wilmslow. The pilot has created the opportunity to influence the approach to natural flood management across the National Trust estates in the North West. Further to developing a partnership, this pilot has also identified a natural flood management opportunity, which meets both organisations strategic drivers and is currently being progressed moving towards detailed design for AMP8.
- 6.3.7 **Greener: Smart water butts trial** – A primary school in Forton, Lancashire, is now part of the UK's biggest high-tech drainage community. The school and around 30 homes in the area received smart water butts and are taking part in a 12-month trial with the aim of reducing flooding in the area and stopping sewers from becoming overloaded during periods of heavy rainfall. UUW worked with the supplier to install the water butts across the village. Since being installed, early findings have shown that the smart water butts were up to 75 times as effective as a standard water butts in providing water attenuation. This will make a real difference in the village when it comes to flooding, and will help to increase capacity in our sewer network as well as deliver local environmental improvements.

- 6.3.8 **Service: mobile water treatment** – We instigated a market research scouting exercise to assess the feasibility of deploying a mobile treatment unit in response to either an operational reactive need or as part of a planned water sufficiency measure (for example: using previously unutilised reservoir or water storage not owned by UUW). Our global search revealed 14 potential technologies (some are not available for AMP8 and many do not have suitable Regulation 31 (DWI) approval and cannot be used), and we have prioritised three with the highest potential and are considering scale-up and adoption. We have gained valuable market intelligence about supplier capability. We forecast £5 million saving using proven mobile treatment technologies for AMP8.
- 6.3.9 **Community: integrated water management for schools** – aims to deliver integrated rainwater management solutions to a potential five schools. Working with a range of partners including local authorities, private organisations, environmental charities and the Department for Education, it set out to test the most appropriate fair funding mechanisms applicable to a large number of sites for delivering SuDS and water reuse solutions to schools, alongside educational engagement around rainwater management and water efficiency.

Case study 33: AMP8 pilot – explore further - Integrated water management for schools

Our SuDS for Schools programme is part of our Better Rivers; Better North West action plan, which will improve the health of our rivers. It supports our ambition to reduce the operation of storm overflows from sewers by 30 per cent by 2025, and improve 184km of waterways.

Christ Church Primary school in Walshaw, Bury, has had sustainable drainage solutions installed in its playgrounds to help harvest water and divert rainfall away from entering the sewer system.

Achieved through the introduction of four rain garden areas that are planted with water-friendly plants, 11 planters, a swale and a water butt. This relieves pressure on the sewer network and reduces the need for releases from storm overflows during times of heavy rainfall.

As well as reducing flooding or pollution risks by creating more space in sewers, we have made habitats for plants and wildlife to filter the surface water naturally, so if water does enter a watercourse, it is less polluted. We have provided education opportunities for the children on the value of water, flooding prevention and the increasing role of nature-based solutions to reduce climate change impacts.

“Our grounds have been greatly improved by the work completed by the SuDs team. Not only in reducing the amount of water collecting on the playground but also in the enhancement of our grassed areas through the numerous rain gardens. The children have loved taking on the responsibility to maintain the gardens and planters, and have enjoyed learning about the different plants growing within them.”

Mrs Sarah Howard, Head Teacher at Christ Church Primary school

We delivered this project with support from the Department for Education, Atkins Ltd and contractor Horticon Ltd and under consideration for wider AMP8 roll out.

We were pleased to be highly commended in the National SusDrain SuDS awards.

Community: utilities together

- 6.3.10 All utility companies, whether water, gas or electricity, are typically serving the same customers in their respective regions, which means they are serving the same customers in vulnerable circumstances.
- 6.3.11 We have partnered with Electricity North West (ENW), Cadent Gas, Northern Gas Networks and SP Energy Networks, and we all recognise that working together for the sake of customers will benefit the overall customer experience with us all. By sharing vulnerability support best practice between us, we have an opportunity to save time, money and resources in implementing customer support. In the North West, we have collectively shared an ambition to support customers and communities, often in extreme vulnerable situations.

6.3.12 One example of the benefits of utility companies working more collaboratively is the creation of a single home audit for specific vulnerable customers in our region. The ‘water and energy in the home’ pilot project has enabled us to offer customers a single home audit, covering both water efficiency and energy saving ideas. Free water and energy saving gadgets are installed at the time of the audit with associated cost savings for the customer. If a plumber is required because of leaks, this can also be arranged for a future date, again, free of charge.

