



Resilience in the round

Building resilience for the future
#resilienceintheround

Resilient, reliable and sustainable water and wastewater services are essential for people, for the economy, and for the environment.

Resilience is the ability to cope with, and recover from, disruption and anticipate trends and variability in order to maintain services for people and protect the natural environment now and in the future.

Though resilience has always been an important issue for customers and the sector, the nature, awareness of and tolerance to future threats is changing. As a result, resilience has moved up the political and social agenda. This document sets out how water companies might respond to the challenge of developing a coherent approach to resilience in the round.

Future threats to the sector are likely to increase in frequency, interconnectivity and unpredictably ([World Economic Forum Global Risk Report 2017](#)). These range from climate change and extreme weather events, to cyber security threats and a rapidly changing labour market. They demand an integrated and intelligent response. So it is right that resilience should be at the core of how the sector plans to deliver its services to customers. And, just as the threats evolve, so do customers' expectations; customer tolerance of service failures is likely to continue to decline.

Resilience in the round is what matters to customers and is a core concept for Ofwat. In order to manage resilience in this more complex and less predictable world, companies will need to see the bigger picture if they are to deliver against customer expectations – linking corporate, financial and operational elements together with customers at the heart.

This document provides water companies and others with food for thought on what resilience in the round might look like.

The dynamic nature of the threats facing the sector means that achieving resilience presents new challenges.

Companies will need to exploit new technologies and new ideas, as well as the existing tools available to them, to design innovative approaches to meet these challenges head on.

This document provides water companies and others with food for thought on what resilience in the round might look like in practice. It highlights a selection of case studies from the water sector and beyond, to illustrate good practice. But the sector is still on a journey – there are, so far, few solid examples of a truly joined up approach to resilience.

We are also, today, publishing a Targeted Review of Asset Health, conducted for Ofwat by CH2M, which highlights a series of challenges relevant to the themes explored in this document, including the need to take an integrated, long-term view of asset health, and the scope for greater innovation in the sector.

We hope companies are inspired by these examples and will consider a wide range of approaches which can be brought together to enhance resilience for the benefit of their customers.



A handwritten signature in dark ink, appearing to read 'J Russell', written in a cursive style.

John Russell
Senior Director, Strategy and Planning

A young boy with dark hair, wearing a light blue button-down shirt, is drinking water from a fountain. Water is splashing out of his mouth. The background is a blurred outdoor setting with greenery. The image is partially overlaid by a blue circular graphic on the left and a large white circular graphic on the right.

Resilient water and wastewater services continue to be a priority for customers, governments and wider stakeholders.

Resilience in context

The world the water sector operates in is changing rapidly. The scale, nature and complexity of new and emerging challenges will require novel and innovative responses to deliver the levels of resilience customers want and can afford now and in the long term.

Acute challenges such as cyber-attacks and extreme weather events, together with future pressures, such as climate change, population growth, and economic and social change, may increase in intensity and unpredictability. This will further emphasise the importance of resilience.

Resilient water and wastewater services have always been an important focus for companies and for Ofwat. It will continue to be a priority for customers, society, governments and wider stakeholders. This focus reflects the risks if resilience isn't achieved, including destructive and disruptive asset failures and an inability to cope with floods, droughts, and other natural hazards. And as the World Bank report in our case study below highlights, getting resilience right can provide value for society and the economy well beyond the immediate benefits to service delivery.

The Water Act 2014 gave Ofwat an additional primary duty to further the long term resilience of water and wastewater services. In the last price review, Ofwat agreed a number of successful resilience outcomes, such as the delivery of the [Birmingham Resilience project](#).

The Welsh Government's Water Strategy for Wales sets out the importance of the water sector's contribution to achieving the resilience of ecosystems. And the Welsh Government has led efforts to test the implementation of payment for ecosystem services markets.

The UK Government's draft strategic priorities and Welsh Government policies and draft objectives both emphasise the importance of resilience. The UK Government has also made clear that the resilience of the UK's water resources infrastructure is a key priority in its approach to water sector policy.

In 2015, we established an independent 'task and finish' group to consider what resilience means for the water sector. We set out our response to the group's work in December 2015 in '[Towards Resilience](#)'. In November 2016 we consulted on how to better incentivise resilience through our outcomes framework and put forward a set of principles for resilience planning.

In our 2019 price review methodology consultation, published in July 2017, we set out our draft resilience tests for the initial assessment of business plans and a further iteration of resilience planning principles.

The concept of "resilience in the round" is at the core of how companies should approach this issue. This includes:

- **Corporate resilience:** the ability of an organisation's governance, accountability and assurance processes to help avoid, cope with and recover from, disruption of all types; and to anticipate trends and variability in its business operations.

- **Financial resilience:** an organisation's ability to avoid, cope with and recover from, disruption to its finances.
- **Operational resilience:** 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.

This document sets out some ways companies might respond to the resilience challenge. The themes explored are inspired by the resilience planning principles, which should guide companies' own approach to resilience planning.

This is not a 'rule book' for companies to follow. We want water companies and others to use this document as food for thought as they develop their own innovative ideas and solutions for resilience.



