

Appendix 12a: Water Resilience in Yorkshire



WATER RESILIENCE IN YORKSHIRE

The methodology and findings of our new framework
to quantify the resilience of our business and services

AUGUST 2018

CONTENTS

ABOUT THIS REPORT

This publication openly shares the process and findings of our new cutting-edge resilience framework. We describe how we have brought together, and further developed, a range of best practice resources to create a repeatable process to quantify the resilience of all areas of our business and the services we provide. In this report we summarise our approach, findings and future plans to maintain and enhance resilience. A separate appendix document provides a detailed, systematic overview of the resilience of each part of our business, including the interdependence mapping we have undertaken as part of our “systems thinking”.

The appendix is available on our website at www.yorkshirewater.com/resilience

TRUSTING THIS INFORMATION

We have undertaken multiple assessments of our resilience to assure our approach, including an independent assessment of our resilience maturity by the Cabinet Office Emergency Planning College - the first in the water industry. We summarise the steps we have taken to assure our resilience in Section 4.

We always want to provide information you can trust. Our Assurance Plan explains the process we have in place to give confidence that the information we publish is accurate, accessible and easy to understand.

You can find our Assurance Plan on our website at www.yorkshirewater.com/discoverwater

GET IN TOUCH

We invite feedback to help us advance our approach to resilience in Yorkshire and we welcome opportunities to support the development of a national standard in the water sector.

Please get in touch with your feedback and questions.

Gordon Rogers
Head of Sustainability
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A comprehensive overview of the resilience of each part of our business and services can be found in the appendix to this document, available at www.yorkshirewater.com/resilience

We know how important it is to our customers that they can trust us to always act responsibly in their best interests and to provide highly reliable water and wastewater services today and long into the future, no matter what the circumstances.

In simple terms, that is what it means for us to be 'resilient'.

FOREWORD



A strong focus on resilience is not new to us, we cannot meet our duties without it. We have listened and actively responded over recent decades when our customers have consistently told us this is a top priority. Over recent months, we have engaged with more customers and stakeholders than ever before to help shape our plans, and this priority has again shone through. Our plans for the next 5 and 25 years have been built with resilience at their heart. Despite a range of growing challenges to our resilience, we are working differently so we maintain and further enhance resilience while keeping bills low.

The resilience of Yorkshire's public water supply is nationally leading, following our response to the severe disruption caused during the drought in 1995 and 1996. This has shaped our culture ever since, with investment in the country's most connected grid network that allows us to move water to where it is needed, combined with extensive long term and emergency planning. We have been tested by several droughts including the one this summer. We have maintained supplies without the need for hose pipe bans or other restrictions.

Our analysis of the latest evidence shows that we cannot be complacent. Extreme weather events seem to be coming more often, and our resilience will be eroded by a range of pressures if we do not act, particularly the changing climate and growing population. Therefore, we are building on our successful long term performance by working towards bold commitments for further substantial reductions in leakage, pollution incidents and sewer flooding. We are also acting to ensure the resilience of our people, processes and systems, for example, securing our IT systems from increasing cyber attacks and simplifying our financial structure.

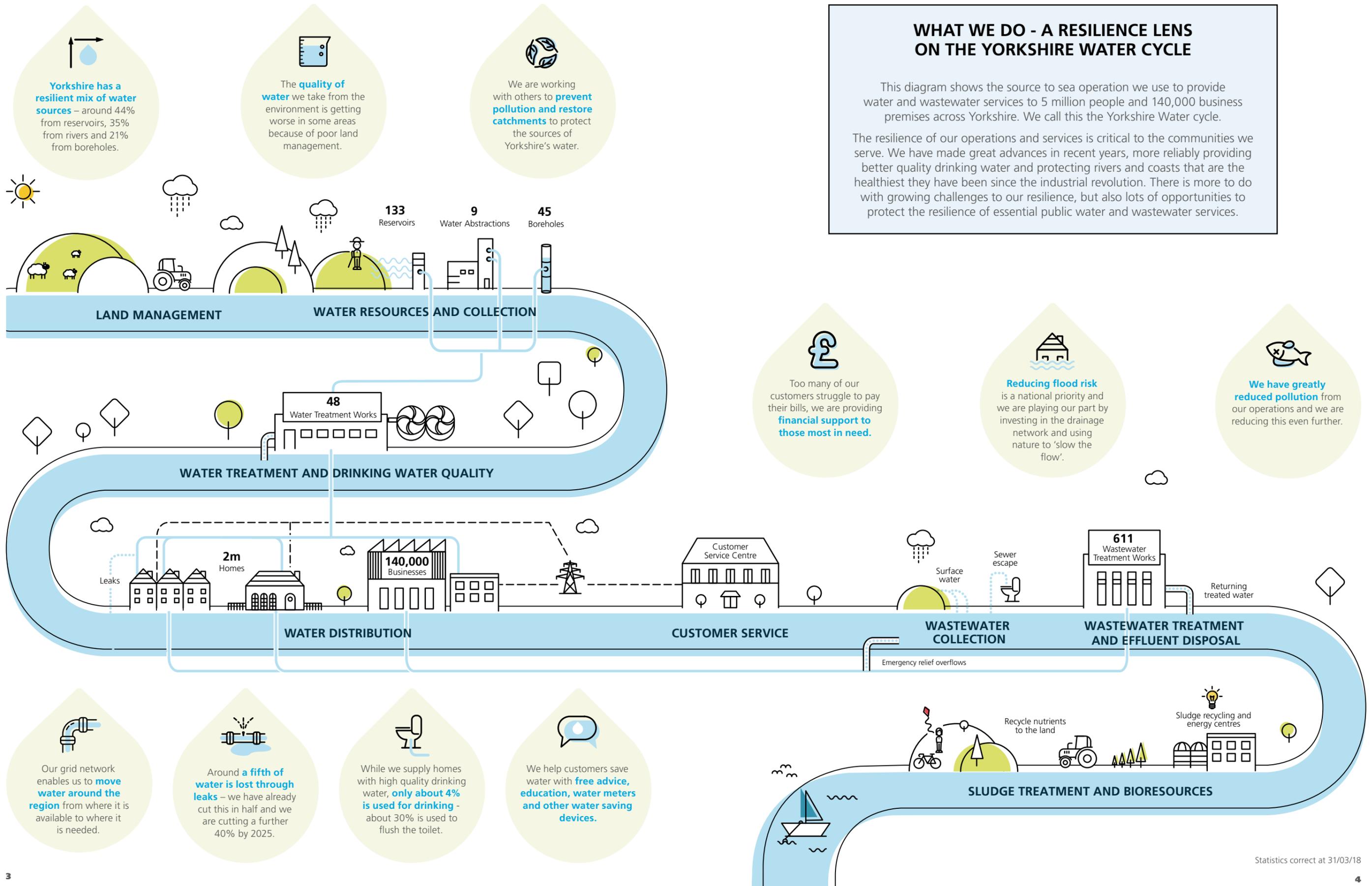
It is a national and regional priority to reduce the risk of flooding and improve how communities can cope with extreme storms. Simply building ever larger sewers is not affordable or sustainable, so we are working in partnership on a range of traditional and innovative approaches.