Community: innovative place-based planning

6.3.13 We are delivering a number of place-based planning pilots, working with a wide range of partners, across our three strategic catchments: Upper Mersey, Eden and Wyre. These pilots aim to provide a holistic and integrated approach to planning for sustainable water services, which puts communities and the places they live and work at the centre of the approach. It ensures we consider and involve customers in the solution and supports preventative, cost effective responses by building resilient communities and targeted investment based on what works locally.

6.3.14 We will build on the pilots into AMP8 to further develop our place-based planning approach, working in partnership to progress this approach. By delivering rainwater management schemes such as SuDS, we will provide enhanced spaces of social, environmental and recreational value within the public realm for local businesses and communities. We aim to maximise the number of schemes we are able to deliver in partnership to achieve many multiple benefits that create less disruption, more benefit and wider outcomes for the North West. In addition, we will scale our work delivering SuDS in schools through our Integrated Water for Schools programme.

Case study 34: AMP8 pilot – explore further - Upper Mersey place-based planning pilot

The Upper Mersey catchment was selected in partnership as a priority area due to the number of challenges it faces with regards to population growth and the impacts of a changing climate.

The partnership are working in collaboration with other stakeholders who have influence over planning, development, and management of water within the catchment to develop a place-based strategy by piloting a place-based planning approach.

An initial workshop was attended by ten catchment stakeholders who agreed to pilot place-based planning within five sub-catchments of the Upper Mersey: River Tame, River Dean/Bollin, Micker Brook, Sinderland Brook and Poise Brook.

The aim of the sub-catchment pilots is to trial different approaches to partnership working with the aim of co-creating a long-term place-based strategy, which has a focus on the water environment and includes multiple benefits, including natural and social.

The pilots in these areas will test elements such as data sharing mechanisms, governance and benefits and funding identification. The pilots have a variety of organisations taking the lead to facilitate the approach and capture lessons learnt.

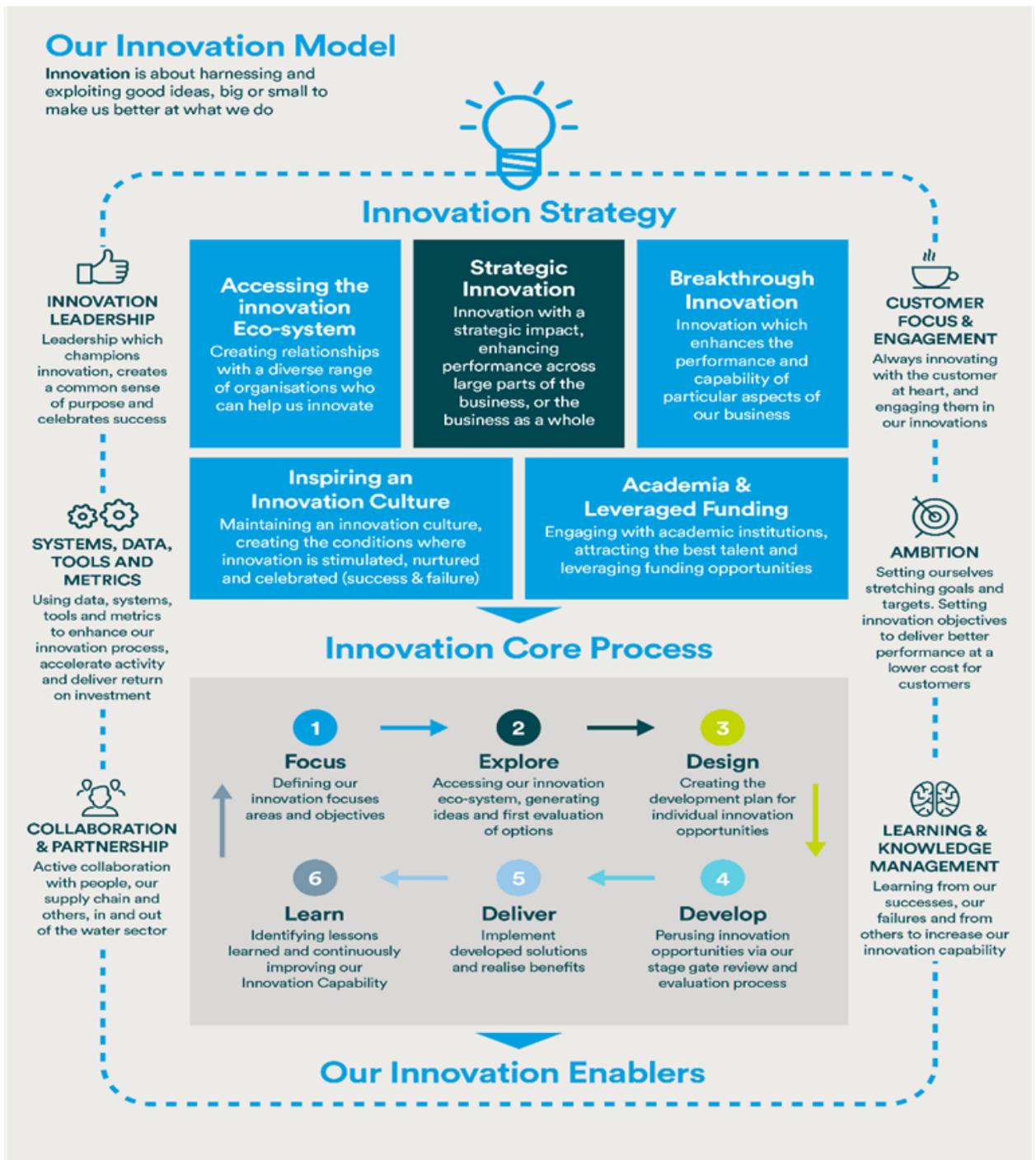
Benefits achieved:

- **Co-created a long-term place-based strategy for each sub-catchment.**
- **Key learning across integrated planning, data sharing, governance and engagement.**
- **Continuation of the pilot groups after pilot phase to assess how we can adopt into AMP8.**

6.4 Our innovation model is effective and remains fit for purpose

- 6.4.1 Good ideas from employees, customers, suppliers, academia and other industries continue to be welcomed and need to be treated with care and managed effectively to understand the opportunity and viability for each idea to deliver real benefits to customers, accepting that not all innovations succeed and there is learning to be gained from failure.
- 6.4.2 We know that inspiration can occur at any moment, but converting that good idea into a solution that can be tested and adopted at scale needs governance, investment and prioritisation. We focus our innovation efforts using our innovation model to allow us to exploit innovation as a welcome and inevitable disruptor to find opportunities to improve and enhance our business plan. The people, process and systems that sit behind it are part of ongoing continuous improvement to ensure that our innovation delivery capability is constantly enhanced.
- 6.4.3 The best performing companies innovate, and they all have a clear **innovation model** to consistently deal with the wide range of types of innovation to be successful. Without such a framework, we waste energy and effort looking at wrong problems to fix and the wrong solutions to implement.
- 6.4.4 Our innovation framework model is not just about technology but also about harnessing the right culture and exploiting key innovation enablers such as data, leadership, customer engagement, collaboration and connectivity.
- 6.4.5 During AMP7, we reviewed our model by comparing to others in global water companies and other sectors, as well as obtaining feedback from suppliers and customers. It remains compliant with the ambitions and visions for Ofwat innovation priorities, Water 2050 strategy and UKWIR, and remains fit for purpose for AMP8.
- 6.4.6 The model is shown in Figure 35 below and has four elements:-
- **Innovation definition:** “Innovation is about harnessing and exploiting good ideas, big or small to make us better at what we do”
 - **Innovation strategy:** based on five key themes that set out how we approach the diverse world of innovation, how we focus our efforts on the tactics to deliver more for less for customers. The five components of our innovation strategy help us improve our performance in key areas of service and environmental improvement, while reducing the cost of that service for customers.
 - **Innovation core process:** the end-to-end sequence of steps needed to make sure every idea receives appropriate opportunity that we de-risk the investment and we learn from every innovation.
 - **Innovation enablers:** from data, leadership, collaboration and ambition, these are the specific factors that are needed and promoted within our organisation to succeed.

Figure 35: Our innovation model



Innovation strategy

- **Strategic innovation:** Our ambition and long-term focus on the strategic drivers affecting the UK water sector leads to significant innovation programmes, bringing widespread improvements across large parts of the company. These programmes are managed centrally with Executive sponsorship and ambitious targets set to improve performance, describing a future state or vision of the future that is better for everyone. Examples include our approach to Open Data, how we consider our operations as interconnected systems including smart networks such as DNM.
- **Accessing the innovation ecosystem:** The innovation ecosystem is the collection of inventors, suppliers, academics, partners, employees and customers, inside and outside the water sector, who are considering concepts that may help us. For us to implement the best ideas for customers, we need to discover where those ideas are being generated and they need to know we are open to innovation.