Resilience in context

In 2015 “[Unlocking the ‘Triple Dividend’ of Resilience](#)” was published by the World Bank in the context of economic losses from natural disasters reaching \$150-\$200 billion globally each year, with devastating impacts on the achievement of international development goals. The study aimed to give both governments and other organisations better insight into the wider financial and social benefits of good resilience planning. It highlighted the global trend of increasing disaster and weather-related losses. However, the main focus of the report was how the value of resilience has three key components, which can be considered in understanding the benefits of good resilience planning:

- **Avoiding losses** – this benefit tends to be the primary motivation for resilience action.
- **Stimulating economic activity** – how good resilience encourages economic growth by making investors confident that risks and resilience are managed well (e.g. confidence in water services is essential for investment in many production activities).
- **Development co-benefits** – the added value of good resilience, particularly how more resilient systems often deliver ongoing service improvements (e.g. strengthening natural capital benefits such as recreation and food production).



It will be vital for companies to have a better understanding of the interrelationships and interdependencies across the systems underpinning their service delivery.

Systems thinking

Water and wastewater services are made up of a complex set of operational, corporate, and financial systems. They are also linked with a wide range of other systems. These include the broader natural environment, social systems, the economy and agriculture. These macro systems also operate in association with infrastructure systems such as communications and energy networks and highways drainage. Impacts on any of these related systems can impact water and wastewater service delivery.

As future pressures converge and increase in intensity, they are likely to increase interactions between these different systems. The legal, constitutional, societal and economic context water companies operate in, such as the nature of markets and the impact of the UK's exit from the European Union, will also continue to evolve. All these unpredictable elements will bring additional complexity and new challenges.

In this context, it will be vital for companies to have a better understanding of the interrelationships and interdependences across the systems underpinning their service delivery (see case study below on the Systems-of-Systems approach highlighting both risks and opportunities). Water companies typically have a good understanding of individual operational and corporate systems. But companies will need to adopt a more truly integrated view taking full

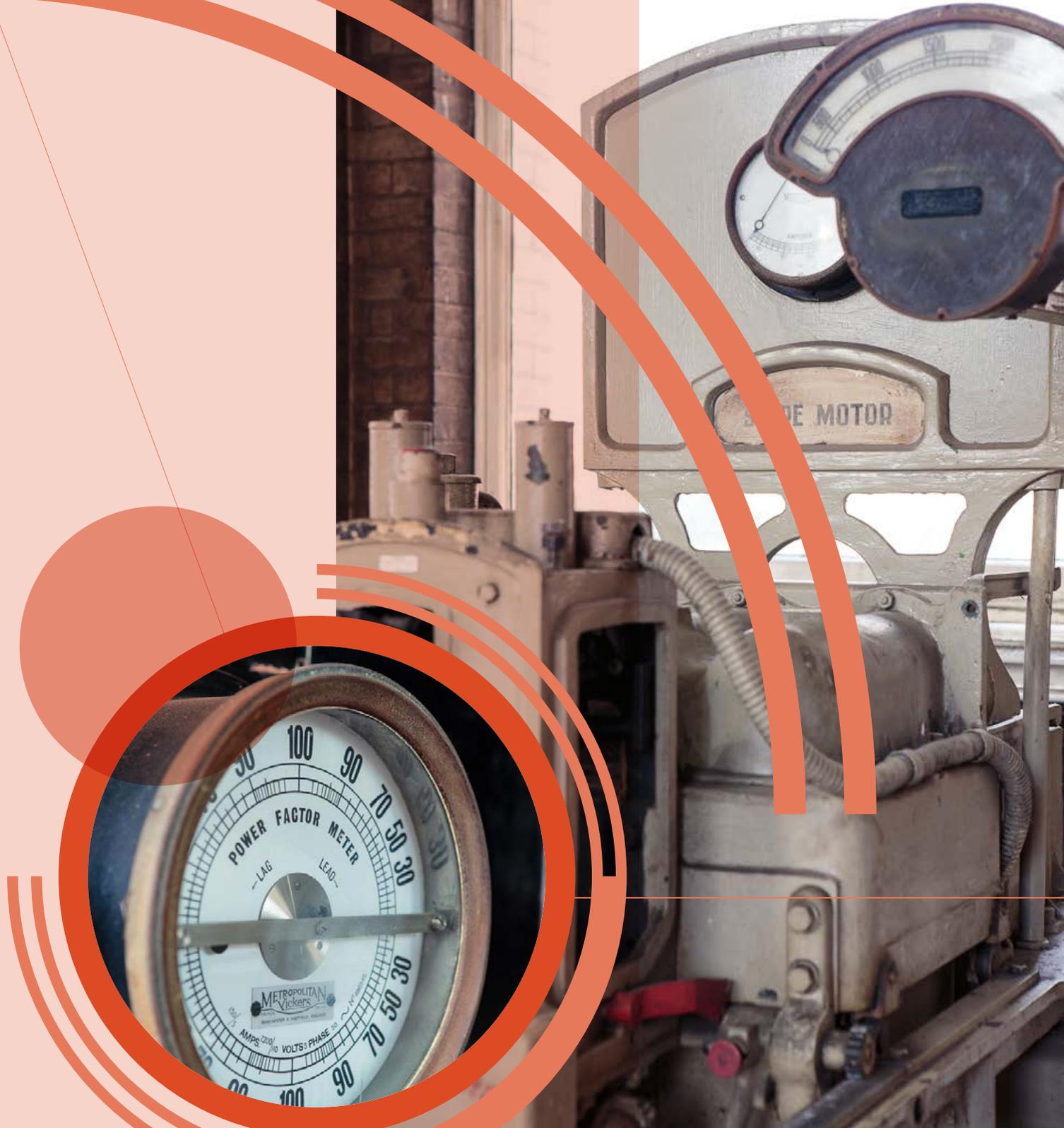


account of the interactions between disparate areas of their business. In short, companies need to adopt a systems thinking mindset at all levels of their businesses.

