

Ref 4.4

PR19 Operational Resilience

September 2018

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Executive Summary

Improving our operational resilience is at the core of our thinking and has been for many years. We have a robust and flexible service, which can respond to extreme events, as demonstrated by our ability to maintain a good overall level of service for our customers during 2018's Storm Emma and our 'developing drought'. Whilst we regret that there was a significant loss of service for some customers, we were only able to achieve this overall level of service due to the implementation of lessons learnt from previous shocks and stresses, like the winter of 2010.

We recognise that it is vital to improve our operational resilience to future potential shocks and stresses. We are working to prepare our service for more frequent and unexpected extreme events, and are already incorporating further lessons learnt from the events of 2018.

Our first step in the process of building resilience was to horizon scan to identify and assess the shocks and stresses that may impact our business now and in the future. To do this we reviewed 'global' good practice. We then improved our operational resilience through developing mitigation to lower the probability our service being disrupted and reduce the impact any disruptions will have on our customers.

We are focusing our mitigation on approaches which have the biggest resilience value, or wider benefits for our customers, environment and network. Customers and stakeholders have been key to the development of our resilience approaches for AMP7 and beyond. In the future we will continue to partner with customers and stakeholders to co-create our resilience plans. Our mitigation will also be considered in the round, ensuring that our approaches also achieve financial and corporate resilience benefits.

We will continue to review monitor how our approaches and innovation are providing improved operational resilience.

This appendix details our approach to building resilience in all the operational areas of our business.

1. Introduction

We developed a framework to assess resilience, the Welsh Water Resilience Wheel, in January 2017, based on international good practice and national guidance. We were one of the first water companies to take such a pioneering approach. The wheel below aims to highlight how the whole of our business is addressing resilience – the capacity to ‘survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks we experience’. This is detailed in our overarching approach to resilience, 4.1 Resilience in the Round Overview. Our wheel splits resilience into three themes; people, infrastructure and environment, and finance and governance.

As set out in 4.1 Resilience in the Round Overview, resilience is a process to enable us to continue to achieve our aims in the face of sudden shocks and extreme stresses. Our wheel therefore aims to help us understand how we need to deliver on some of our key business objectives, for example:

- **Meeting customer expectations:** This is focused on collaborating and co-creating with stakeholders and customers, community education, and the information sharing process to enable the provision of critical services to customers. This improves our inclusivity, allows us to deliver improvements we would not be able to alone and increases our customer’s trust in us.
- **Providing affordability and value for money:** This is focussed on delivering smart resilience, i.e. multiple benefits for maximum value. This improves our inclusivity, allows us to deliver improvements we would not be able to alone and increases our customer’s trust in us.

Our wheel also reflects the three Ofwat themes of resilience, operational, corporate and financial resilience under a variety of indicators, as shown in Figure 1.

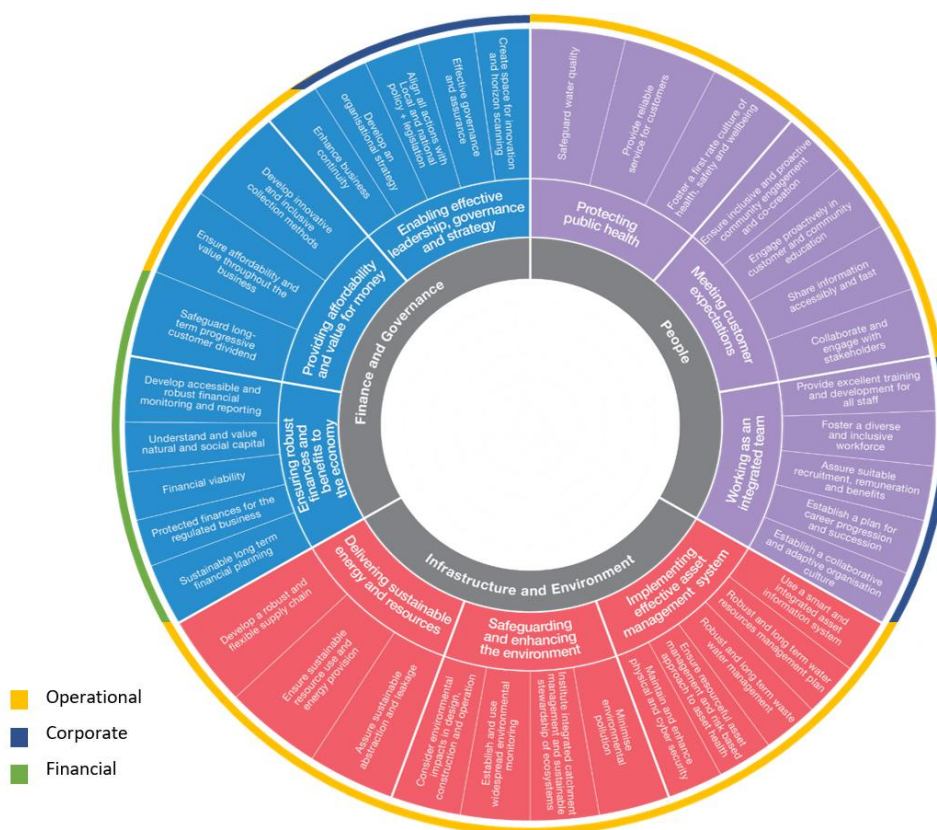


Figure 1: How Ofwat’s three themes of resilience are reflected by the Welsh Water Resilience Wheel. The outer ring of orange, green and blue show the Welsh Water indicators which reflect Ofwat’s resilience themes.

Our definition of operational resilience, taken from Ofwat's final PR19 methodology, is

'the ability of an organisation's infrastructure, and the skills to run that infrastructure, to avoid, cope with and recover from disruption in its performance'ⁱ.

As reflected in Ofwat's methodology, in practice this means a reduced probability of service interruptions, from shocks and stresses, and reduced impact of these events through actions like good communication and quick recovery.

This appendix is focused on operational resilience. The other two Ofwat resilience themes, financial and corporate resilience, are covered in two separate documents (4.2 PR19 Corporate Resilience, and 4.3 PR19 Financial Resilience). We have assessed resilience as a whole using the Resilience Wheel, as we believe you cannot be a resilient organisation unless all areas of your business are resilient. The aim of this document is to set out how we have considered future shocks and stresses that may impact our operational business and provide examples of the actions we are undertaking to mitigate for these challenges. We have highlighted some key examples of our resilient approach across our business, and the multiple wide-reaching benefits, or the 'resilience value', of these approaches. We recognise that to obtain the full resilience value and improve our service, it is key for us to ensure that our operational actions also have corporate and financial resilience benefits.

We have clear and robust processes to enable us to continually review the progress and success of our approaches to resilience. These processes provide us with the opportunity to update our programmes and provides us with the flexibility to be able to adapt to changing circumstances.

Responding to extreme events: an example of resilience in action, 2018 'developing drought'

We are seeing new extremes in weather, with 2018 being the hottest and driest summer in Wales since records began. We therefore need to consider both robust and flexible methods to mitigate and respond to this challenge.

Our response to the 2018 'developing drought' included connecting five water resource zones. This involved a two-way transfer between Anglesey and the mainland, overland connections between water resource zones, use of standby boreholes, and temporary pipelines. We will look to make these temporary solutions permanent in AMP7, where suitable, to improve our long-term resilience.

We were also adaptable to changing circumstances by using our tanker fleet and deploying an extra 150 contract staff to undertake this work to ensure other day to day tasks we not impacted.

We are the first company to provide drinking water to people not connected to the mains in a drought event. We worked in partnership with the Local Authorities, who distributed bottled water provided by us.

We look for new techniques to solve problems, both low and high tech. We are taking a data science approach to use predictive analytics to help our incident management teams. We also recognise that simple changes can mitigate issues. This was shown by the addition of a tarpaulin at our Sluvad treatment works site, preventing the red algae growth we experienced for the first-time due to increased sunlight.

2. Resilience challenges

A full set of our resilience challenges is set out in 4.3 Resilience in the Round Overview, on our overarching approach to resilience.

We have considered both shocks and stresses when looking to the future. Shocks are short term disruptive events, like floods, fires and cyber-attacks, which we consider through our risk register. Stresses are chronic conditions that weaken the function of systems in the long-term, such as climate change, demographic change or ageing infrastructure. We have set out these long-term trends in Welsh Water 2050. At a certain tipping point these stresses can be felt as shocks, and will we integrate these into our risk register.

Although short term shocks and long-term stresses can be reviewed, assessed and prepared for, in the current dynamic environment, the frequency and diversity of these challenges is increasing. This means that we must be more prepared for increasing uncertainty, be flexible and adapt our work to the uncertainty of unknown disruptive events. Recent events, such as Storm Emma and the ‘developing drought’, have only strengthened our resolve to build resilience and learn from these events.