We are restoring natural landscapes to slow the flow of water, and I am delighted that we have already planted tens of thousands of trees in the Calder Valley as part of our commitment to plant one million trees over the next decade. Working as part of the Living With Water partnership in Hull, we are developing and testing a new City Water Resilience Framework as part of a joint vision for this area – the only city in Europe to be involved in this innovative project, which we can then apply to other communities across Yorkshire.

I challenged my team to deliver an industry leading resilience framework that adds further depth to the useful work already done in the sector, including Ofwat's publication 'resilience in the round'. And I am pleased with our progress. Working with resilience experts at Arup, we are leading best practice with an approach which uses 'systems thinking' and quantifies our resilience so we can compare relative strength and track progress over time. We have aligned our approach to the British Standard for Organisational Resilience, BS 65000, and we were the first in the water industry to have the experts at the Cabinet Office's Emergency Planning College assess our maturity against this standard.

I am delighted to openly share the new approach we have developed and the findings of our assessments. We believe this is the most comprehensive framework yet developed in the UK water sector and I hope it will become an industry standard. I would welcome your feedback and look forward to supporting national debate and progress.

Richard Flint
Chief Executive



EXECUTIVE SUMMARY



RESILIENCE IS A LONG STANDING FOCUS FOR US

Customers highlight resilience as a top priority and we know the significant impacts that can result from disruption to public water and wastewater services.

The reliability of our essential services is critical to communities, economic growth, environmental protection, and ultimately to human life and livelihoods.

We have a resilient business, successfully maintaining services through many extreme events over recent years as well as responding to long term trends. For example, our water service is one of the most resilient in the country with advanced emergency and long term plans combined with our highly flexible grid network which has recently been extended to 99% of the population.

There are always limits to levels of resilience and we can never be complacent. Our resilience will be eroded by a range of pressures if we do not act. There are many factors that we monitor and plan for, including extreme weather, climate change, population growth, cyber threats, complex supply chains, and global financial instabilities.

We have a thorough understanding of the internal and external environments that we operate in and how they are changing. We have the right governance structure, processes and programmes to ensure a coherent and integrated approach to managing these risks and we are taking the right steps to continue to strengthen our resilience across the business.

We need to enhance the performance of increasingly complex systems in the face of multiple hazards, as well as preventing or mitigating the loss of assets and services due to specific events. To advance our approach to resilience at the Company, project and community levels, we have:

- Engaged customers to understand their resilience priorities and shape our new plan, and also to agree how customers will support effective resilience.
- Developed a best practice framework which enables us to better govern and openly report our resilience. The framework is leading in its use of 'systems thinking' and its process to quantify resilience across the whole business.
- Undertaken a range of detailed resilience assessments to help shape an effective business plan and specific proposals within it.
- Started an innovative project with Arup and the Rockefeller Foundation to pilot the new City Water Resilience Framework in Hull with our Living With Water partners.
- Aligned our framework and Integrated Management System (IMS) to the British Standard for Organisational Resilience (BS 65000). We were the first water company to ask the experts at the Cabinet Office Emergency Planning College (EPC) to independently assess our maturity to the best practice standard.

WHAT IS RESILIENCE?

“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.”

Resilience Task and Finish Group, Summary Report 2015, adopted by Ofwat

We have ensured our current activities, new five year business plan and long term strategy all have resilience at their hearts.

The most efficient and effective plan has been developed with a mix of innovative and partnership solutions alongside mature and accepted traditional solutions where they remain the best option. We have used our Decision Making Framework (DMF) to assess mitigation options to ensure the best value approach. We have also examined how we might apply our six capitals approach as part of our resilience framework to help us fully understand the impacts.