By taking a more systems based approach, companies will be able to see the bigger picture, and benefits are likely to include:

- **Better customer engagement** by helping customers understand the wider context of resilience, e.g. the links between energy security and water security.
- **Better planning** by understanding system pinch points e.g. bridges vulnerable to flooding which also carry key water and communications infrastructure. Or potential weaknesses in company supply chains which, if well understood, can be better managed.
- **Better value options** to deliver for long term resilience, e.g. catchment management schemes using environmental systems to deliver long term resilience outcomes, technology solutions such as remote sensing and control, big data and analysis, and potentially artificial intelligence as well as the ability to reveal commercial opportunities.

Resilience in the round is built upon the concept of interdependencies between related systems with customers at the heart of it all. To deliver against expectations, companies will need to demonstrate a sophisticated understanding of these interactions. This will enable them to deal with the causes of future threats, rather than just the symptoms, through adopting a stronger systems based approach.





Systems thinking

100 Resilient Cities and New York

100 Resilient Cities (100RC) is an innovative global network pioneered by the Rockefeller Foundation to help cities around the world become more resilient to 21st century challenges. The basis of the 100RC approach is to look at the system as a whole and include the physical, social, and economic interrelationships and interdependencies together.

The approach looks not just at shocks (superstorms, blackouts, heat waves, and other acute events) but also stresses that weaken the fabric of a city on a day-to-day or cyclical basis (aging infrastructure, unemployment, public transportation, inequality etc.). By addressing both the shocks and the stresses in a holistic manner, cities are better able to deliver basic functions in both good times and bad.

New York City was in the first wave of cities to join the 100RC network in 2013. Using the 100RC framework, New York City took a systems level approach in terms of assessing both risks and outcomes in developing its resilience strategy. By taking a more comprehensive systems approach New York City now has an integrated plan bringing together economic growth, societal health, sustainability and long term resilience.
<http://www.100resilientcities.org/>

The Future of National Infrastructure: A System-of-Systems Approach

A 2015 study from the Infrastructure Transitions Research Committee infrastructure research consortium sets out the value of a systems based approach to making choices about future infrastructure (energy, transport, water, waste and ICT). It illustrates how water and wastewater services do not exist in isolation and how interconnected systems and networks can deliver better outcomes for resilience and sustainability. They can provide a conceptual framework and methodologies for modelling and evaluating systems-of-systems.

Royal Society: Resilience to Extreme Weather

In 2015 the Royal Society considered resilience to extreme weather. It made a range of recommendations for how policy makers and others should integrate systems approaches to responding to extreme weather events. The report set out the need for better understanding of the interrelationships and interdependences both within and across whole systems. It observed that:

“Systems thinking is... central to the planning, design and maintenance of resilient infrastructure. It involves taking a holistic approach and recognising that vulnerabilities or failure in one sector can affect the whole system, potentially leading to a cascade of failures. These knock-on effects are due to interdependencies in the system, which can be exposed by stresses and shocks such as extreme events.”

We want to see companies embracing opportunities to ensure the natural environment can continue to support long-term resilience.



The environmental foundation for a resilient sector

The natural environment is at the core of water and wastewater service delivery. Managed well, this natural system underpins resilience. But managed poorly, it will exacerbate many of today's threats and introduce new threats in the future. Companies should see the environment not simply as a resource to be exploited, but as a key enabler of long term, best value, resilience. We want to see companies embracing opportunities to ensure the natural environment can continue to support long-term resilience.

The water environment is a finite, but largely renewable, natural resource for water and wastewater services. But changes in the natural environment, such as the effects of [climate change](#), or declining health of river catchments, can result in instability and fragility.

Upstream or catchment management (including Sustainable Urban Drainage Systems), water demand management





and environmental market approaches should be assessed and implemented wherever they provide best value. In particular, we want companies to continue to work with other stakeholders, in partnership, at all levels. Companies should make more use of innovative market-based mechanisms to achieve environmental resilience where they deliver best value for customers.

Water companies are an important set of stakeholders in planning for and achieving improvements to the health of catchments. We want to see companies working with others to implement a range of sustainable catchment management approaches.

At the 2014 price review, we were pleased to see the sector making some good progress on green infrastructure and catchment management. But the scale of these emerging options was generally modest.

The three case studies we have highlighted below are great examples of the types of schemes which work with the environment to deliver better, long term, resilience outcomes for customers.

Companies should now be actively seeking to adopt and develop these innovations to fully exploit their potential. Some, such as Wessex Water's EnTrade (see case study below), the Severn Trent Environmental Protection Partnership (STEPS), and Anglian Water's "Slug It Out" are notable examples. These, and other catchment management and system operation models, have the potential to offer widely applicable lessons.