We assess short term shock events, using our Top Tier Risk Register, and this enables us to identify and manage our key risks.

In our long-term strategy Welsh Water 2050, we have identified eight long-term trends, which may be felt by our business as stresses. We collaborated with Arup and the University of Cardiff to identify these from a long list of shocks and stresses and assess their potential impact on our business. This was based on a resilience literature review of relevant frameworks and guidance documents, which were then applied to the water sector. This including government guidance from the Cabinet Office, international best practice like the City Resilience Index, and private sector research.

The key future trends for our business are:



Change in customer expectations



Protecting essential infrastructure



Demographic change



Changes to the structure of the economy



Policy and regulatory change



Climate change



Environmental change



Protecting public health

We will undertake a process of regular review to reconfirm that these continue to be priorities for our business. As set out in Welsh Water 2050, we will undertake a full reassessment of shocks and stresses every five years. However, annually we will review emerging trends / threats.

In the following chapters, which are aligned to our Resilience Wheel, we have described in detail how shocks and stresses may impact our business and how we are currently managing and mitigating them as well as how we plan to do this in AMP7 and beyond. Much of what is contained in this document is repeated elsewhere in our business plan, highlighting the pervasive and all-encompassing nature of our approach to resilience.

3. Protecting public health

Resilience drivers

In this section, we are focused on providing water to our customers which is both safe and of high quality, which will provide our customers with a reliable and robust water service. We will deliver a vital resource to support our customers' health, now and in the future.

Our customers have told us that a reliable source of water is of great importance, and that we should be able to sustain water supply to customers in all but the most extreme of droughts, where temporary use bans would apply. Our domestic and business customers have some tolerance for brief outages of supply, however, they become increasingly less accepting of outages the longer they last and the more frequent they are. We are striving to ensure that we provide an increasingly reliable service for our customers in the face of future shocks and stresses. As highlighted in Welsh Water 2050 trends that may particularly impact the level of water resources water supply required to meet our customers' needs include:

- Population growth, especially in South Wales
- Changes to the structure of the economy, such as industrial decline leading to oversized pipes, and a transition towards a more service-orientated economy and growth in tourism, leading to additional demand in some areas
- Tightening environmental regulations which can restrict our ability to abstract, and uncertainty over future regulation due to Brexit
- Changes in customer behaviour including when and how they use water
- Extreme weather events due to climate change, affecting water resources and demand patterns.

We are also focused on improving the quality of water we provide to customers. 99.96% of the water that we supply meets drinking water quality standards at customer taps, in line with average drinking water quality compliance standards in the UK. We know, however, that our performance for acceptability of water is lower than for other water companies in England and Wales, mainly due to discolouration, but also taste and odour. This is linked to our unlined iron mains and the upland sources of our raw water, which generally has a high manganese content. There is little understanding amongst our customers as to whether discoloured water is safe to drink, most of our customers would avoid drinking discoloured water – and would prefer to purchase bottled water instead.

Old pipes are one of the 'front of mind' threats to water supply for our customers, and they are keen to see pipes replaced with new materials to ensure supply is future-proofed. In our long-term strategy, Welsh Water 2050, we have identified that there could be further deterioration of raw water quality from extreme weather and intensification of land use affecting the quality of raw water we abstract. The deindustrialisation in our supply area in recent years means that our network is already often oversized leading to sub-optimal velocities in our cast iron mains. The age of our iron mains also means that they are prone to bursts, impacting flow and discolouration. We want to improve this service for our customers to increase the trust they have in us.

Ensuring a reliable service for customers

We have worked to deliver a reliable and stable water service to our customers during AMP6. We reduced our customer minutes lost per property by 55% since 2015-16 and plan a further 30% reduction by 2025. We have started to address the root causes of discolouration as well as taste and odour problems, with our forecast suggesting we will reduce customer contacts by 17% in AMP6.

Upgrading ageing and ineffective assets which impact service provision

We are proactively targeting assets at highest risk of failure – whilst always minimising the impact of service interruption on our customers.

In AMP7 we plan to invest in replacing water treatment works (WTWs) which have issues with reliability of supply. Over the course of AMP7 and AMP8 we will be replacing three existing WTWs (Pontsticill, Llwynon and Cantref) which experience three times the rate of failures as the rest of our works, with a new facility at Merthyr Tydfil. The Pontsticill WTW needs a significant upgrade to enable it to meet new DWI regulatory requirements, but a lack of the physical space required to add additional treatment processes and the shutdown window availability required for major maintenance makes this prohibitively expensive at the current sites. Combining the required work for all three sites by building a new WTW at a new location has the lowest whole-life cost for customers and significant resilience benefits for them, with the provision of 24hrs of treated water storage for a significant part of the south Wales Valleys area. We will also look to improve our strategic storage on other areas of our network.

We are working to ensure constantly acceptable water quality through our Bacti Action Audits to highlight any bacteriological risks in post disinfection tanks, channels, pumps and vessels at our treatment works. These will be continued in AMP7 by collating all the information into one central dashboard which will give a single view of risk, which will then be used to make the most effective investment decisions. We are investing in enhancing our existing wastewater assets to improve raw water quality. We are investing £50m to meet our Water Framework Directive (WFD) legal obligations, manage ineffective assets and deal with regional growth. To achieve this, we have proposed to build one new Gwili Gwendraeth wastewater treatment works (WwTW) to meet the required WFD outcome, thereby replacing seven of the eight ageing WwTWs discharging into the Gwili and Gwendraeth Fawr rivers.

We aim to reduce the amount of lead in our drinking water supply as the health impact of lead in drinking water are becoming increasingly unacceptable. In AMP6 we trialled replacing of communication of supply pipes where samples show over 5 µg/litre of lead in the water. In AMP7 we are continuing our lead pipe replacement programme, and working with our Project Cartref (Home) scheme and Welsh Government's Arbed and WaterSafe schemes to make this work even more effective.

Resilience Value: Upgrading our underperforming and ageing assets will allow us greater flexibility to deal with tightening water quality standards as well as enabling maintenance improvements. This will also ensure that we are ready for future challenges, such as the population growth predicted for Cardiff, Newport and Swansea by 2035.

Flexible system management

We recognise the importance of flexible management of key assets and distribution systems to deal with extreme and unexpected events. We have started working towards an interconnected grid

system, which will build flexibility and redundancy into our water distribution systems, by investing £23 million into upgrading our Maerdy-Pontypridd water mains system. In AMP7 we will continue to work towards an interconnected grid system, to provide resilience of supply to South Wales through improvements to our east-west Felindre Trunk Main. This will include the twinning of strategic mains at vulnerable points, including where they pass under rivers, roads and railways.

Resilience Value: We will build redundancy into our water supply systems to ensure that our customers will always have a suitable source of supply.

Designing for the unexpected

We recognise that we are, at present, not able to mitigate burst mains for some of our customers through emergency response. In AMP7 we plan to perform resilience assessments for all communities where over 5000 properties are fed from a single source of supply and identify possible solutions in the event of a supply failure.

We can provide supply through emergency tankers and rapid response units in each operational area if required. We will also seek advice on the optimisation of tanker base locations and other emergency equipment. We can now accurately calculate supply interruptions due to the pressure loggers and alarms we have implemented in AMP6 so that we can address bursts quickly. We are planning to link pressure loggers to our predictive systems improving how we can 'get ahead' of problems before customers notice they have an issue and deal with leakage.

Resilience Value: This ensures that we have robust plans in place to deal with properties with a single source of supply and can identify and repair leakage quickly.

Learning from past events

We have learnt lessons where our assets have not performed effectively in past extreme events. During AMP6 we learnt lessons from incidents to improve the robustness of our service. In August 2015 Broomy Hill treatment works was shut down due to the loss of the single source of supply from the river Wye, which had the potential to impact 50,000 properties. This led us to review potable water options in the area and to the construction of additional storage at a downstream reservoir and rezoning another, increasing potable storage from 9 to 40 hours².

Following Storm Emma, we identified that our monitoring should be extended to all rural areas, reducing impact to customers, and have started this implementation process. During Storm Emma, we also recognised that there were some difficulties in sharing up-to-date information internally on the situation. This prevented the customer service team from being able to provide up-to-date information to customers. We recognise the importance of adequate network monitoring and communication to mitigate such events in the future, and have begun further work to improve our data and communication. We were one of the first UK water companies to join the international 'Smart Water Networks 'SWAN', knowledge sharing group and are working to apply leading approaches to the compilation and use of network operational technology systems.