- We make ourselves attractive to this ecosystem and easy to do business with, focusing on partnership and collaboration. Examples include how our scouting programmes and Innovation Lab programmes unearth new entrants and start-ups to the water sector. Our early interactions have given us first-mover advantage.
- **Breakthrough innovation:** The water sector supply chain and our employees are incrementally innovating every day and this is a valued part of our strategy. We also encourage the development of highly disruptive, breakthrough ideas with potential for significant improvements. We observe that these breakthrough ideas have technology at their heart and potential to align with our systems thinking ambitions. We have an innovation team established to manage an innovation process that finds, tests and implements these breakthrough ideas where risk taking is needed. Examples include our ground-breaking and early adoption of AI and use of nature-based solutions in WINEP.
- **Academia and leveraged funding:** We do not rely on traditional ideas alone, and working with the leading researchers and thinkers in academia is a key part of our strategy:-
 - We want to stimulate new research by sharing our business drivers, learn from what is being researched by others and take advantage of their completed research to make improvements.
 - We target universities for recruitment, support their research programmes and course curriculum, and with employment opportunities with a focus on our graduate intake and offering internships and paid work placements.
 - We know that innovating is risky and can be expensive, which is why we collaborate with others to share the knowledge, resources and cost across all parties.
 - We also know that bidding is costly and the effort to support the funding provider governance is complex and resource heavy. Examples include our contribution to the Ofwat Innovation competitions with substantial new idea generation, extensive sharing with others, bidding and project delivery.
- We introduced a sector-first method of assessing collaboration behaviour in these partner projects and have adopted it as our method of co-ordinating these leveraged fund projects. We have shared this approach to the water sector in a SPRING showcase in June 2023.
- **Inspiring an innovation culture:** We need all our employees and key suppliers to create and implement new ideas. We set innovation expectations with our strategic suppliers. For our employees, we create the right environment for innovation to thrive by using innovation in our recruitment criteria, incentivising employees through the annual appraisal and bonus process and providing access to training and development opportunities through our various activities and programmes.
- We provide key talent groups with bespoke innovation training to increase innovation skills and use innovative systems and processes to get employees engaged with local improvements, voting on ideas and helping to implement new ideas. Throughout, we provide safe environments to ‘try and fail’ with coaching on resilience and continuous improvement so that, next time, they try and succeed. Examples include our ‘Tell Us’, our drive for Operational Excellence, our internal innovation champions network and talent programmes.

Innovation process

- 6.4.7 Our core process starts with identifying the problem, exploring possible options without discrimination, prioritises a few ideas, trialling to test concepts and prove value, preparing the company for roll out and then implementing and optimising. It is a circular process as often reviewing one idea leads us to consider other ideas, exposing more challenges and opportunities. The process is collaborative, relying on the strengths of each party to de-risk and deliver the best result.

Stage 1: Focus, which considers both problems and opportunities

- We use data analysis to find the problems and insights in our performance that needs improving. Through our digitally centric, data-driven approach, as well as gaining insight from our customer-facing employees, we uncover a lot of insights and, therefore, identify root cause problems not just symptoms. Senior leadership confirm what areas to prioritise, which starts this process.
- However, focusing solely on problems misses a large area of innovative thinking. Therefore, we make sure that we capitalise on new opportunities as they arise. This is a vital dimension at this first stage. Developing economic and social drivers, changing customer priorities and emergence of new technologies and trends. These new opportunities arise frequently, so being able to act on them quickly is a rich source of innovation, supported by our increased trend watching capabilities (see Section 4).
- We have found an effective approach in this first stage is to bring problems and opportunities under campaigns, which allows us to explore many possible ideas to solve different aspects of the same issue.
- The output of stage 1 is a clear statement of opportunity for exploration.

Stage 2: Explore – where we list ideas that have the potential to solve the area of focus from stage 1

- At this stage, we generate many ideas and do not discriminate, using many sources of inspiration including other industries, our supply chain, academia, customers and employees. We also engage with water sector idea scouts and our network of innovation champions across the company.
- The output of stage 2 is enough ideas to move to the next stage.