The Natural Capital approach also provides an opportunity for the value of ecosystems to be better incorporated within the evaluation of resilience. In the 2019 price review business plans we are expecting companies business plans to consider their broader environmental impact. The Natural Capital approach could be incorporated into assessments of the impacts of company activities, and the effect they have on all facets of resilience in the round where appropriate.

The environmental foundation for a resilient sector

South West Water: Upstream thinking

South West Water's Upstream thinking project is a multi award-winning catchment management initiative. The project is pushing new boundaries on how water companies can work with the environment to deliver long term, sustainable, resilient outcomes for customers. The Upstream Thinking initiative works with a wide range of land users, such as farmers and conservation groups, to improve water quality, quantity and reduce runoff to improve key water catchments across the South West. This approach reduces the need for down-stream, end of pipe, fixed infrastructure solutions, which benefits both the environment and customers.

RainScape - Sustainable Urban Drainage Systems

Sustainable Urban Drainage Systems (SUDS) provide opportunities to deliver long term resilient drainage solutions for communities. SUDS work with natural systems and mimic natural runoff processes by reducing the flow rate into the system. Through this mechanism SUDS provide local sustainable solutions which can help reduce the need for wastewater infrastructure and reduce surface water flooding.

Dŵr Cymru Welsh Water's RainScape approach is using innovative solutions to manage the amount of surface water entering sewers. Using modern engineering materials, the RainScape project has created storage tanks beneath roads and kerbs to reduce the speed of surface flows through the catchment.

EnTrade

The use of trading platforms and market mechanisms to deliver outcomes is still relatively new in the UK water sector but holds great potential for the future. Wessex Water have developed a unique market platform, EnTrade, to reduce pollution in Poole Harbour. The scheme provides a market platform delivering water quality resilience by paying farmers, via reverse auction, to reduce their application of chemicals to the land in the catchment. This approach avoids the need for costly, less flexible fixed water treatment infrastructure at the bottom of the catchment. EnTrade is a recent winner of the Institute of Water's Innovation Prize.

Resilience is important for customers and companies will need to ensure customers are actively involved in determining the levels of resilience they receive.

Customers at the heart of resilience

Resilience matters because it is important to customers, and developing solutions to resilience challenges requires a sound understanding of customers' preferences.

In our recent report, [Tapped In](#), we highlighted our ambition for customers to be seen not simply as passive recipients of water and wastewater services but as active participants with a real impact on the services they pay for. And as the case studies below demonstrate, customers can play an important role in delivering more resilient services.

Resilience is important for customers and companies will need to ensure customers are actively involved in determining the levels of resilience they receive.

Engaging customers in decisions about resilience - particularly resilience to low probability, long-term, but high impact events, can be challenging, as reflected in the Targeted Review of Asset Health conducted for Ofwat by CH2M. For example, insights from behavioural science tell us that initially customers are typically better at assessing circumstances that affect them today rather than tomorrow. Nevertheless, these challenges can be overcome with

innovative approaches. Companies should inform customers of threats to resilience in a nuanced and balanced way, and company plans to mitigate against those threats should be supported by evidence of clear value to customers.

We have encouraged companies to change how they [engage with customers on resilience](#) issues in a number of ways, for example setting out our expectations for transparent community-led engagement being part of the planning process in the Tapped In report. Customer Challenge Groups also play a vital role in reporting on the quality of this customer engagement and how it is included in plans.

We have begun to see many companies embrace customer engagement across their business planning programmes such as Southern Water's domestic metering water efficiency campaign (winner of the Environment Agency's 2014 Chairman's Award). Companies will want to step up efforts to engage customers in determining their approaches to resilience in the round.

We will be expecting to see:

- Companies informing and **engaging with customers on resilience**. Companies should make sure their plans reflect the needs of future as well as current customers.

- **Greater customer participation which** embeds customer engagement in the design, production and delivery of their water and wastewater services. Participation techniques can help companies understand customer behaviour and preferences to improve long term resilience. [The Cabinet Office's open policy toolkit](#) provides insight into a number of innovative, yet cost effective engagement techniques. We are pleased that the sector has begun to embrace such [innovative approaches](#) and can take further inspiration from other sectors. For example, NHS "[Hack days](#)" help policy makers collaborate with experts to work together with patients to create solutions to policy problems. This type of method should be directly transferable to water companies.
- Companies **working with customers to co-create and co-deliver more resilient services**. In particular, customers have a direct role to play in informing the design of demand management options, as the case study from Belen, Costa Rica below, demonstrates.





Customers at the heart of resilience

Applying behavioural nudges in Belen, Costa Rica

Evidence from a randomised control study in Belen, Costa Rica demonstrates how water utilities can work with communities to develop targeted “nudges” to reduce water consumption. Focus groups were used to develop a range of behavioural interventions that were then tested across the municipality’s entire metered customer base.

One intervention demonstrated how using brightly-coloured stickers on water bills gives direct feedback on a customer’s water consumption in comparison to that of the average household in their neighbourhood.

Households with above average consumption in the neighbourhood received “frowny face” stickers while those below average received “smiley face” stickers.

This simple, but engaging, approach demonstrated real impacts on water consumption with an average household reduction of 3% - 6%. These findings are consistent with the effects of similar experiments conducted in other sectors in the UK, USA, and Australia.