Resilience Value: Taking lessons from past events to improve the way we invest in and manage systems is key to providing a service that is reflective and does not repeat historic failures.

Ensuring acceptable water for customers

We have taken a 'source to tap' approach to improve our acceptability of water and are investing in water treatment processes to control chlorine and reduce manganese, Geosmin and MIB that leads to discoloration, and taste and odour.

Our Zonal Studies programme is focused on improving acceptability of water through up-to-date hydraulic modelling, replacing unlined iron mains with plastic mains, cleaning and reconditioning mains, and developing care plans. We are investigating the root cause of issues, to achieve a comprehensive resolution. The programme also includes additional valves and hydrant points, which will restore supply more effectively and reduce the number of customers affected by a burst main. In AMP7 this programme will continue and we will complete interventions in an additional 17 zones which have DWI legal notices for improvement. This includes the replacement of 420 kilometres of water mains along with mains cleansing and rehabilitation. During AMP8 to AMP12 we aim to use the outputs of our zonal studies to replace 500 kilometres of iron mains per AMP, or 2,500 kilometres in total, and may upgrade a further 800 kilometres if found to be necessary.

We want to reduce discolouration of treated water and we are therefore working to remove manganese from our water treatment works, to reach of a goal of 2µg/litre manganese.

To reduce chlorine taste complaints, we have focussed on maintaining levels as low as possible without risking a decrease in bacteriological compliance. Again, this is an area where our extensive network modelling data is applied to good effect.

Resilience Value: Ensuring that our water is acceptable for our customers will increase their trust in us, provide them with water as a basic need, and reduce the complaints we receive.

Robust health, safety and wellbeing systems

We also recognise that having robust health and safety systems in place is key to ensuring that we are able to continue to provide a robust service. We have achieved the Welsh Government 'Platinum' Level award for Occupation Health and Safety in 2018. We are recognised by the Health and Safety Executive (HSE) as a leading company for good practice in Wales. We have a five-year strategy to improve leadership, management and culture around health, safety and well-being. This is reflected by 97% of our staff stating we take health and safety serious in our 2017 annual employee engagement survey³. We are transitioning our H&S management system to the new ISO 45001 standard as we enter AMP7. We have successfully retained the RoSPA 'Gold' standard for H&S performance and management systems for the last 3 years.

In AMP7 we want to build on this programme by learning from other sectors like the oil and gas industry, more investment in health and safety training from Board to 'front line' level and using technology to improve reporting and personal risk assessment. We may also build health and safety further into our appraisal process with formal competency standards and improve our health and safety monitoring by using more leading indicators.

Resilience Value: This will improve our colleagues' skills in health and safety, improving the reliability of dealing with extreme events.

4. Meeting customer expectations

Resilience drivers

We recognise working with customers and communities is essential to co-create solutions. We want to work with customers to shape our service, ensure community buy-in and ownership of projects and improve public perception of us as a water company. One of the main aims of our customer engagement work is to build a trusting relationship with our customers. This will enable customers to play their part in improving resilience, alongside us playing our part. To do this we recognise that we need to improve familiarity, or our contact and visibility in communities, and favourability, or our customer service. Building this trust with our customers will strengthen our ability to deal with potential future customer expectations.

We recognise that there is a need for different types of engagement with customers, for different project and programme needs, ranging from confirmation to co-creation and active participation in co-delivery. We have increased our proactive community engagement between the last two price reviews based on talking to customers. Most customers want us to introduce initiatives to avoid waste and reduce leakage, incentives for rain water harvesting and further education and information to improve water use efficiency and water conservation⁴. Safeguarding the natural environment is also regularly highlighted as a customer and stakeholder priority.

We also recognise that in the future customers may be impacted by societal and economic changes and work that we can do to build resilience to deal with these changes will be vital.

Improving resilience by working with our customers and stakeholders

Asking customers key questions for how their service should be run is important to us. In our 2016 'Have your Say' engagement we undertook an open consultation with 12,000 of our customers to influence how we spent our Return of Value money. This survey told us that only 3% of customers want us to use this money to reduce bills and 47% of customers wanted us to invest in communities and social tariffs. We took this on board and have invested in the programmes below.

Building customer trust and participation across our service area

Our widescale community participation campaigns are an essential way we share learning across our customer base. This includes our 'One Last Breath' reservoir safety campaign which went viral, our 'Stop the Block' campaign to reduce blockages with a flushable materials education, and 'Wrap up Wales' campaign, to ensure that empty buildings were prepared for cold weather. These programmes enable our customers to create improvements that we would be unable to achieve on our own. These are continuing to run in AMP7 and beyond, and a new programme will be added, 'Tap' to promote the use of refillable water bottles. We have used behavioural economic to influence our 'Stop the Block' campaign, and hope to incorporate this into further programmes to target long lasting behaviour change.

We have an education plan specifically for schools, primarily focused on primary school children but recently expanded out to older children including a number of challenges for the Welsh Baccalaureate. These lessons are conducted in 'Discovery Centres' or in schools as part of a wider outreach programme. These lessons and workshops are focused on key business objectives like water efficiency, RainScape and STEM promotion and aim to also influence parents⁵. We have well used visitor centres, which have been visited by 164,000 children to date. We have recently started opening up sewage works in the 'Your Community Works' programme to allow open access two days a year and to community groups.

We created a Youth Board to help prepare us for PR19, we plan to make this permeant by teaming up with Wales Council for Voluntary Action (WCVA). We also plan to keep the Online Community, which was started in AMP6. This provides us with a customer base to work with quickly to enable us to adapt and to keep up with the pace of change. We are also working to be more transparent with our customers through our open data pilot, which partners with NRW to share combined sewer overflow (CSO) spill data with the public.

We are looking at new ways to track how our customers feel about us through a customer sentiment dashboard, Tableau. This is a heat map dashboard which uses text analytics methods and other statistical techniques, we can evaluate sentiment based upon how our customers have interacted with us. This enables us to closely track the level of service we provide customers and quickly identify where there are hotspots of poor service which requires further work. In AMP7 we plan to update our Tableau database to include social media inputs.

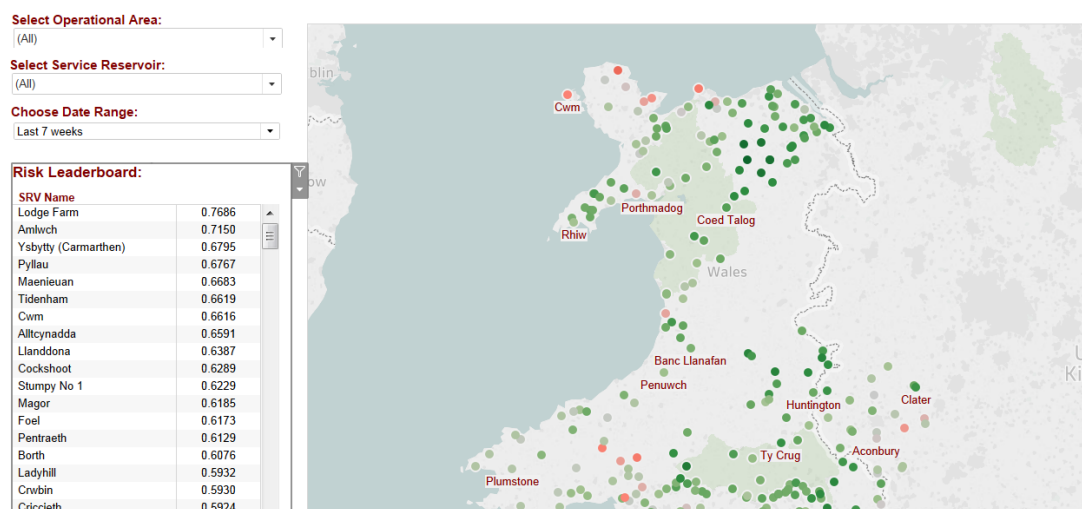


Figure 2: Tableau - heat mapping of customer sentiment

Resilience Value: Working to adapt behaviours across our operational areas enables greater long-term benefits that we could achieve by working alone. Working more closely and data collection will enable us to be more reflective of our customers' needs and adapt more quickly.

Building trust in our communities

In AMP6 our Water Resilient Communities pilot, which has been running in Rhondda Fach for 10,000 properties, saw us taking a dramatically different approach creating wider community benefits. This area was identified as it is one of the poorest communities in Wales, with poor transport links and

underperforming education yet had below average take up of our social tariffs. Through our zonal studies programme, it was also identified for capital investment. Since January 2018, the start of the scheme, we have promoted our social tariffs leading to £60,000 saving in social tariff index (reduced bills from social tariffs). We worked with the Local Authority, trusted partners and community leaders to deliver in support of the area's well-being plan. This work includes working with schools on water efficiency and aligning with the Local Authority 'Milk Teeth' plan and investing in 29 community fund projects. We also targeted the area for apprenticeships and graduate schemes as well as ensuring that six young people undertook the Princes Trust 'Get into Construction' Taster, in order to boost wealth creation.