In this report, we explain the process of, and findings from, our new cutting-edge whole-business resilience framework, including how customers and stakeholders have shaped this and how independent assurance confirms our approach is robust. We also provide a summary of the current resilience of each part of our business, and how we are maintaining and enhancing resilience through our plan to 2025 and our strategy beyond. In the appendix accompanying this report, we provide more detail with an overview of the resilience of each of our business functions, including more granular resilience scores, interdependence maps and more information on our plans to maintain and enhance resilience. The appendix can be found on our website at www.yorkshirewater.com/resilience

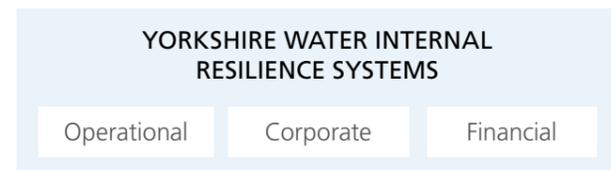
THE FINDINGS OF OUR RESILIENCE ASSESSMENT

We have worked with Arup, leaders in resilience planning, to deliver a substantial project to develop a repeatable framework which quantifies the resilience of all our activities and which builds on recent work in the water industry, including Ofwat's publication 'resilience in the round'. The framework has been developed by adopting international best practice and tailoring this to complement our existing risk and resilience processes.

The approach uses and aligns to the best practice BS 65000. We use the maturity rating from the Standard to quantify our resilience in different ways, including:

16 internal functions (or 'systems')

These cover all our corporate, financial and operational activities and processes. We examine the resilience of these systems to a comprehensive range of internal and external shocks and stresses which could ultimately impact our services.



Five qualities of resilience

This approach expands on the widely accepted Cabinet Office model for effective infrastructure resilience by adding a fifth measure which recognises the value of learning from events (reflection).



Four timescales

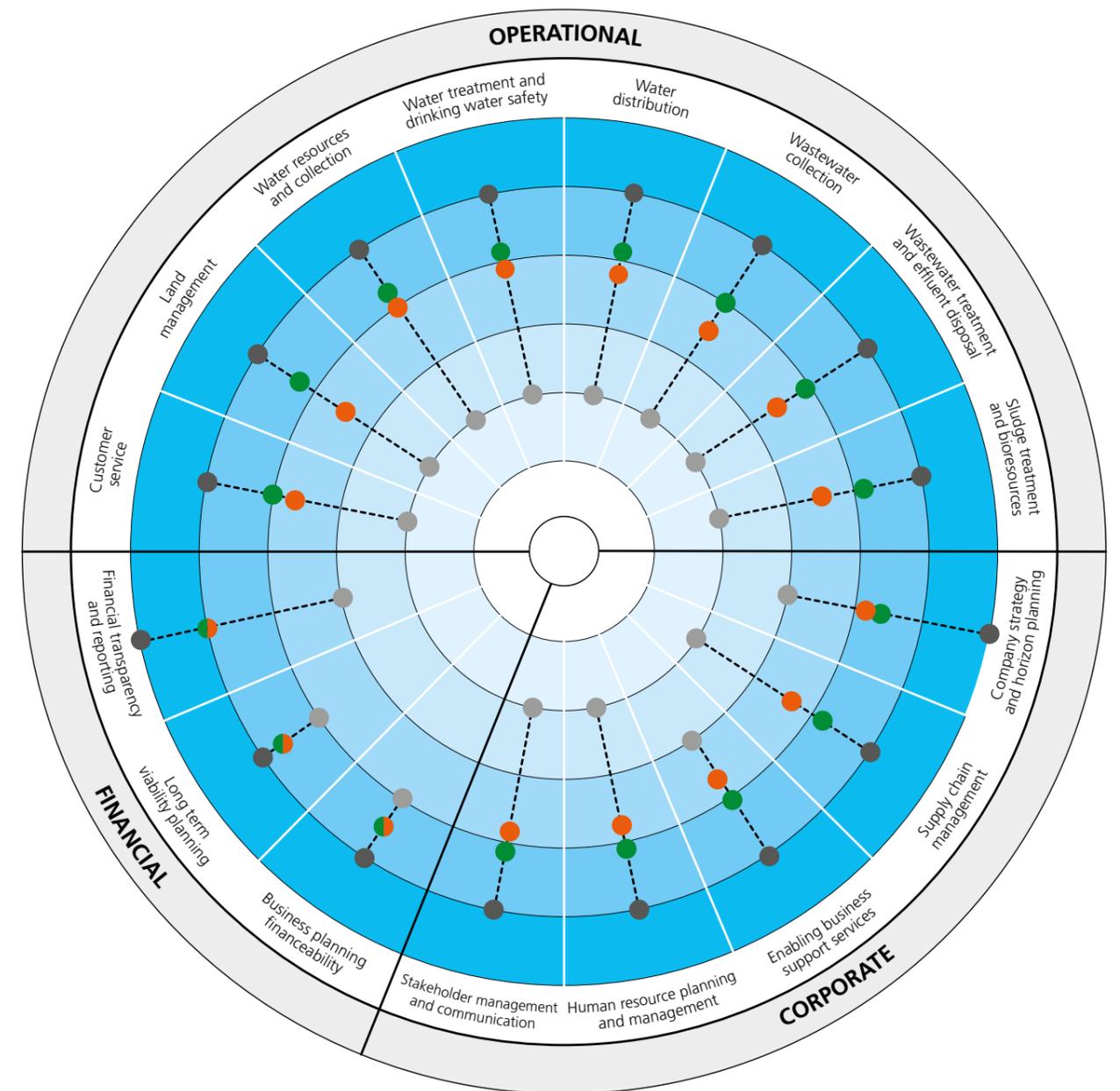
- 1989** A high level review of our resilience at privatisation.
- NOW TO 2020** A detailed review of our current/near future resilience, assuming completion of our plan to 2020, including the extra investments we have committed to.
- 2025** A detailed review of our resilience assuming we complete the proposed investment plan to 2025.
- 2050** A high level review of the long term, assuming continued levels of investment and projected climate and population trends.