Drought Resilience in Valencia, California

During a recent record-breaking five-year drought across much of California the state government quickly recognised the value of resilience through water demand management. By working with customers to manage the demand for water down, it was possible to conserve supplies and extend the timeframe. This is before further measures might be required, including restrictions, costly investment and environmental damage.

The Valencia Water Company pioneered a wide range of innovative initiatives with customers, such as tailored customer drought reports, enhanced information on bills, watering days and online education. As a result, between 2013 and 2015 water consumption in Valencia was reduced by 25%, meeting the toughest California state targets. This scale of water demand management represented a real resilience benefit for customers and communities both in terms of water security and customer bills.

Keep it clear – Anglian water

The majority of all pumping stations failures are the result of blocked pumps, costing £4m a year in the Anglian region alone which adds to the cost of water bills. The normal price range for call out for private drainage clearance is between £60 and £240.

Anglian targeted the root of the problems in their area - nappies, building rubble and food waste. It tested and piloted a number of initiatives using personal mailers, targeting key customer groups, including 35,000 local children through its “Keep It Clear Mad Science Shows”. It also improved customer participation by partnering with NGOs, retailers/ manufacturers and local government enforcement teams to roll out flushable test guidelines.

Anglian found a 20% reduction in blockages in locations such as holiday resorts where the campaign was rolled out.

Resilience planning

Planning processes are already well embedded in the water sector. But these processes, though increasingly long-term in nature, are typically focused on risk mitigation, rather than planning for resilience in the round. Risk management and resilience require different approaches, and we expect companies will need to adapt their approach to corporate, financial and operational planning to achieve resilience in an ever-changing world.

At the 2019 price review, part of the initial assessment of company business plans will be how companies demonstrate an appropriate planning approach to resilience management.

To plan effectively for resilience, companies will need to focus less on discrete elements of service delivery, such as financial planning, water resources, network operation and wastewater. They will need to shift towards a more integrated approach reflecting the interdependencies between these systems. But more than this, planning processes will also need to reflect a deeper understanding of interdependencies with other sectors and systems, such as the energy network, the labour market and supply of critical skills. Companies will need to have an increasingly sophisticated understanding of how these various internal systems interact with the supply chain and other organisations to impact on the resilience of local communities as well as the retail market.

The shift from planning to mitigate specific risks to managing cross-cutting resilience requires a more integrated approach to planning, to strengthen networks of services and functions, and to enable effective monitoring of resilience across the board.

Companies will need to put in place mechanisms to respond to new and emerging threats, some of which, such as cyber-security threats, are evolving rapidly. And planning processes

PR19 provides a clear challenge for companies to develop Business Plans which truly embrace planning for resilience in the round.

will need to accommodate considerable uncertainty in the way threats evolve and affect their businesses. Examples such as extreme weather threats, population movement and the effects of technology on consumer behaviour present clear challenges which companies will need to consider carefully.

Companies should explore and embrace national, international, and multi-sectoral best practice in planning. These include new and emerging planning techniques able to incorporate complexity and uncertainty into planning at an early stage. The two regional water resource groups ([Water Resources South East](#) and [Water Resources East](#)) are great examples of how advanced decision support systems can be used to identify better outcomes for best value, long term, resilience.

There may be opportunities for more widespread use of business continuity management (BCM) standards in the water sector. For example, few UK water companies currently hold a ISO 22301 BCM accreditation, which specifies requirements for a management system to protect against and respond to disruptive incidents. However, while such accredited processes may be useful in driving the adoption of integrated planning approaches, adoption of such standards needs to be accompanied by active management support and ongoing oversight.

Advances in technology provide clear opportunities to deliver improved efficiency, better service and enhanced resilience. But as companies embrace new technologies, they will also need to carefully plan to ensure they have access to the right skills and workforce capacity. The Energy and Utilities Skills Strategy case study below highlights good workforce planning and its essential role in the delivery of resilient water and wastewater services.

The 2019 price review provides a clear challenge for companies to develop business plans which truly embrace planning for resilience in the round. The combination of emerging acute risks and a clear focus on long term resilience, as highlighted by the Targeted Review of Asset Health conducted by CH2M highlights, means that the planning landscape is getting more complex. So companies must rise to this challenge and adapt and evolve their approaches with creativity, rigour, and imagination.



Resilience planning

Hunter Water, Australia, Critical Stage of Future Water Planning

Hunter Water Corporation (HWC), in Australia, is currently at a critical point in its water planning. It has a 20 year window before demands exceed supply capacity. HWC has set itself the goal of adding an extra 10 years to this timeframe. This will give them a window-of-opportunity to explore new solutions to offset the need for significant new fixed infrastructure solutions. They are taking an adaptive pathways approach to planning to help them understand key decision points and create additional opportunities in the planning process.

In the next 10 years, the company believes, technology will have advanced to enable potential new approaches, such as intelligent homes, greater customer choice and smarter infrastructure systems to be considered more fully. HWC has recognised the value of not investing too early in new water infrastructure that locks in substantial resources to large-scale solutions that may prove redundant because of changes in technologies and customer behaviours.