In AMP7 and beyond we will continue to build on the Water Resilient Communities project and rolling it out to new communities, with the aim of focusing on one new community each year. The communities will be identified through a set process which considers major capital investment area, social tariff index and multiple deprivation factors.

We have undertaken some smaller scale community specific programmes such as in Cardiff and Swansea, where we have specifically been working with Muslim communities to understand the impacts of Ramadan on water usage.

Resilience Value: This community specific approach to address each community's unique challenges is an inclusive and resourceful way to build lasting trust in the community. We will enable communities to enhance their own resilience, as well as us playing our part.

Partnership working on projects with stakeholders and customers

For many of our projects a close relationship with customers and stakeholders is key to achieving the project's goals, particularly for our WaterSource and RainScape programmes. For example, for Greener Grangetown, one of our RainScape projects, we collaborated with Natural Resources Wales (NRW) and Cardiff City Council to promote regeneration, growth and investment in the area. It maximises the use of green infrastructure to remove 483 roof equivalents of rainwater from our sewers annually and to futureproof the drainage network against climate change. It also enhances public spaces, promotes sustainable transport and improves ecology.

It was developed through extensive public consultation and engagement, with residents actively participating in the design of the streets. The ground-breaking and collaborative nature of the project led to national recognition as it was awarded Engineering Project of the year at the 2018 Water Industry Awards. We will implement further RainScape projects in AMP7 and AMP8, for example, we will work collaboratively with stakeholders to leverage a co-ordinated RainScape strategy in central Cardiff.



Figure 3: Greener Grangetown ©Greener Grangetown

Our WaterSource programme includes initiatives like PestSmart and Weed Wiper which work with customers and the agricultural community to improve catchment management. We will continue to invest in collaborative catchment management through this programme in AMP7 driving water quality improvements upstream of our networks and avoid requirements for costly treatment works upgrades. We may also undertake more strategic level stakeholder mapping, across programmes, to leverage better partnership working. We have sourced international ‘good practice’ for this and are working with the New York ‘Catskills’ catchment programme in the US, to influence our activities.

We have collaborated with local flood management authorities to create a community flood programme. We have made £1 million available in a community flooding fund, with a specific set of criteria, to ensure that this investment reduces flooding effectively.

Resilience Value: integrated working with stakeholders and the community ensures that the mitigation actions we implement are aligned with the requirements of the local area and are able to provide wider social and environment benefits compared to traditional designs (or a resilience “dividend”).

5. Working as an integrated team

Resilience drivers

Over the past 10 years, we have grown from 200 to over 3,100 staff; merging across disparate companies in an attempt to bring key outsourced processes and capability back in-house to support growth. Due to our geography, we experience challenges in both hiring and contracting for high in-demand skill sets, like quantity surveyors and data scientists, and enabling talent mobility and promotion, linked to low attrition and high retention.

As we identified in our long-term strategy Welsh Water 2050, there are a number of future shocks and stresses that we must consider in order to improve the resilience of our business. One of the key stresses that is both currently being felt and will be likely to continue to be a challenge for us is skills shortages. Our location and the technical skills we require mean that we struggle to attract some skill sets. As technology and job requirements change in the future we may continue to find this challenging.

We may see changing demographics in the future, particularly an ageing workforce, so we must ensure that these members of staff are supported to learn new skills and undertake suitable tasks. However, we are 'live' to this challenge and so far have achieved good progress in terms of replacing our experienced workforce with new recruits to the sector. Over 50% of our people have joined the business in the last 5 years and through targeted apprentice, graduate and trainee schemes have managed a successful 'knowledge transfer' to enable new colleagues to acquire new 'vital' operational skills and expertise.

We will also have to become more open to change, with our future workforce likely to have different working patterns and expectations of working with us. This will also be required as we start to experience more extreme events from stresses like climate change, we will be required to provide our staff with more flexible working options.

In 2018 we achieved the 'Gold Standard – Investors in People (IIP)' Award, which is a level achieved by only 7% of IIP accredited organisations in the UK. It recognises our commitment to development of the organisation and is a solid platform on which to build our AMP people plan.

Building a resilient workforce

Skills development

We are about to undertake a strategic workforce planning process to identify critical skills we need now and for the future to better direct talent attraction, development and retention. We have already identified current skills gaps, which include engineers and quantity surveyors and are working to fill these gaps.

There are a number of 'key investment' programmes that seek to develop skills and capability that are of strategic future importance to the industry. To further incentivise staff interested in developing their Engineering, Science and Surveyor capability further, we have introduced a policy to support and fund chartered accreditation. Additionally, we network with our Capital Delivery Alliance partners, EU Skills Talent Network and cross industry suppliers to discuss partnering to address skills shortages. We are thinking of ways to broaden development beyond the preferred classroom training to more online methods. We also have an 'Ageing Workforce Fitness for Work Strategy'

which could support reskilling and mobility of the ageing workforce; creating new career opportunities for many.

We consider impacts to the future workforce, including national scale infrastructure projects, looking 10 years into the future. To mitigate these future workforce risks we are actively working with schools and universities to educate and entice future talent to develop STEM skills and careers; offering work experience, projects like the Education Engineering Scheme Wales and experience days. We have an employability skills programme, with a focus on STEM roles, and joint apprenticeship programmes between Welsh Water and our Capital Delivery Alliance partners. These schemes have been running for eight years and cover 30 key skills. We plan to expand the number of internships and work experience placements which are promoted through schools, colleges and university contacts. We are working with Network 75 and the Resilient Communities programme to ensure that there are Welsh Water role models for STEM careers in isolated or deprived communities. We are also working with NMiTE – New Model in Technology and Engineering (a new university in Hereford) to sponsor students, in this transformational approach to engineering education.

We have recently been shortlisted for the School Leavers Award 2018, and the BITC Inspiring young talent award. We have also been shortlisted for two awards with Business in the Community to recognise graduate and apprentice programmes and health and well-being of colleagues in 2017.

Resilience Value: identifying long term skills gaps and supporting the development of both our current colleagues and young people aims to ensure we have the flexibility and skills to continue to provide a robust service in the future.

Flexible working

Flexible working is both a need, given our disparate geography, and a challenge. Weather incidents have put pressure on staff and customer service, which could have been mitigated with the benefit of more agile, home working. We have started process to address this by looking at flexible working in our Retail business and plan to look to address this issue in AMP7 in other areas of our business.

Resilience Value: being adaptable in the way we support our colleagues to be able to work will allow us to attract the very best workforce which can continue to work in changing circumstances.

Diverse and adaptive culture

We recognise that having a diverse workforce provides us with more resilience and a greater range of skills and experiences. We aim to ensure our workforce is diverse with our Board diversity statement and our zero-tolerance policy on discrimination or harassment which is reinforced through education, e-learning and workshops. We are planning to develop an Equality, Diversity, and Inclusivity Strategy in AMP7. In AMP6 we have piloted 'Equality, Diversity and Unconscious Bias Training' workshops, which will be rolled out to all our people during 2018-2019 to support more diverse hiring and decision making. We also promote gender diversity, BAME and LGBTQ colleagues through our nominated Diversity Champion community (linked to Stonewall), employee networks and programmes like 'Women in Leadership'. We promote disability and mental health awareness

and inclusion with our active participation in the Change 100 programme and our links with Mind Cymru on training our colleagues to recognise and support mental illness.

We have a strong shared culture, with our mission and vision shared widely with our colleagues. We recognise that we have some areas of siloed working and issues with cross team collaboration, exacerbated by our dispersed geography and lack of virtual working facilities. We have a culture change plan in progress and this will continue into AMP7 to address our cultural challenges. We may also undertake an organisational development and cultural change programme, which will focus on embedding change capabilities across our business allowing us to be more flexible.

Resilience Value: Ensuring our workforce is diverse and able to change will allow us to better adapt to expected and unforeseen shocks and stresses.

6. Implementing effective asset management systems

Resilience drivers

Our customers expect us to provide a reliable water and wastewater service. Our domestic and business customers have some tolerance for brief outages of supply, however, they become increasingly less accepting of outages the longer they last and the more frequent they are. There is also a low tolerance of wastewater flooding events as it is perceived as a negative impact on business and a health hazard.