The framework also considers interdependencies within internal systems and with the external systems in which we operate, such as other infrastructure systems and the natural environment. Effective consideration of interdependencies is widely recognised as complex and challenging so this demonstrates the leading nature of our approach.

We have also undertaken a range of detailed resilience assessments to help shape an effective business plan and specific proposals within it.

The diagram opposite shows the headline findings. The maturity and rate of improvement in our resilience varies depending on the combination of shocks and stresses facing that part of the business, and the potential for mitigating actions and supporting levels of investment. Throughout this report and in the appendix you can find more detail on our framework, our assessment findings and our plan to secure effective resilience.

Our assessments show that our business plan will maintain and enhance resilience in all areas of our business and essential services, against the broad range of shocks and stresses we face, and despite increasing pressure from climate change, population growth and other factors which would erode resilience if we did not act.



MATURITY SCALE	YEAR
LEVEL 5: OPTIMISING	1989
LEVEL 4: PREDICTABLE	2020
LEVEL 3: ESTABLISHED	2025
LEVEL 2: MANAGED	2050
LEVEL 1: BASIC	
LEVEL 0: IMMATURE	

OUR PLAN TO ENSURE EFFECTIVE RESILIENCE

We apply a mix of approaches that work together to ensure an effective approach to resilience. Our resilience framework and assessments show that our plan will maintain and enhance resilience in all areas of our business and the services we provide.

Key elements of our plans are summarised below and further set out in Section 3. We provide a comprehensive overview of our current approach and future plans for each of our business functions in the appendix.



RESISTANCE
Protection to withstand a hazard.

<p>Sewer demand management by reducing the amount of rainwater entering the network and working with customers to reduce inappropriate items being flushed.</p> <p>Catchment management to protect raw water quality while delivering wider benefits for recreation, biodiversity and carbon storage.</p>	<p>Water demand management by cutting leakage and supporting customers to use less.</p> <p>Protecting critical assets to maintain services despite extreme events.</p> <p>Investing in defensive technologies to protect against increasing cyber attacks.</p>
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RELIABILITY
The ability of an asset to operate in a range of conditions.

<p>Maintenance to ensure assets are functioning as designed and ready when called upon.</p> <p>Enhancement to ensure assets meet latest best practice and legal requirements.</p> <p>Innovation to increase our ability to respond to priority resilience threats and opportunities.</p>	<p>Design standards to ensure new assets and processes are planned to be robust for their expected lifespan.</p> <p>Diversity, training and development of our workforce to ensure agility, competence and expertise.</p>
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REDUNDANCY
Designing capacity into a system.

<p>Enhancing network capacity and flexibility so we have options to move water and wastewater to where it needs to be.</p> <p>Backup systems in operations, IT and supply chains to ensure continued service when something fails.</p> <p>Managing gearing to provide financial headroom in case of an economic shock.</p>	<p>Catchment management to reduce flood risk by working with nature to make space for storm water while delivering wider benefits.</p> <p>Multi-agency partnerships to deliver a joined-up approach to long term planning and preparedness, for example on flood management.</p>
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RESPONSE AND RECOVERY
Enabling fast and effective response to, and recovery from, an event.

<p>Emergency planning and equipment to improve readiness for unusual events.</p> <p>Communication to support and engage the public during an event or emergency.</p> <p>Collaboration with other agencies to ensure a joined-up emergency response.</p>	<p>Real time monitoring and control to see and manage our assets.</p> <p>Mutual aid agreement with other water companies to share resources in times of need.</p> <p>Insurance to support the costs of loss or damage we might incur as a result of extreme events.</p>
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REFLECTION
Continuously evolving as a result of learning from past experiences.

<p>Incident reviews to learn from events and raise improvement actions.</p> <p>Internal and independent audits to test our approach and raise areas for attention.</p> <p>National engagement to share our latest insight and learn from others.</p>	<p>Risk and Resilience Committee to ensure regular, ongoing senior level oversight and direction.</p> <p>Horizon scanning for latest evidence on matters that could influence our business, applied to inform our strategy and plans.</p>
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1

WHY RESILIENCE IS A PRIORITY

OUR SERVICES ARE ESSENTIAL

We understand how important our water and wastewater services are for the people and business we serve. Our water is used in the home for drinking, washing and cleaning, and by businesses for producing goods and food products. We all use it for brewing a good cup of tea or coffee! We also collect the human and wastewater from our customers' premises, along with rainwater that runs off roads and roofs into our sewers. We take wastewater out of harm's way and treat it for safe recycling back to the environment.

The consistent, reliable and quality provision of our services is essential to the people, economy and environment of Yorkshire.

“

STAKEHOLDER QUOTE

“Securing the long term resilience of the water sector is not simply the role of government or regulators. Water companies must lead the way in taking action to ensure that they can continue to meet the needs of people, businesses and the environment. We want to see the sector work with customers, partners and regulators to develop a strong understanding of future needs, explore every option to meet these needs, and build consensus on their plans for delivery.”

Department for Environment, Food & Rural Affairs, *Creating a great place for living - Enabling resilience in the water sector*, March 2016

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WE FACE GROWING CHALLENGES

Resilience has long been a top priority for us because we know the significant impacts that can result from disruption to public water and wastewater services. We cannot deliver our services and meet our duties without being highly resilient.

In the past, we have successfully managed a range of circumstances that have presented risks to our services. For example, we have demonstrated our resilience to many extreme hot, cold, dry and wet weather events, and we have expanded our services to meet the demand of a growing population.