Energy & Utilities Skills Partnership

Energy & Utilities Skills Partnership is an initiative bringing together sector leaders from across England, Wales, Scotland and Northern Ireland, to find ways to ensure effective planning for a resilient, skilled and sustainable workforce. The Council of 29 Chief Executives has published the first ever **strategic workforce renewal and skills strategy for the UK utility sector**. It pursues three overarching strategic priorities (recruitment, investment in skills and targeted actions on skills) and provides a new foundation on which people and skills resilience can be based against existing and emerging UK policy priorities. Active measures to manage the future supply of skills needed to support innovation and new technologies are likely to be an important part of securing resilient operational and corporate services.



New, innovative, “smart” approaches to delivering long term resilience will be required.



Smart resilience

Just as increasing uncertainty and complexity implies the need for better planning for resilience, the same forces mean new, innovative, “smart” approaches to delivering long term resilience will be required.

The interventions delivering best value resilience outcomes are likely to be different to those effectively addressing individual risks. A smart approach to resilience needs a broader perspective, not only in terms of reducing the chance of threats but also improving the ability to cope and recover when they occur.

The water sector has historically invested in options which enhance capacity, especially operational capacity. Though additional capacity has an important role in delivering resilience against some threats, we now expect to see companies looking at a wider set of factors in order to deliver “smarter” options for the future. These factors are likely to include:

- **Valuing options which are scalable, adaptable and can be rolled out incrementally**, to manage uncertainty without locking a company into fixed options which may subsequently not provide best value in the long term. For example, some demand management interventions can be scaled up and down in response to both short term and long term pressures.
- **Addressing multiple threats through a single intervention.** For example, enhancing network connectivity to reduce the number of customers reliant a single source of supply. This type of approach can provide water supply resilience to multiple threats such as outages, drought and contamination.





- **Recognising that any intervention will have its own embedded vulnerabilities** to future threats. Understanding the vulnerabilities of option types will be critical to planning respective roles in delivering the planned level of resilience. For example, water transfers between areas of surplus and deficit can be a good options but might be vulnerable to wider scale drought impacts and/or contamination.
- **Accepting that a mixed set of options types might provide greater resilience in the face uncertainty.** Our case study for long term climate change management in Perth, Western Australia, shows the value in reducing reliance on a single resource type. The adoption of new technologies carry many important benefits, but systemic overreliance on a single technology may present a resilience risk. At the same time, manual backup systems may be less prone to failure or be better protected against emerging threats such as cyber-attacks.

In addition, the government's framework for resilience planning, [Keeping the Country Running – natural hazards and infrastructure](#) provides a useful outline of types of solutions to be considered in the water and wastewater sector.

Companies must be prepared to innovate in their thinking on how to deliver solutions, as highlighted in the Targeted Review of Asset Health conducted by CH2M, which points out that innovation in other sectors is considerably greater than that in the water sector. Collaborating with partners in other sectors and the supply chain with similar or shared objectives, but different types of expertise, may help deliver better overall value for money for customers. We have already begun to see some companies developing an innovation mind set. But we want companies to embed systemic models which create truly innovative approaches to operations but also to customer service and to corporate processes and practices. These approaches need to cover not only resistance to interruptions and failures, but also response and recovery. This includes companies considering how they can work with local partners to understand the impacts of service disruptions and interactions with other wider services. This will build integrated partnerships based on a sound mutual understanding of each others' concerns. This is likely to lead to companies needing to commit to, and to measure, recovery performance levels.



Smart resilience

Californian Reservoir Protection

In 2015, after four years of relentless drought, California was facing difficult choices about how to safeguard water supplies. In Los Angeles, city officials came up with a new, innovative, sustainable and cost effective solution - they used millions of cheap plastic (recycled) balls which float on and cover the entire surface of reservoirs. These plastic balls significantly reduce the amount of sunlight reaching the water and protect against algae growth (maintaining and enhancing water quality) and reduce evaporative losses.

Perth, Western Australia

The Water Corporation in Perth, Australia, historically had a high reliance on reservoir storage, at around 90% of supply. From the 1970s onwards the inflows to existing reservoirs slowly reduced as the climate shifted. Rather than simply build more reservoirs, which had previously been the favoured option, in 1980s and 1990s the Water Corporation took the decision to develop a mix of option types to provide resilience. Today the water supply for Perth is comprised of reservoirs (<10%) and a mix of groundwater, desalination and now water reuse via groundwater – all in combination with demand management. This mix of option types, each with their own individual vulnerabilities, provide Perth with greater resilience than reliance on a single option type.

Heathrow Winter Resilience

Following the severe weather at Heathrow in December 2010 BAA, which then owned the airport, commissioned the [Heathrow Winter Resilience Enquiry](#). The review made a number of important recommendations on how BAA could learn lessons to improve Heathrow's resilience to disruption in order to improve passenger welfare and experience.

In response, as part of its 2011 [Winter Resilience Program](#), Heathrow led the joint development, with airlines and other stakeholders, of a passenger welfare charter that clearly set out common ambitions to support passengers at times of disruption. The charter was accompanied by clear roles and responsibilities for both airlines and the airport. Heathrow also launched a formal Reservist Program – over 900 non-operational airport staff trained in passenger assistance roles ready to be deployed during both disruptive incidents and peak travel periods.

Developing meaningful methods to measure and monitor resilience should be an important factor in achieving resilience in the round for the long term.

Monitoring and measuring resilience

The ability to set a baseline and then measure and monitor performance is a pre-requisite for achieving sustained improvements in outcomes. So developing meaningful methods to measure and monitor resilience should be an important factor in achieving resilience in the round for the long term.