Our customers expect us to have contingency plans in place and to rectify issues quickly to prevent impacts to businesses and homes. Protecting our critical supply assets is consistently ranked as being of high importance by our customers, as problems would have a major impact upon them.

As a result of climate change, storms are increasing in frequency and intensity and droughts are more prolonged. These factors place greater strains on our water resources, water supply service and our sewer networks and treatment works. These more commonplace extreme events place a greater challenge for continued compliance performance from our assets.

We need to protect our critical assets from flooding, loss of power and asset failure and ensure that our contingency plans are up to date and tested. We need to develop our systems approach which references our asset vulnerability against the failure of other critical infrastructure such as power or telecoms. We must also consider other external factors such as the energy market and the state of and our impact on the Welsh economy as a whole.

Building resilience into our assets

Protecting critical assets

In AMP6 we committed to improving our understanding of the resilience of our most critical water and wastewater treatment works, as well as through our supply and network assets. We are taking a proactive, resilience-based approach to protecting these assets to ensure that we minimise disruption to our customers at an affordable cost.

We have identified our most critical assets, where failure would lead to a significant service impact. In these cases, risks cannot be mitigated by operational means alone. We have developed resilience scorecards for these critical assets and we are undertaking a prioritised programme of improving protection at these assets. These scorecards rate resilience in terms of how well protected we are against extreme weather events, power failures, control failures, stresses including coastal erosion and our ability to recover from service failures arising from those events, and hence the overall risk to asset operations. Our resilience scores from these scorecards are reported to Ofwat annually, to demonstrate progress made in protecting our assets. We strive to continually improve the resilience of our assets, with a clear framework to achieve 100% score on our resilience scorecards on our most critical assets by 2050.

In our water supply system, we focused on dams, our water network above-ground assets, e.g. critical WTWs, storage and pumping stations, and our below-ground assets such as critical sections of trunk mains.

In our wastewater system we extended our focus to include key trunk sewers and sewage pumping stations, which could impact bathing and shellfish waters. In AMP7, we are also enhancing power

resilience at our critical WwTW and sewage pumping stations (SPS) to ensure that there are two discrete sources of supply that could supply 100% of our energy needs. We will also invest in the operational works, ensuring there are emergency plans and access, and conditions surveys at critical sewers.

In AMP7 and AMP8 we will focus on continuing to protect our critical network assets through projects such as Cardiff city centre network resilience and Cardiff wastewater treatment works coastal erosion resilience projects.

We believe we will start AMP7 at 52.7% resilience on our critical wastewater assets and will achieve 60% resilience. For our water supply assets, we are confident that we will achieve our target of 87% resilience for our critical assets.

The resilience improvement programme was planned by understanding and verifying the root causes which are affecting our score, by technical investigation and alignment with our investment manager system of risks.

Resilience Value: improving our understanding of the risks to our assets and continually reviewing the causes allows us to make more informed investments to build resilience.

Using technology to build resilience

We have installed new telemetry and SCADA systems to ensure we have visibility of our operations and they are fit for the future and resistant to cyber-attack. We have also implemented a new auditable security pass key system for chemical deliveries to our treatments works, which ensures that only certain individuals can accept chemical deliveries.

In AMP7, we will complete security upgrades at 22 sites per year. These upgrades will include:

- Securing access points, including windows and doors, and fencing and enclosures with appropriate resistance to intrusion
- Intrusion detection systems, including CCTV and lighting, linking alarms and access control systems to our corporate and telemetry systems
- Attendance management systems, to provide information around the presence and identity individuals in a controlled area
- Mothership, SCADA, telemetry and automated control
- Smart Blockage management through integrated catchment management (ICM), Blockage risk monitoring, Smart networks, maintenance and reliability support (MaRS) and Spot the Block our artificial intelligence to manage blockages
- Renew contingency plans for WTW and physical security upgrades
- Smart pilots – automation and control of storm tanks using predictive weather data

Resilience Value: using technology to support new ways of modelling, detecting and controlling systems will create more reliable service with fewer service interruptions.

Robust and long-term asset planning

We have created our long-term water resources management plan to assess the water supply and demand in water resource zones (WRZs) between 2020 and 2050. This highlights that most of our WRZs will be in surplus in this period, bar two zones for which we have highlighted high-level solutions to address the deficit. We are also working to build the resilience of these supply zones by linking WRZs. This is through projects such as Felindre Trunk Main improvements to link south-east and south-west Wales, Bwlch Tunnel, to re-enforce supplies to Deeside and the mainland and linking Hereford and Vowchurch WRZs.

We are in the process of updating our current Sustainable Drainage Plans (SDPs), which assess current and future risks for all our catchments. These SDPs will be replaced by Drainage and Wastewater Management Plans (DWMPs) which are at a larger scale, so will need an update of the current approach. The DWMP framework, which will be signed off in September 2018, are outcomes of the 21st Century Drainage Programme that is chaired by our Director of Environment, Tony Harrington. We plan to integrate DWMPs into our investment management processes to prioritise long-term solutions.

Over the past five years, regulation and good practice guidance relating to reservoir safety have seen significant updates. New regulations were introduced in 2016 driven by the Floods and Water Management Act 2010, reducing the capacity of reservoirs that are covered under the Reservoirs Act 1975 from 25MI to 10MI. This regulation has only been introduced in Wales and has increased the number of our reservoirs that will require statutory inspections and related maintenance from 86 to 131.

In addition, good practice guidance relating to the management of flood risk at reservoirs (Floods and Reservoirs 4th Edition, 2015) and relating to drawdown in an emergency (Guide to drawdown capacity for reservoir safety and emergency planning, 2017) have been introduced. These guidance documents will lead to the need to upsize spillways, raise dam crests and upgrade pipes and valves at our reservoir sites. As the safety of our customers is a key priority for us, we must upgrade and maintain our 131 reservoirs which provide 75% of the water supply for the 3.1 million people and businesses we serve.

Since 2015 we have adopted the new Risk Assessment for Reservoir Safety (RARS) methodology to carry out a comprehensive review of our reservoir asset base. The RARS methodology is a risk framework, which looks at the risk of several failure mechanisms of the reservoir and the subsequent risk of loss of life. This represents a real change in approach. Required investment and intervention is now being identified based on a proactive quantitative assessment of the risk called the Portfolio Risk Assessment (PRA), rather than simply reacting to observations and recommendations made during statutory inspections.

From the PRA, we have developed a multi-AMP strategy to improve our reservoir safety. At the end of AMP6 we will have completed works at ten sites to address priority issues and we have prioritised the investment required for AMP7, 8 and 9. This will ensure regulatory compliance and best-value for customers over the long-term.

We currently monitor the resilience of our critical reservoirs and report our performance via our annual regulatory returns. The resilience scoring is quantified using the following inputs:

- Failure risk of the reservoir (related to the PRA risk category);

- Access resilience to the reservoir - for both operational and construction purposes; and
- SEMD (Security & Emergency Measures Direction) classification.

At the start of AMP7, we believe our asset resilience score will be 85%. At the end of AMP7, owing to the investments necessary to meet revised legal obligations, we anticipate that the score will improve to 94%. We forecast by the end of AMP8, the score will further improve to 97%.

Resilience Value: planning for the long term will enable us to support long-term sustainable growth and deliver improvements in our service.

7. Safeguarding and enhancing the environment

Resilience drivers

In this section, we are focused on protecting the environment and promoting biodiversity as part of the provision of our service. Our customers want us to have a strong environmental conscience and reduce the impact we have on the environment⁶. An important aspect of the feedback was the viewpoint that the countryside and rivers should be protected for wildlife, health and tourism benefits⁷. This led us to add a specific strategic response 'supporting ecosystems and biodiversity' to our long-term strategy, Welsh Water 2050.

Our customers recognise our work such as our catchment management schemes can also have significant co-benefits, and feel it is important to protect the countryside and rivers to support tourism, recreation, wildlife and the wider health and well-being of Wales and the parts of England that we serve⁸.

Our long-term strategy, Welsh Water 2050, highlights that changing demographics, land use change, climate change and new sources of pollution all contribute to increasing pressure on the environment. For example, a growing population could lead to habitat loss and fragmentation, while at the same time increasing the demand for abstraction. In addition, in the future we might be subject to new, more stringent environmental standards and legislation. At the same time, we know that an environment that supports biodiverse ecosystems benefits our raw water supplies and encourages public participation and engagement with the natural world.

We will need new ways of working to deal with the impact of extreme weather events and intensification of agriculture, which may cause increased levels of pesticides, fertilisers, nutrients and pathogens, along with higher turbidity in raw water.

Considering our customer's priorities, the Well-being of Future Generations Act (2015) and our own commitment to delivering a holistically sustainable water service, we recognise that we have a duty to enhance biodiversity and promote the resilience of ecosystems in our work.