Stage 3: Design – where we compare possible solutions and select the best ones to progress

- The design stage is based on urgency and potential to resolve issues. Accepting that innovation, by its nature, carries a higher risk than well-established processes/technologies, and we deal with many immature ideas with significant uncertainty. Design is not prohibitive but conversely ensures that risk is mitigated through a fail fast approach.
- We have learned from previous innovation projects to use our judgement and innovation tools to help us. Usually, for disruptive ideas, they need de-risking and many uncertainties removed through trialling. The design stage also allows a fast track to stage 5 when the idea is well proven or we have enough confidence to bypass the trialling stage.
- The output of stage 3 is a set of prioritised ideas for further testing.

Stage 4: Develop – where we test and trial the new idea

- We realise that using untested ideas in direct contact with customers is not always feasible and, in some cases, would breach regulations if we did this. However, we also recognise that the best environment to test is in our live asset base and with customers. Therefore, we have a number of facilities at our disposal where we can test ideas safely before we introduce them to live networks, such as relationships with universities or our own in-house test rigs (see section 4).
- We set out trial criteria and, if met, could lead to full implementation.
- The output of stage 4 is a proven idea with internal approval for roll out.

Stage 5: Deliver – where the proven idea is implemented into the company

- This is where we realise the expected benefits and continually optimise the idea to further refine and extract more value. It is important that we gather feedback from all our collaborators and fully roll out the new idea and realise the benefit, gathering the key points of success or failure through our learning workshops and celebrating success. This is typically done internally through newsletters, team briefs, employee awards and other celebrations, and externally via trade press, newsletters, social media and our websites.
- We keep innovating to generate new ideas that can then be optimised. Here, we also optimise the idea once implemented to see how far we can push it – refining the innovation until we need a new

disruption to make the next improvement. This stage also allows us to generate new insights into new technologies or ways of working.

- During AMP7, we introduced a new contract style called Innovation Development Partnerships for suppliers typically proven from our Innovation Lab programmes. This gives us access to any new ideas that the supplier generates and we get first refusal to explore them together. In this way, we get a steady pipeline of new ideas from smart innovators, and we use this first mover advantage to get more ideas adopted faster, delivering value to customers.
- The output of stage 5 is an adopted idea and benefits measurement (e.g. financial, carbon, social value, environmental) and agreement on how best to start optimising. All parties are encouraged to celebrate the success.

Stage 6: Learn – where feedback is gathered from collaborating parties and learning is shared

- We do this in presentations such as ‘Food For Thought’ lunchtime learning sessions, team updates and updating business process documentation to describe and sell the vision of the future. We also share results and learning externally, and are active in UK conferences and water sector events.
- An example of learning from success was adapting the leakage sniffer dog concept to our wastewater area, based on similarities around sensing, while reducing customer disruption and manual effort.
- Another example is where we reduced the cost and time for adoption by learning from others with SmartValve – other water companies had already proven the concept, we just needed to test how our processes and systems would integrate.
- The output of stage 6 is new insight and learning that we can apply to the next relevant innovation.

Learning from failure

- 6.4.8 It is important to be resilient and not be deterred by failure. In AMP7, we have taken a mature attitude to risk taking. Not all learning is from success – our innovation model encourages us to continually learn, and learning from failure is vital too.
- 6.4.9 We know that not all our innovation investments can be adopted. We are breaking new ground, so a number of ideas will inevitably fail. We are not disheartened by this, as it is the nature of innovation. We accept this risk, knowing we will collect valuable learning that will inform and add value for our customers in the long term. The key is fail fast, use resources wisely, and refocus on a new direction to develop the next idea. One example of learning from failure relates to how we tried to help customers reduce their in-home water consumption.

Case study 35: Learning from failure: water efficiency

Background

Water consumption is a critical environmental challenge, especially for our region. While businesses must play their part, customers also play a crucial part in reducing water consumption. Our approach is to provide incentives to encourage local behavioural change. We invited suppliers to share their ideas to find ways to help customers reduce their own water consumption in a challenge entitled 'Connected Homes and Smart Metering'.

Innovative solution

We selected a French water technology and data start-up that were active in France but a new entrant to the UK water sector, and offered a new type of shower head that changes colour based on running time. Via a supplier-bespoke app, the user sets a time limit to define a maximum water use target, and the shower head would change colour:

- Green – comfortably within time and water use limit;
- Amber – approaching time and water use limit; and
- Red – outside time limit/exceeding water use target.