We have set out a clear expectation that as part of the 2019 price review business plans, companies will develop their own forward looking **resilience metrics**. These metrics will need to be focused on what matters for customers. We have been pleased to see progress being made by the Task and Finish Group on Resilience Metrics working to the Water and Wastewater Resilience Action Group (WWRAG) described in the case study below. However, more is required and we expect to see the sector working in partnership to embed these metrics in business plans.

Naturally, it is a challenge to develop metrics for resilience against rarely materialising or, indeed, so far unidentified or unexperienced threats. We recognise that some forward looking metrics will need to work in combination with more traditional, backward looking, performance metrics, such as mains burst frequency or interruptions to supply, to inform operational and corporate planning.

The ability to monitor and measure resilience provides important benefits which need to be developed further. These include:

- Improving **customer engagement**. If customers are better able to understand the relative baseline resilience of the services provided by water companies they will be better placed to engage in discussions on levels of investment and costs of resilience options. At the same time, aggregate measures may obscure important information, so great care will need to be taken in developing these metrics.



- Robust monitoring of resilience will also enhance companies' ability to **plan and deliver best value resilience investment**. Being able to understand what level of resilience different types of options could provide will support good decision making. In addition, as our Asian Water Development Outlook case study below illustrates, resilience metrics can also be used to highlight relative disparities in resilience standards between regions, which can inform strategy and investment in combination.
- Once companies have agreed resilience outcomes with their customers we will expect these to be incorporated within the company's **performance monitoring plan**. This will enable customers to hold companies to account for their performance, and support the building of trust and confidence in the sector.

Effective monitoring is also part of good corporate and financial resilience. Companies already report under the financial monitoring framework, which provides a view of their solvency, liquidity, and risk management, as well as their long-term financial viability. We also expect companies to maintain a focus on the resilience of their business. For example, their customers will be better served if their work force has the right skills to meet future challenges that changes in technology may bring. A company will only know this if it takes an informed view on the skills required, the threats to supply of those skills, and knows how much it needs to do to meet that requirement.



Monitoring and measuring resilience

The Asian Development Bank

Asian Water Development Outlook (AWDO), developed by the Asian Development Bank, provides one of the first national and international sets of resilience metrics – the National Water Security Index. Incorporating eastern Asia and Australasia, the AWDO has developed a methodology to compare and rate different aspects of water resilience, using common metrics, across countries.

Three outlooks have now been published in 2007, 2013 and 2016. The overall aim of each successive AWDO is to provide a better country-level snapshot of the region's water security status and provide guidance on recommended actions to improve resilience. While an index allowing for international comparisons, across a diverse range of countries, is necessarily high level in nature, the index provides a model which could be adapted for use on a range of geographical and operational levels.

Water and Wastewater Resilience Action Group – Resilience Metrics

The Water and Wastewater Resilience Action Group (WWRAG) established a Task and Finish team on resilience metrics in late 2016. This cross sector team developed a set of initial resilience metrics across water supply, wastewater, asset health and the environment. The key criteria the group used were to develop metrics which were forward looking, could be applied consistently and would be meaningful for customers.

The group developed methodologies for drought and wastewater flooding metrics and we discussed the potential for these to play a role as draft common performance commitments or performance measures in the Ofwat 2019 price review methodology consultation, published in July 2017.

Labour Availability Dashboard

Changes in the availability of skills and capacity in the labour market present potential resilience issues for water companies, supply chain and other partners. Energy & Utility Skills are now publishing a dashboard of key labour market metrics to help keep companies informed about trends in the labour market so they can plan and manage appropriately.



The Board has a strong role to play in understanding and leading strategic thinking on resilience.

Company Boards and resilience

How a company is governed and led plays an important role in the delivery of the service it provides. A lack of strong Board leadership and governance can lead to problems with service delivery to customers and how a company addresses the longer term challenges which it faces.

Resilience is about identifying and managing the risks to the delivery of the vital public services on which customers and society depend. We expect the board of every water company to focus strongly on resilience, through strategic thinking, challenging and supporting company management to deliver, and monitoring performance.

Delivering resilience in the round in the long term may require trade-offs over a range of complex, and potentially conflicting, factors. Ownership and responsibility for meeting this challenge must rest with the Board.

In addition to Boards taking ownership of the issues, strong corporate governance is essential. We seek to support and challenge Boards and companies through a range of tools. These tools help ensure they have robust arrangements in place to deliver the services that customers and wider society require. They help shine a light on what Boards and companies are doing to ensure services are resilient and challenges them to take action to improve resilience in a timely way.

Our Board leadership, transparency and governance principles set clear expectations for companies.

These include expectations about the importance of independent Chairs and Non-Executive Directors, and ensuring that Boards comprise high-calibre individuals with a diverse but relevant set of skills and experience.

A Board with the right composition of individuals and the right balance of skills can, with the right assurance processes in place, help deliver corporate resilience as well as challenge executive to deliver operational and financial resilience. The Northern Ireland Water Case Study below illustrates the risks attached to governance processes and Board leadership.

We encourage greater transparency on the level of financial resilience within regulated water companies, including by requiring companies to produce Long-Term Financial Viability Statements (LTVS) statements in their annual performance reports, which require companies to consider a number of factors consistent with guidance produced by the Financial Reporting Council (FRC) and the UK Corporate Governance Code (September 2014).