Building a resilient environment

Protection and promotion of the environment

A multitude of challenges threaten the integrity of our environment, and we want to mitigate this by protecting nature, enhancing biodiversity and promoting ecosystem resilience while we carry out our water and sewerage activities.

Our approach to protecting and enhancing the environment is embedded in everything we do. For example, we always consider RainScape as an option to manage surface water, reduce flood risk and reduce pollution.

Our Biodiversity Plan sets out our commitment to maintaining and enhancing biodiversity up to 2019, to meet our Environment (Wales) Act duties, and this will be updated in 2019. Our approach includes working with our communities and colleagues to highlight the importance of the environment, as well as undertaking specific environmental enhancements, including our National Environment Programme as agreed with NRW which includes conservation schemes and removal of fish barriers.

We have Biodiversity Champions, staff based on wastewater sites, who have the responsibility of to raise awareness of our biodiversity duties with our contractors. We also aim to promote understanding of Invasive Non-Natural Species (INNS) species, through our biodiversity booklet and our funding support to community and volunteer groups, who have projects to curb growth and spread of INNS. We work with river trust and community groups through our WFD third sector and biodiversity improvement grants schemes.

Resilience Value: improving ecological resilience will support the key natural resources our business relies on, helping to futureproof our service delivery.

Minimising environment pollution from our catchment

In our service area only 37% of rivers meet WFD 'good status', however of the actions required to improve this status only 9% are actionable by us. This means that to enable widescale change, we will need to continue evolving and developing new approaches to partnership working.

We have identified that a key cause of pollution from our network is caused by wastewater blockages. We have taken a two-pronged approach to this, using both behavioural science techniques to encourage customer participation and technology. Over half of sewer blockages are caused by customers flushing inappropriate items or pouring fats and oils down sinks. Our community outreach programme 'Let's Stop the Block' is a key method to address this sewer abuse, using a variety of innovative methods. This has led to an estimated reduction of 5% in sewer abuse blockages in the areas we are active. The technology used includes installing event duration monitoring (EDM) at all our CSOs by the end of AMP6 to highlight and mitigate for CSO which are high spillers. In AMP7 we plan to further invest in:

- ICM Live, real time forecasting of blockages
- Blockage risk modelling, creating maps of high- risk blockage locations to focus investment before issues impact on the environment
- Smart Networks, improved telemetry monitoring at CSOs, SPS and WwTW
- MaRS programme of condition based monitoring of pumping stations in business as usual

To reduce the impact on the environment from our wastewater activities, in AMP7, we will lead new Sustainable Management of Natural Resources (SMNR) approaches in four catchments, Rhyl, Afan, Alyn and Teifi, to establish different solutions to the wastewater challenges we have in those catchments. We plan to use a participatory approach to involve local communities and other stakeholders including NRW.

Resilience Value: Improving our monitoring and control of our wastewater systems will enable them to be more flexible and able to cope with change and ensure we direct investment effectively. Working in partnership is key to gaining wider environmental benefits.

Catchment management to improve water quality

Catchment management forms our first line of defence in improving raw water quality. In AMP6 we identified Safeguard Zones which are catchments at risk of raw water quality deterioration. To improve water quality in these zones we have developed WaterSource - our evidence-based,

collaborative approach to catchment management. WaterSource includes PestSmart and the Weed Wiper Partnership, peatland and fenland restoration, and reservoir interventions.

It also includes our Brecon Beacons Mega Catchment strategy, which in AMP7 will see us continue to strengthen stakeholder relationships, and create a sustainable steering group to oversee the implementation of activities. This includes buffer zones to limit livestock access to rivers, tree planning, peatland restoration and land purchase where necessary. As part of this work we will work with farmers to improve bulk storage of slurry and oil and working with communities to manage the impact of private WwTWs. We will also develop Farming for Water approach, which would consider appropriate rewards to drive good land management practice above regulation⁹.

Resilience Value: working closely with partners to improve land management will enable us to provide a better service to customers while also improving ecological resilience.

8. Delivering sustainable energy and resources

Resilience drivers

Our customers recognise that many organisations have commitments to reduce their overall energy consumption and to use renewable sources, and understand the importance of energy generation and energy efficiency measures¹⁰. This is seen as an important area to invest in, and our customers would like us to continue to do so¹¹.

As we highlighted in our long-term strategy, Welsh Water 2050, climate change will affect almost all aspects of our business, and the UK's power distribution resulting in more frequent failures going forward. We are committed to playing our part in mitigating climate change, as well as adapting to it. There are some natural resources used in our processes that are facing greater scarcity. In response to this, the circular economy principles support designing out waste, maintaining natural resources in a useable form and regenerating natural systems.

In response to these trends, our 2050 strategy led us to adopt a bold target – that we would become an energy neutral business by 2050, generating 100% of our own energy needs and minimising the energy we use.

As described above, there are many future trends that impact the amount of water available for our customers, as a key natural resource. We recognise that addressing leakage is key to ensuring we are efficient with our resource use and meet the expectations of our customers. Our customers often give us an emotional response when we talk about leaks – they feel it is wasteful and should be reduced wherever it is cost effective to do so¹².

Building resilience into our resource use

Sustainable energy use and generation

We want to increase our resilience to power failures and reduce our long-term energy costs, recognising that our customers' want to see us increase the proportion of our consumption that comes from renewable sources. Our approach is to boldly build self-generation capacity, reduce our demand by improving the energy efficiency of our assets and ensure we can buy external energy when it is cheapest.

We have focused first on minimising our energy use by implementing energy efficiency measures. In AMP6, and continuing into AMP7, we are investing to improve our network management, more efficient aeration processes, behavioural energy efficiency and the lighting at our sites. We also aim to keep our energy costs affordable through demand side management and storage.

We want our new energy generation capacity to be renewable where financially viable and feasible to do so, using anaerobic digestion, hydropower, solar PV and wind turbines. By 2021, we plan that 30% of our energy use will be from renewable energy generation.

For example, Five Fords Energy Park, a WWTW near Wrexham, is implementing several methods of generating renewable energy, with the goal of becoming self-sufficient as well as supplying energy to the local grid. The treatment works uses advanced anaerobic digestion, which is linked with a combined heat and power and a gas-to-grid plant. This plant produces biomethane, which is fed into the local gas grid for domestic and commercial use. In addition, the park is building a solar park and is planning to install a wind turbine and a hydro turbine at the works outfall. Processed sludge from

the anaerobic digesters is recycled to local farmers as fertilizer. The park has the first gas-to-grid plant in Wales, is the first UK water industry site to integrate so many technologies and will be the first Welsh WWTW to use its outfall for hydro-electric generation. It currently generates enough energy for about 5000 homes.

In the longer-term, we will review the way we manage the construction and operation of our assets and align this with the circular economy approach. This may be formalised in the development of a circular economy plan.

Resilience Value: Minimising our energy use and maximising the renewable energy produce will reduce our exposure to energy price volatility, reduce our impact on the environment, and increase the diversity of our energy supply making it more reliable in times of stress.

Robust supply chain

We are working closely with our supply chain to improve our resilience of physical resources and skills. We have a risk and value assessment that applies to the whole supply chain. Contracts with a gold rating (e.g. chemicals) have KPIs for alternative sources of supply and resilience.

We are updating how we manage our Capital Delivery Alliance partners and our Water Network Alliance. We have provided our Capital Delivery Alliance Partners with visibility of the AMP7 programme enabling not only effective resource planning, but also providing the ability to assist forecasting for procurement of equipment, services and suppliers. Our Water Network Alliance will use an innovative contract process to combine current contracts, improve efficiency of scale and improve the reliability of finding contractors to work in isolated and rural areas on reactive work.

We are working with our Capital Delivery Alliance to understand the regional variations in supplier capacity. There are some areas with limited capacity of skilled labour, due to demand from competing infrastructure projects (e.g. Hinkley and HS2). The Alliance has visibility and is therefore planning for procurement to the end of AMP6, with some forward planning for AMP7. We will continue to review ways to work more closely with our supply chain to identify needs of our business and theirs and potential long-term resource issues.

Resilience Value: improving how we work with our supply chain will help provide control over our people and physical resources, meaning resources are available when required and increases flexibility in the face of uncertainty.

Reducing water demand and leakage

We are developing a more innovative model of leakage reduction that works with the active participation of customers and communities by proactively identifying leakage, focusing beyond the customer boundary with the rapid repair or replacement of leaking pipes or appliances. This works towards our goal of no greater than 10% overall leakage by 2050.