There is a limit to the level of resilience designed into any system. This can be limited, for example, by affordability, engineering capability and technical understanding. Capability reflects a combination of factors, including designed capacity of assets and systems, and their availability and condition. Recognising that we can't design assets to cope in all conditions, we have extensive emergency plans to enable a fast and effective response to, and recovery from, an asset or service failure. Through our plans and investments we work to maintain and continually develop the level of resilience we provide.

We need to act just to maintain current levels of resilience. In the 21st century, emerging threats such as climate change, cyber attacks and economic pressures pose new challenges. Risks are increasingly complex and unpredictable due to greater reliance on technology, globalised supply chains and interdependent relationships between organisations, compounded by climate change and geopolitical instabilities.

We regularly review the latest and best available evidence on the short term risks and the long term trends we need to manage. On page 14 we show some examples of the latest evidence we have considered.

A PRIORITY FOR ALL OUR STAKEHOLDERS

Customers have been consistent in their view of our top priority. Every time we have asked over recent decades, customers have highlighted they want us to provide a reliable supply of clean and safe water. To inform our latest plans, we have talked to more customers than ever before and used innovative approaches to gain a rich understanding of how people use water and what they really want from us. The box below summarises customer and stakeholder feedback to inform our approach to resilience.

The Government and our regulators recognise that resilience is a top priority for the water sector and much more widely. In their national policy and plans, the Department for Environment and Rural Affairs (Defra) has recognised the impact on local communities from recent extreme events, and the growing pressures on the natural environment upon which we all rely. The Water Act 2013 established a new formal resilience duty for Ofwat, the economic regulator of the water sector in England and Wales. Ofwat has included resilience as one of four national priorities for the water sector as we define future plans.

We have reviewed the latest evidence and listened to our customers, regulators and other stakeholders to inform our plans and our new approach to resilience.

STAKEHOLDER QUOTE

“We expect companies to undertake a systematic and integrated assessment to understand the risks to resilience across the entire business, and mitigate these risks in the way that provides the best long term value for money for customers.”

Ofwat, Delivering Water 2020: Our methodology for the 2019 price review, Appendix 4: Resilience, December 2017

CUSTOMER AND STAKEHOLDER FEEDBACK

Priorities include: affordability, collaboration, customer service, environmental protection, innovation and resilience

Support development of technical skills

Better reflect the society we serve

Continually **engage**

Be a **highly responsible** business

Keep bills low by being highly efficient and innovative

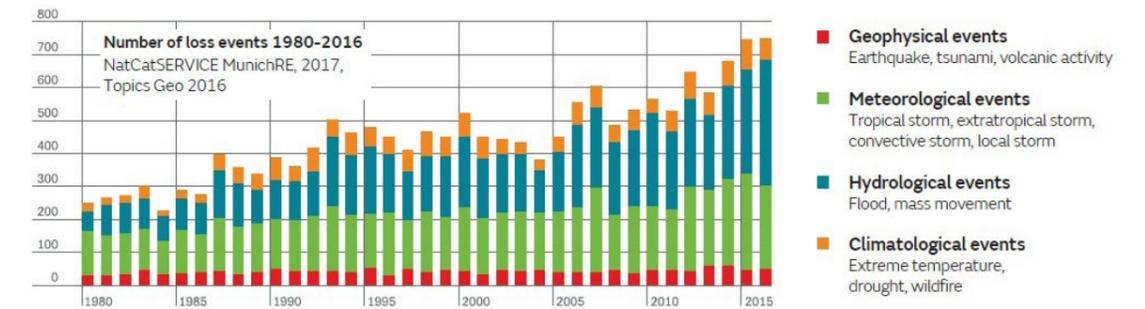
Support those who struggle to pay

Demonstrate long term planning and viability

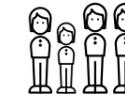
Be fair and open

HIGHLIGHTS OF THE LATEST EVIDENCE ABOUT THE FUTURE WE NEED TO PREPARE FOR

Extreme events have increased over recent decades¹

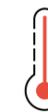


The population of Yorkshire is expected to grow by around 1 million people by 2045.²



We currently have around 5 million customers so this will present substantial growth in demand for our services. We have successfully managed a similar level of growth over the last 25 years.

Average temperatures are projected to increase by around 2.7°C by the 2050s, with heatwaves and dry spells projected to become more common.⁶



Historically, demand for water usually increases when it is warmer and drier as customers want to drink more, bathe more and water their gardens.

Heavy rainfall events are more likely to occur, increasing the risk of flooding.^{3,4,5}



Reducing the impact of flooding is a national priority following the severe disruption caused by many storms over recent years. The chance of a heavy storm is likely to grow in the changing climate.

Sea levels are projected to rise on the Yorkshire coast by around 41cm by 2050.⁷



This could have a significant impact on low lying areas in our region, including the City of Hull.

¹ www.metoffice.gov.uk/climate-guide/climate/what-affects-climate/extreme-weather

² Office for National Statistics, population estimates

³ Kay et al., (2011) Journal of Hydrology, 406 (1-2), 97-112.

⁴ Pall et al., (2011) Nature, 470, 382-385.

⁵ Schaller et al., (2016) Nature Climate Change, 6, 627-634

⁶ The UK Climate Projections 2009 (50th percentile, high emissions scenario). An updated set of projections are expected to be published soon and we will be analysing them once they are available.

⁷ The UK Climate Projections 2009 (95 percentile, high emissions scenario). An updated set of projections are expected to be published soon and we'll be analysing them once they are available.