Our company monitoring framework encourages water companies to provide high-quality assurance of the information they produce and put processes in place so that the underlying data can be trusted.

We will continue to use these tools to encourage company boards to take ownership of delivering resilience and hold them to account, where it is clear that their approach has been ineffective. But, it would be a mistake for any company Board to see resilience

as something they need to do just to satisfy the regulator, they should be engaging with and delivering resilience for all their stakeholders.

For example, the Companies Act 2006 sets out certain expectations on how a company director will act, including considering the long term consequences of decisions. In doing so, they should have regard to a range of factors, many of which are aligned to fundamentals of delivering resilience in the round.

More generally, a company that understands the risks and threats it faces, and develops robust systems and processes to ensure resilience in the long term will be in a strong position to meet and exceed the expectations of all its stakeholders, including investors.



Company Boards and resilience

Northern Ireland Governance

Severe adverse weather in Northern Ireland in 2010 led to significant bursts of water mains and communication pipes across the network. Preparedness and the initial response arrangements were not sufficient in the face of a major crisis which occurred over a holiday period.

Subsequent reviews of the incident emphasised the role governance has to play in ensuring resilience to such events.

The issues identified included ensuring clarity (and appropriate scope) of senior management roles in major events. This included ensuring the right mix of relevant skills and experience within senior management, lessons from previous incidents were captured and acted upon and the importance of a corporate culture that focuses on customer service. These were reflected in a number of recommendations subsequently delivered by NI Water.

Cyber Security Tool Kit

The British Retail Consortium developed a Cyber Security Tool Kit in 2017 to build resilience against cyber security threats.

The tool kit provides comprehensive advice on cyber security issues for the retail sector but importantly incorporates the role of Board ownership and assurance well throughout. The toolkit provides a useful checklist for the Board which clearly help to define the appropriate level Board ownership appropriate to ensure cyber security resilience.



Companies must take ownership of the resilience challenge, and develop on the ideas... to develop their own innovative and integrated plans to bring resilience in the round to life.

Next steps

Resilience is important for customers and in this changing world will remain so in the future. It will continue to be a vital part of Ofwat's work.

Resilience in the round for the long term is a key focus in the 2019 price review. Just as we hope that this document will help to inform water companies' business planning for the 2019 price review and beyond, we also want it to be of use as they consider the corporate, financial, and operational challenges and opportunities presented by the full range of policy initiatives, and economic, social, and environmental trends which are emerging.

We will publish our 2019 price review Final Methodology in December 2017, which will take account of feedback we have received on the draft methodology we published in July. In September 2018, companies will submit their business plans which, subject to our scrutiny, will take effect from 2020-21 to 2024-25.

We will also be engaging with and responding to a range of UK and Welsh Government initiatives in the coming months and years which have a direct bearing on the delivery of resilience in the water and wastewater sectors:

- In line with their established policies, the UK and Welsh Government's forthcoming Strategic Policy Statements for Ofwat are both likely to emphasise the importance of long term resilience of water services and the natural environment;
- The UK Government has commenced the process to bring forward a National Policy Statement for water resources, in 2018 to ensure that the

planning system facilitates delivery of nationally significant water resources infrastructure projects;

- The National Infrastructure Commission will also publish a National Infrastructure Assessment in 2018 which will identify infrastructure needs and suggestions for how these needs can be met; and
- The Welsh Government's continued delivery of its Water Strategy for Wales, within the context of its broader focus on sustainable development, places a clear emphasis on the importance of sustainable and resilient infrastructure, communities, and natural resources.

Companies have also begun the process of developing their Water Resource Management Plans. This will set out how they will provide a secure supply of water to their customers. These will take effect from 2020. As part of the 2019 price review process, we will be focusing our attention on how companies are addressing resilience of wastewater services, particularly through the Drainage Strategy Framework.

In April of this year we opened the largest retail water and wastewater market in the world. It is still early days only six months on, but we are actively monitoring its development to identify whether new services that are innovative and resilient are emerging that could offer value to all customers.

However, the next steps to be taken by companies are the most important. Companies across the sector must take ownership of the resilience challenge, and consider the ideas and examples in this document, to develop their own innovative and integrated plans to bring resilience in the round to life.

Ofwat
Centre City Tower
7 Hill Street
Birmingham B5 4UA

Phone: 0121 644 7500
Fax: 0121 644 7533
Website: www.ofwat.gov.uk
Email: mailbox@ofwat.gsi.gov.uk

[Twitter.com/Ofwat](https://twitter.com/Ofwat)

ofwat

Trust in water

Ofwat (The Water Services Regulation Authority) is a non-ministerial government department. We regulate the water sector in England and Wales. Our vision is to be a trusted and respected regulator, working at the leading edge, challenging ourselves and others to build trust and confidence in water.

September 2017

ISBN 978-1-911588-11-5

© Crown copyright 2017

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit nationalarchives.gov.uk/doc/open-government-licence/version/3 or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email psi@nationalarchives.gsi.gov.uk.

Where we have identified any third party copyright information, you will need to obtain permission from the copyright holders concerned.

This document is also available from our website at www.ofwat.gov.uk.

Any enquiries regarding this publication should be sent to us at mailbox@ofwat.gsi.gov.uk.