In AMP6 we undertook the Leakage Transformation programme, which created a new team responsible for leakage strategy, detection, pressure management and water efficiency, this will continue in AMP7. We will improve our speed and accuracy of dealing with leakage events in AMP7 through:

- deploying our 'WaterNet' leakage tool,
- introducing permanent acoustic monitoring on our trunk mains,
- using drone and satellite imagery to identify burst mains,
- using automated and predictive systems to monitor pressure and manage leakage,
- improving economic modelling for leakage, and
- continuing to deploy digital smart meters in our deficit or marginal water resource zones.

We are also reshaping our demand strategy to focus on encouraging behavioural change by customers, due to our better understanding of customer side leakage. We know that up to 40% of total leakage losses occur on the 'customer supply' side. We are targeting individual properties that are likely to be experiencing leakage through Project Cartref (Home), which we trialled in 20 supply areas in AMP6. This is a scheme where we use innovative 'stopwatch devices' to detect very low flows that might be indicative of domestic leakage within individual properties. A dedicated trained plumber offers to carry out a domestic water efficiency audit to understand the source of leakage we offer leakage repairs and water efficiency devices at our cost. We are rolling this programme out to 30,000 properties, a 600% increase compared with AMP6.

Resilience Value: reducing overall leakage improves efficiency and prevents lost energy and resources used to treat this water, increasing resilience to resource scarcity. This will also build our customers trust.

9. Ensuring affordability and value for money

Resilience drivers

Affordability is defined in Delivering Water 2020 as “the ability of a customer to pay their water bill”¹³. Currently the majority (82%) of our customers believe that our bills represent good value for money¹⁴. However, as debt and poverty on the rise in Wales,¹⁵ we must work to ensure that our services remain affordable for all customers.

We must consider both current and future needs to ensure that delayed investments do not result in unaffordable bills for future generations¹⁶. As set out in Welsh Water 2050, we are committed to ensuring that we continue to provide the best service in increasingly innovative and efficient ways, and pass these savings on to our current and future customers to ensure that our service remains affordable for all.

We recognise that many of our customers are vulnerable, and that the rate of vulnerability could increase in the future. Our customers can experience vulnerability through a combination of factors, including physical or mental health, financial conditions or a change in life circumstances (such as a bereavement or a job loss). We are acutely aware that the areas of Wales and England that we serve include communities that are amongst the poorest in the UK. Moreover, Ofwat has identified that 32% of households spend more than 3% of their income on water, while 15% spend in excess of 5%¹⁷. It is vital we consider the economic and non-economic factors that lead to customer vulnerability, so that we can tailor our services to meet the needs of all our customers.

Building resilience for efficiency and affordability

Ensuring efficiency and value for money

Efficiency is an important narrative throughout our business and risk and value is analysed on all projects. This is undertaken as part of the capital investment process and applied to all part of our business and our external partners. It is an economic approach to risk management and considers whole life cost using net present value.

New ways of working and collaborating are key to our approach to efficiency, such as our integrated Water Network Alliance which will deliver us efficiencies of £10 million/year. This will include combining our leakage delivery partners into a single contract for the whole of our operating area. The Alliance will also integrate a new ‘pain and gain’ commercial model to drive improved performance and encourage risk sharing. Our Capital Delivery Alliance is working to create an optimisation team, in order to help configure assets in a more efficient and cost-effective manner.

Our iLab initiative is part of the governance process that we have in place to manage and prioritise new ideas across our entire business, many of these are focused on delivering efficiencies.

Resilience Value: improving our efficiency, in a resilient manner, ensures that we provide an effective and innovative service that is also able to cope with future change.

Ensuring affordability for all

We have identified over 25,000 customers in vulnerable circumstances and captured this in our priority services register, with a target of growing this number to 100,000 by 2025. We have

responses in place to deal with a range of vulnerable circumstances that our customers might find themselves in. In AMP6, to respond to customers in states of financial vulnerability, we launched our current social tariff, Help U, in 2015. Take up has increased since this came into being, and 2,000-3,000 new people register each month. The Rhondda Fach Water Resilience Communities pilot, detailed in 6.5 Water resilient communities: Rhondda Fach interim report, was set up to address the issue that social tariff take-up is lower in some areas than the socio-demographic profile of the area would suggest it should be.

In AMP7 we will follow our Vulnerable Customer Strategy which aims to proactively identify customers that need support and prioritises the role we have in providing employment opportunities to help marginalised and disadvantaged communities. This includes working with partners to understand the barriers they face. We are also establishing an Affordability team to oversee our work with disadvantaged communities, provide money saving advice and work with our partners. We have informal links with around 180 community and third sector groups. These are partners to help identify and work with these vulnerable customers. This includes local authorities, job centres, and money advice charities. We are working with Local Authorities on 'tell us once' schemes for bereaved families and teams have been trained to deal with bereaved families.

We will also pilot a flexible direct debit for financially vulnerable customers, undertake training for our colleagues on how to spot vulnerable customers, and fund debt advisors with Citizens Advice.

Resilience Value: ensuring that our customers are supported enables us to support wider resilience in the community, delivering resilience for all our customers. Our not-for-profit status provides us with the funds to build this service and our customers have told us that social tariffs are a key way to us our 'return of value' fund.

10. Enhanced business continuity

Resilience drivers

We need to make our service as robust and reliable as possible. Our domestic and business customers have some tolerance for brief outages of supply, however, they become increasingly less accepting of outages the longer they last and the more frequent they are.

Our long-term strategy, Welsh Water 2050, highlights that there is a great deal of uncertainty around the future environment. Extreme events are likely to become both more frequent and more intense. Climate change is likely cause increasing service continuity challenges, leading to more frequent extreme temperatures, as seen in 2018's Storm Emma, and precipitation changes, as seen in 2018's 'developing' drought. This could lead to a multitude of pressures on us including, but not limited to, an increased risk of both water deficits and flooding, reduced water quality, increased pressure on all our assets. We also consider other potential shocks from malicious intent, such as an increasing cyber threat.

A robust business continuity and emergency response approach enables us to deal with growing uncertainty and unexpected events.

Building resilience to support business continuity

Planning for extreme events

We plan for a variety of extreme events which impact our service with a set incident response structure, which is detailed in our Emergency Response Manual. We have Gold and Silver response teams who are tasked with getting the service back to normal when an event occurs.

We are currently rolling out incident management software which will make information centrally visible, this will be used by the Gold and Silver teams. We have developed our business continuity processes in line with ISO 22301 and an emergency management audit is undertaken annually for Welsh Government. Our Water Total Loss Contingency plans identify points of weakness in our system, including where energy supply loss could affect service delivery. We also have plans to expand our modelling our overall network capacity for the whole of Wales, to improve our planning tools.

To ensure that all our colleagues know what to do in an event we undertake a programme of exercises each year, with 15 emergency planning simulations each year, to test our responses to incidents. We are effective at mobilising extra personnel from across the business to support us in extreme events, and to support these colleagues we are planning training to prepare our staff for incidents. Members of the emergency planning team also undertake the emergency planning Cabinet Office training.

Our PR19 plan includes extra investment in upgrading our emergency response approach. This includes:

- Providing standby power generators to improve the resilience at operational depots,
- Mobile phone coverage in Silver rooms at all operational depots,

- Updating the emergency bowser plans (where they are deployed in different areas if the water supply was unavailable),
- Total loss contingency manuals update,
- Mobile command centre replacement,
- Updating emergency response plans, and
- Learning from the response to 'Storm Emma' and the 2018 Summer Drought, both our own lessons learn and learning from other companies.

We have invested in our preparedness for cyber threats by replacing our IT network and data centre infrastructure with enhanced cyber protection. We also have an independently assessed programme of cyber protection which has achieved the Cyber Essentials Plus accreditation, with a plan to become certified to ISO27001 by 2020.

Resilience Value: ensuring that we have robust processes in place, which our people understand and practice, means that we will be able to respond more rapidly and effectively in an incident, reducing the impact on our service for customers.

Continual learning from past extreme weather events to improve future management

During the cold snap in December 2010, and the issues that arose following the Boxing Day defrost we found that our winter planning was not in depth enough to properly manage the situation. Based on this experience, we now have a far more extensive water winter plan, with each operational area having a separate plan which gets reviewed and re-signed off every year.

At the start of the 2010 incident, we had a fleet of only 10 tankers and 50 four-wheel drive vehicles. By the end of this incident we had increased this to 35 tankers and 200 four-wheel drives as well as investing in our own snow clearing tools for them. We also found we were unable to identify critical alarms on reservoirs due to the set-up of our systems. This led us to install real-time alarms on our service reservoirs, which link up to SmartHub screens, which solved this issue. In 2010, we also recognised that we needed to improve how we looked after our people during extreme events. There was a 'hero culture' around working long shifts which would not be sustainable were the event to last for a long period. This led us to implement maximum 12-hour shift, mandatory days off, and named staff responsible for the welfare of Gold and Silver Teams. We are now planning in AMP7 to build on this still further, working with business physiologists to support getting back to normal work after a Gold response.