2

OUR RESILIENCE FRAMEWORK

We have developed a bespoke framework that helps us quantify the resilience of all our activities through a robust and comprehensive evidence-based assessment. Our framework uses a 'systems thinking' approach which recognises the complexity of our operations and our links with external systems such as our customers, the natural environment, the economy and other infrastructure sectors. The project to develop the framework was substantial, taking several months and involving colleagues from across the business to gain a rich understanding of our resilience in all our functions. The result is an approach that:

- Informs better decision-making by helping us improve how we measure and track our resilience and ensure our approach is based on an extensive assessment of the shocks and stresses that could impact on our corporate, financial and operational resilience.
- Enables us to be more transparent with our customers about the resilience we provide to them and the impact of our activities and investments.
- Builds on recent work, including Ofwat's 'resilience in the round' publication, to advance best practice in the water industry.

The process behind our new resilience framework is summarised in the diagram over the page. It is a circular process that drives continuous improvement. Our new process will be owned at the highest levels in our governance structure by expanding our Risk Committee to become the Risk and Resilience Committee – ensuring an aligned approach between these closely related activities.

WHAT IS SYSTEMS THINKING?

"Systems thinking is a way of exploring and developing effective action by looking at connected wholes rather than separate parts. Systems thinking is a powerful approach to support evidence based decision making and is essential to successful delivery of complex projects where there are many stakeholders and many possible solutions."

**Introduction to systems thinking,
Government Office for Science, 2012**

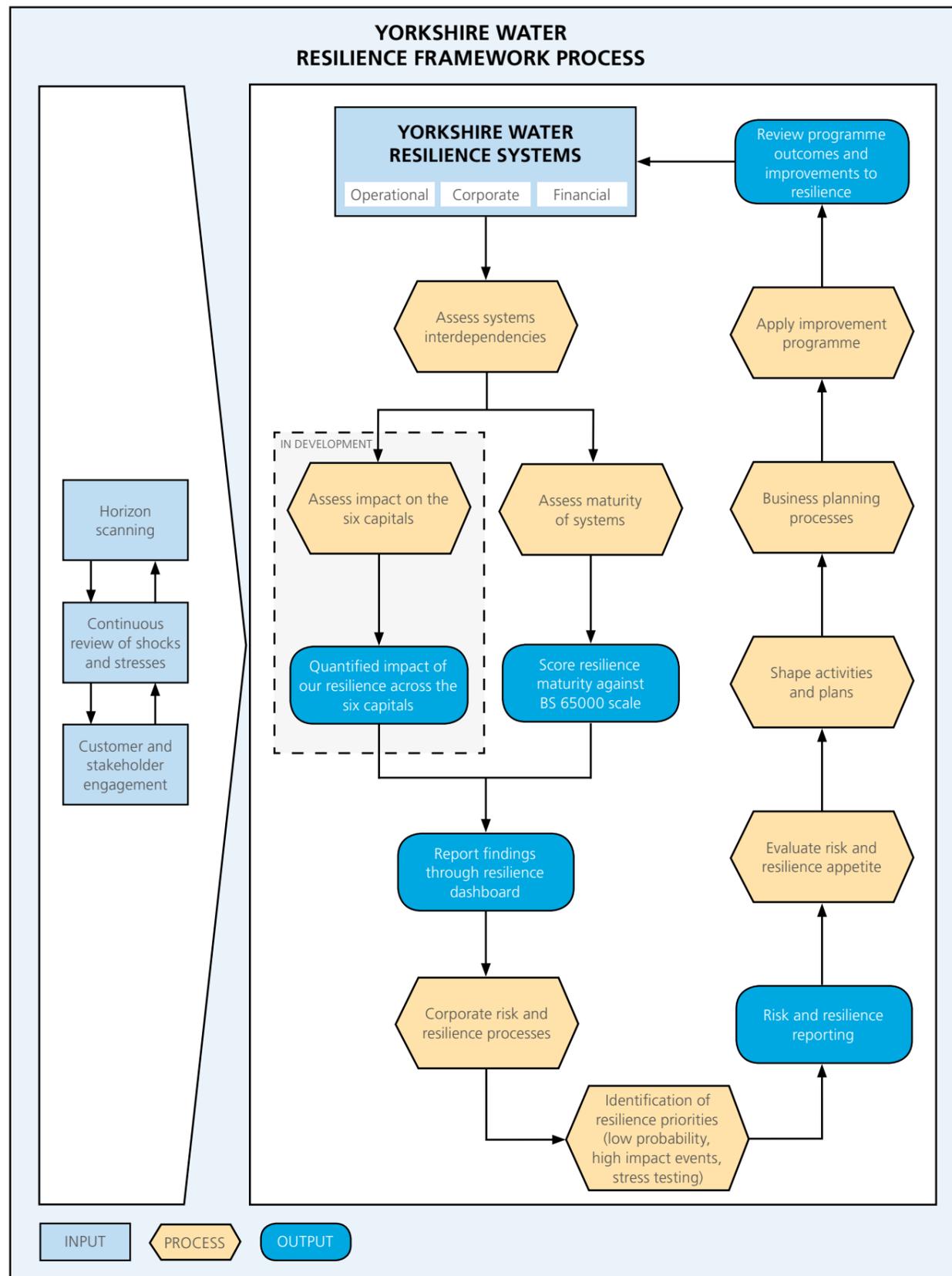
ADOPTING INTERNATIONAL BEST PRACTICE

The framework has been developed by tailoring best practice to complement our existing risk and resilience processes. For example, we used the:

- British Standard for Organisational Resilience (BS 65000) by aligning our approach to the standard and independently assessing our maturity against it.
- Organisation for Economic Co-operation and Development (OECD) Guidelines for Resilience Systems Analysis.
- Rockefeller Foundation City Resilience Framework.
- University of Cambridge Centre for Risk Studies taxonomy of threats.
- Cabinet Office guidance to Critical Infrastructure Resilience.
- UK Water Industry Research (UKWIR) Good Practice Guide on Resilience Planning.
- Ofwat's latest guidance and publications, including 'Resilience in the Round'.