Alongside 'nudge' behaviour change techniques, the supplier claimed significant water use reductions and we were encouraged by:

- the supplier claims of 20 per cent water saving with all power for the sensors from the water flow; and
- Positive feedback from one of our innovation knowledge share partners, a water utility in Asia.

Results

We could not deliver the return on investment we were looking for. The showerhead, while a novelty to customers, did not satisfy us and we could not influence the supplier to change their offer to better suit our requirements. The 20 per cent water efficiency was only achievable with considerable ongoing (and expensive) support from the supplier, not providing best value to the customer. In addition, the supplier insisted on their own app and data provision, which stifled our utilisation of the data to gain new insights.

Our learning

We discovered that the suppliers have won a large contract with PUB, the water company in Singapore. We learned that this is at a similar (and expensive) cost to UUW but PUB have different government incentives and funding so can afford the purchase price. We found that the combination of high initial purchase price, significant ongoing operational support cost and nature of the contract required meant we were unable to proceed.

Next steps

Undeterred by this, our lessons learned process meant that we proceeded to unearth other opportunities that were better suited. We shared our findings with other water companies and, together, we now have an innovation programme of water reduction for customers including:

- Partnering with North West home builders to fit water efficient products on the first install; we have renewed our focus on the Future Homes efforts with Salford University and use our partnership links with Greater Manchester Combined Authority (GMCA) to make better progress, sharing our progression along the way;
- Residential water harvesting – we successfully trialled Smart Water Butts. As mentioned earlier in Section 6, harnessing water reuse and reducing water consumption, all while demonstrating benefits of 'slowing the flow' and buffering storm events. The trial showed there were practical benefits, and we are now progressing the next steps, including collaborating on the Ofwat innovation project 'Enabling Smart Water communities';
- Inner city industrial scale rainwater harvesting – water retention and reuse using our blue/green roof project. See case study 11 for more information – and
- Consider how new ideas could be better supported using the AMP8 water efficiency fund.

Innovation enablers

- 6.4.10 While our strategy provides the focus needed to start the innovation process, the right environment is necessary for our employees to thrive and to treat innovation as an essential activity and not a discretionary one. We recognise that applying effort to create the required environment is worthwhile, and is supported by our innovation enablers.
- 6.4.11 **Customer focus and engagement:** innovating with customers is at the centre of what we do. We make sure that we innovate with purpose and that ideas deliver customer benefit. We have recognised that customers want a more active engagement with their water company, so we regularly involve customers in what we do and the services we provide. This has led to new services such as our Priority Services and Affordability efforts. We intend to repeat this approach and increase our efforts in AMP8.
- 6.4.12 **Ambition:** We work best when we have challenging targets to meet as it brings out the best in people. We strive to deliver more for less in our innovation focus, in building the business case and through benefits realisation.
- 6.4.13 **Collaboration:** Working with others is the most effective approach for innovation. Drawing on the strengths of others is the lowest cost method to progress ideas through the innovation process. Collaboration comes from knowing your ecosystem and taking time to build effective relationships so that all collaborators can reach their potential and are incentivised to do so. We are proud of our increased co-operation, collaboration and partnership efforts in AMP7, especially our role in developing the Water 2050 innovation strategy, the establishment and championing of SPRING, the development of the Ofwat innovation Competitions and our partnering with five start-ups to continually optimise their ideas and adopt earlier.
- 6.4.14 **Learning and knowledge management:** High performing innovation organisations invest in innovation training and opportunities for personal development. We regularly trying new things, learning from success and failure and apply this learning to the future ideas. Great innovations need to be shared. We have invested in systems and methods to transfer learning and good ideas across our organisation. We are also active in creating environments for our talent groups to learn our innovation processes and tools, and to try new ways of working with a high frequency of feedback to aid learning. This builds on our employee innovation focus around Operational Excellence, 'Tell us' process, departmental awards and the CEO challenge initiative, and our AMP7 plans to get more talent groups involved.
- 6.4.15 **Systems, data tools and metrics:** Using data-enabled, repeatable processes for all our employees to follow and it needs to be easy for everyone to innovate. In line with our innovation ambition, we ensure our systems and metrics are inclusive for all to innovate.
- 6.4.16 **Innovation leadership:** We set innovation expectations through our company value. All performance appraisals use these core values to assess individual performance, which leads to pay and bonus benefits. This has led to many employee-generated ideas. For our supply chain, we encourage best practice sharing and reward innovation through financial and reputation incentives.

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