During Storm Emma in 2018 we identified a number of areas to improve and, after the post incident review, our Board provided £4 million investment to address these issues. We identified that our remote network monitoring in rural areas was not consistent. This led us to invest to implement monitors across the whole network, down to hamlet-sized residential areas, and implementation is currently in progress. As well as this, we have a new role in Silver response teams of a communications role, with a focus on identifying problem areas from social media traffic. We also plan, in AMP7, to invest in more heavy-duty snow clearing kit, and rely less on the Local Authority, to ensure that we are always able to access our sites.

We are effective at getting extra staff support in extreme events, with staff from across the business manning the customer lines during Storm Emma. For our response, we were commended by Ofwat, in 'Out in the Cold', for our customer communication response. This plan was recently shared as 'good practice' at the Water UK 'post Freeze / Thaw' workshop on 13 July 2018. Despite this positive feedback, we still plan to learn from issues that we flagged in the event, including creating an easier to use customer software and a wider training programme to prepare our people. We also aim to improve how we target communications better, especially to customers in vulnerable circumstances. We intend to enhance the current emergency procedures to further integrate management of customer communications into the 'Crisis Management' and Gold level command structures. There are also plans to create satellite customer contact centres and the introduction of home working to increase the resilience of customer communications.

In the remainder of AMP6, we will learn from other companies' cold weather response to Storm Emma for example aiming to work more closely with farmers and landowners who carry out road clearance for Local Authorities.

Resilience Value: being reflective of our experiences in extreme events is key to continually improve and create improved future decisions.

11. Bringing it all together: our systems approach

Our aim is to become a truly world class, resilient and sustainable water service for the benefit of future generations. To do this we need to continue to undertake programmes with significant resilience value which wide benefits to multiple drivers and take opportunities for more of a systems approach, such as our RainScape programme.

Pursuing projects with a significant resilience value: RainScape

Our RainScape programme involves retrofitting surface water systems and providing green infrastructure to slow, treat and return surface water to the natural environment while diverting water from our sewer systems.

We believe that implementing RainScape is the right thing to do in our systems due to the wide-reaching benefits and long-term resilience of this approach. It can provide a best value approach which protects our customers, environment and networks, while supporting growth and promoting well-being. Our Llanelli RainScape strategy is an award-winning approach which is the largest retro-fit of RainScape in the UK. In total 42ha, or 20% of the urban drainage area, has been diverted away from combined sewers and into natural watercourses. Rainscape provides the following benefits:

- Our customers can benefit from RainScape as it protects them from sewer flooding at a fraction of the cost of a conventional engineering solution, keeping our service affordable.
- The community can benefit from RainScape as it enhances public spaces, promotes sustainable transport and improves ecology, promoting community well-being. We aim to develop our RainScape interventions through public consultation and engagement with the residents actively participating in the design of the streets. RainScape can also provide room for growth, providing new critical infrastructure allowing opportunities for development.
- Our environment benefits from RainScape as it can promote biodiversity, green the urban environment and maintain flows in our natural waterways. It can reduce the amount of storm water entering our networks, which reduces the likelihood of CSO overflows and therefore reducing the risk of pollution. RainScape is also often the most efficient option, providing carbon savings compared to traditional approaches, reducing our contribution of climate change.
- Our networks benefit from RainScape as this approach reduces reliance on critical wastewater assets and improves the raw water quality in our operational area.

RainScape is an area where we can collaborate with other stakeholders, such as local authorities, to get the best outcome for all our investments. It promotes a joined-up approach to understanding existing assets and risks, and how these will be owned and maintained in future.

We plan to update our risk and value process to incorporate and value these wider social and economic benefits in our cost modelling. In AMP7, we plan to significantly expand our RainScape approach and remove the equivalent of 25,000 rooftops of surface water from the sewer network. In the longer term, we plan to install RainScape in all cities and conurbations at highest risk of sewer flooding and pollution.

The future shocks and stresses we have identified are only a current snapshot of challenges and that we may face in the future. This means that we will need to be adaptable to future events that may occur. We will continue to horizon scan to identify future trends as well as innovation opportunities and adapt our approach to incorporate these changes. Our plans for AMP7 will help us to improve our resilience. This is shown by our independent resilience assessment of the work we have planned, shown in Figure 4.

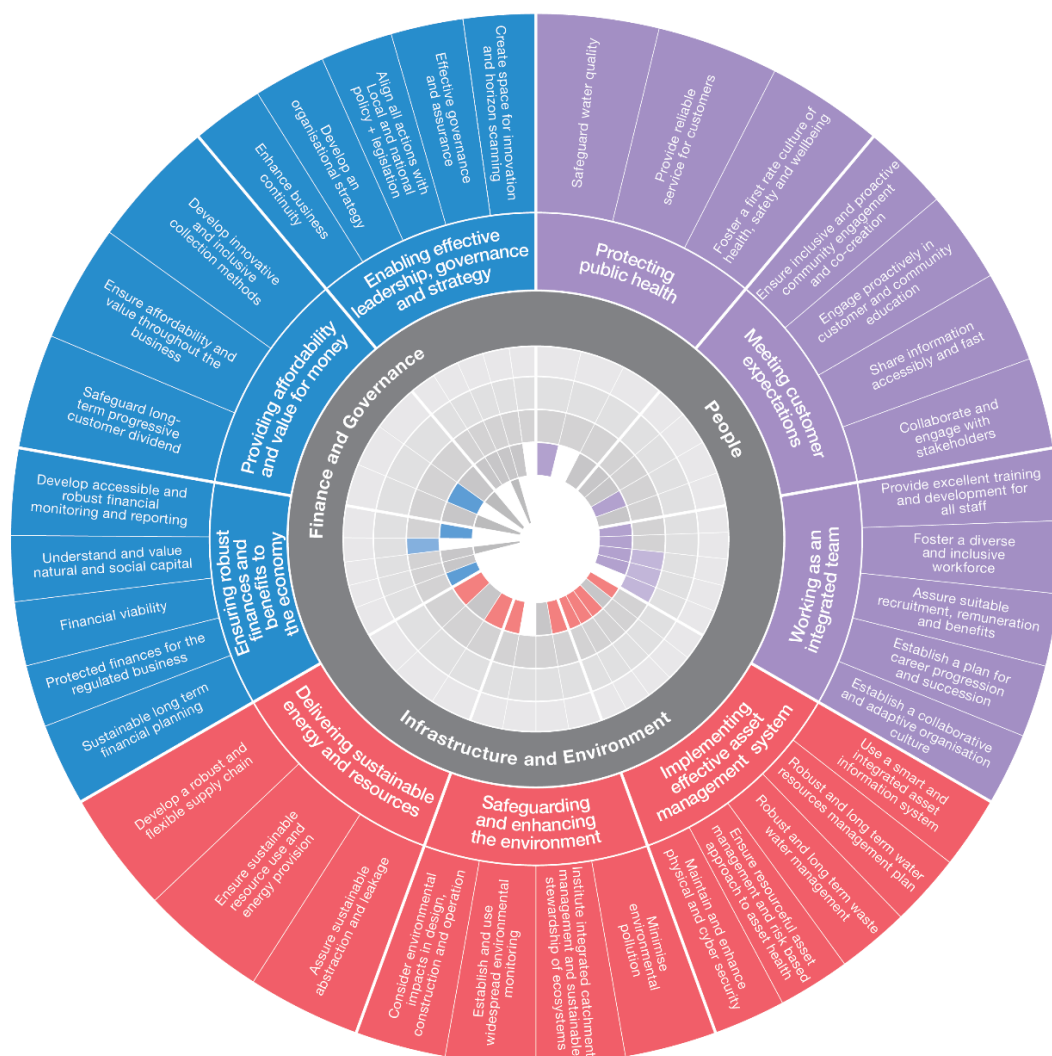


Figure 4: The results of the independent assessment of our Welsh Water Resilience Wheel.

We will need to continue to review and update our assessment of shocks and stress and update our organisational strategy every five years, to ensure it continues to be pertinent. During these updates, we will continue to involve the community in the decision making we undertake, and in the meantime working in partnership to deliver the current strategy.

Customers have been key to the development of our resilience approaches for AMP7 and beyond and will continue to be involved during the development of our plans. We will report to them each year on the progress that we have made. We will also continue to review and monitor how our approaches and innovation are providing improved operational resilience.

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