We have also built on our own data and processes, including our:

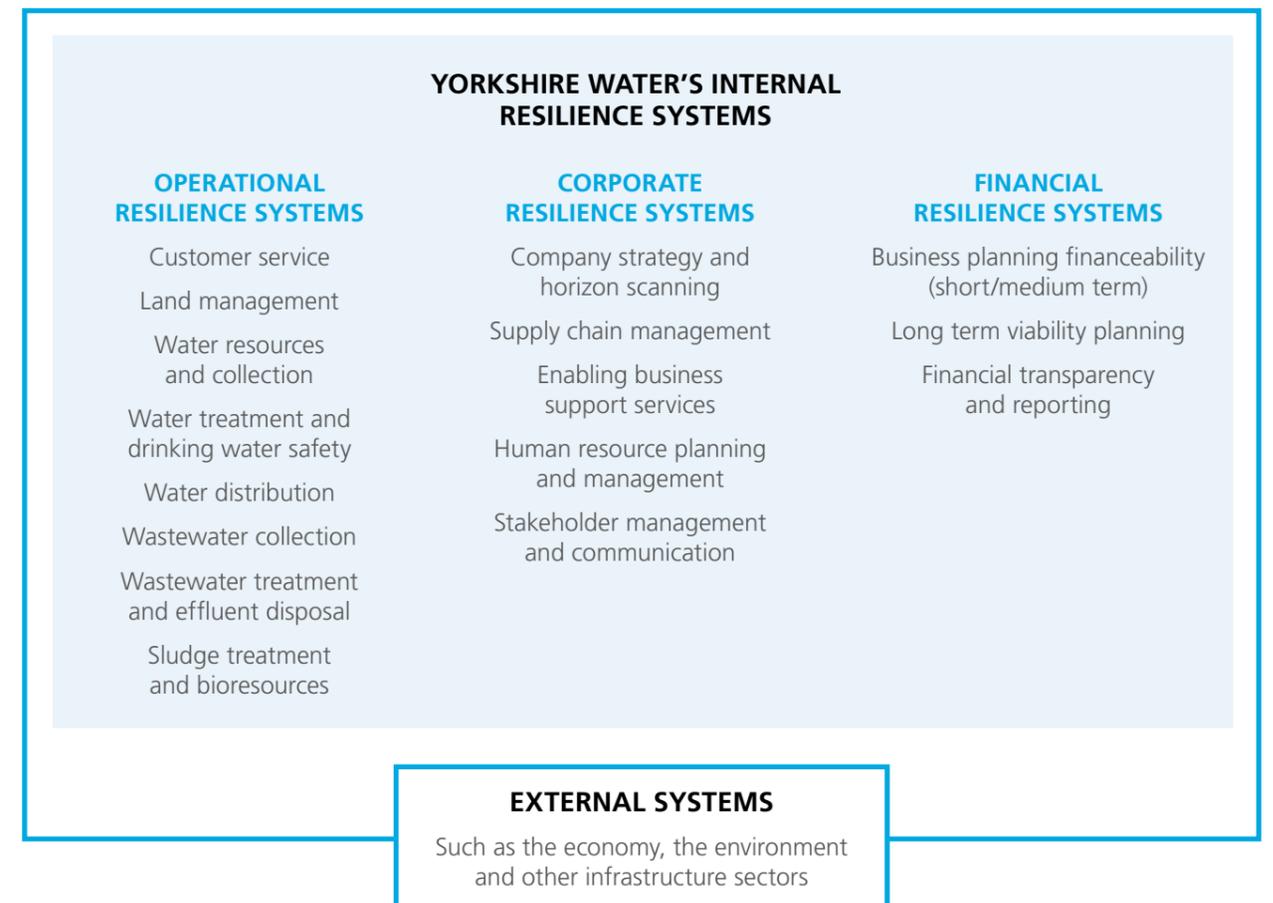
- Climate Change Strategy and Risk Assessment which we introduced in 2014 and updated for our latest adaptation report to Government, found at www.yorkshirewater.com/climatechange
- Corporate Risk Framework
- Granular risk and resilience quantification studies and tools for all areas of priority, such as our water, wastewater and bioresources assets
- Decision Making Framework (DMF), including our cutting-edge six-capitals optimisation system, to assess the best value mitigation options. The system also includes customer willingness to pay and other customer preference data.



USING SYSTEMS THINKING AND MAPPING INTERDEPENDENCIES

Systems thinking is useful in managing resilience because it aims to improve understanding, and therefore management, by providing a holistic view of a complex process, its constituent parts and the relationships both within the system and with other systems. We defined and mapped 16 systems that cover all of our operational, financial and corporate activities. Interdependency analysis was carried out to understand the connections between these internal systems and their relationships with the external systems in which we operate.

This has allowed us to adopt a systems thinking approach and encourage collaboration across the business in responding to resilience challenges. Effective consideration of interdependencies is widely recognised as complex and challenging, so this demonstrates the leading nature of our approach. The 16 systems are summarised below and more detailed maps of each system and their interdependencies can be found in the appendix to this report, available at www.yorkshirewater.com/resilience



A COMPREHENSIVE ASSESSMENT OF SHOCKS AND STRESSES

Through horizon scanning, examination of best practice, and feedback from Yorkshire Water colleagues, customers and other stakeholders, we have developed a detailed taxonomy of the disruptive events (shocks) and long term trends (stresses) that may impact on our systems and services. We have reviewed more than 120 shocks and stresses. We have narrowed these down to 34 which have, or are likely to have, the greatest impact on us.

Our identification of the priority external systems within which Yorkshire Water operates has helped us understand the sources of the shocks and stresses, and the interdependencies between our operations and those of other sectors. It has also helped us understand the consequences of disruptions of our services on stakeholders such as customers and local communities.

34 SHOCKS AND STRESSES HAVE BEEN SHORTLISTED FOR INCLUSION IN OUR FRAMEWORK*



ENVIRONMENTAL

- Climate change
- Environmental change
- Environmental pollution
- Erosion and ground movement
- Extreme cold
- Extreme rainfall
- Heatwave and drought
- Infectious disease - flora & fauna
- Land use change
- Natural disasters (geohazards)
- Space weather
- Storm and high wind



SOCIAL

- Change in customer behaviour and expectations
- Harassment and discrimination
- Infectious disease - human
- Population growth
- Skills shortage
- Vandalism
- Violence and terrorism
- Vulnerable communities and customers
- Urban creep



ECONOMIC

- Bad debt
- Costs increase
- Financial crisis
- Industrial and trade disputes
- Recession
- Supply chain failure



POLITICAL-LEGAL

- Political and macro industry change



TECHNOLOGICAL

- Ageing infrastructure
- Asset failure
- Cyber attack
- Disruptive technologies
- Major industrial and/or transport incidents
- Power failure

* In alphabetical order

Sources: University of Cambridge Centre for Risk Studies taxonomy of threats, Ofwat methodology for 2019 Price Review, UKWIR guidance on resilience planning, internal Yorkshire Water business planning studies and Corporate Risk Register.

RESILIENCE AND IMPACT ASSESSMENT

QUALITIES OF RESILIENCE

The five qualities of resilience included in our framework are shown below. In its 2011 guidance, 'Keeping the country running', the Cabinet Office shared a model of the four components of effective infrastructure resilience. We embedded this model in our planning approach at the last price review, for example in our climate change strategy. Our resilience framework has built on this approach by further developing this best practice model with a fifth quality of resilience, called Reflection. This addition recognises and supports the importance of ongoing review and learning.



QUANTIFYING THE MATURITY OF OUR RESILIENCE

The levels of resilience in different systems across our business have been assessed and quantified through a resilience maturity model using the maturity scale in BS 65000. The six levels of maturity are shown below.

Level 0: Immature

Few measures implemented to strengthen the system. No coherent framework and no management direction. No encouragement of innovation or flexibility.

Level 1: Basic

System strengthened through specific disciplines. No formal communication on resilience across the system.

Level 2: Managed

Activities are controlled and maintained with results specified. Limited coordination between related activities. Improvements made in isolation.

Level 3: Established

Management has set direction and understands the internal and external environment and how it is changing. Steps and programmes undertaken to bring coherence to resilience and to strengthen the operations. Programme to strengthen the system in operation.

Level 4: Predictable

Resilience activities being executed consistently over several years, aligned with corporate strategy. Coherent approach working. Strengthening measures implemented and agreed, continual improvement ongoing.

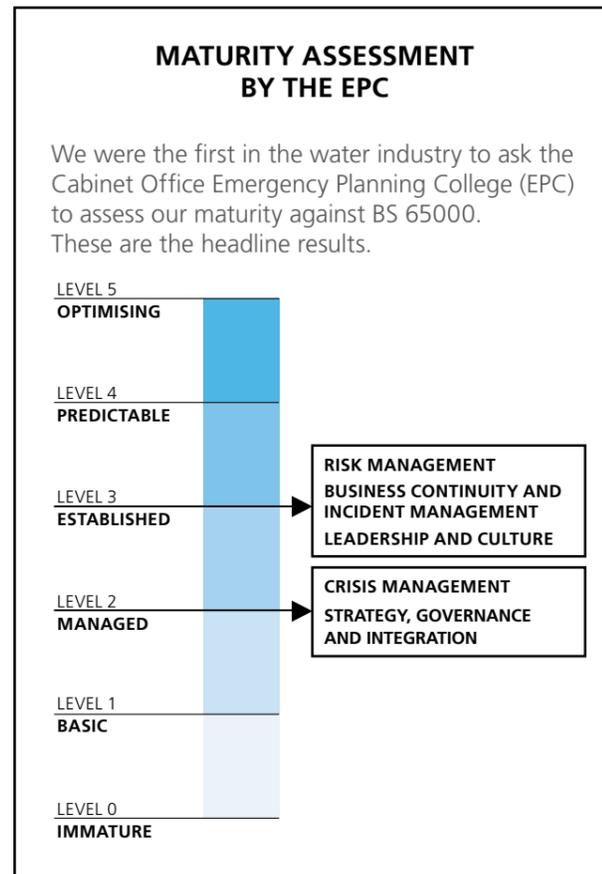
Level 5: Optimising

Activities are repeated, measured, evaluated and continuously improved to meet current and projected business goals. Divisions are proactively cooperating for improvement. Collaboration with other organisations, as appropriate. Demonstrated application of innovation and flexibility throughout the system.

There are limited opportunities to directly compare our specific maturity scores and rates of improvement because our approach and the British Standard are new and few others have yet published parallel information.

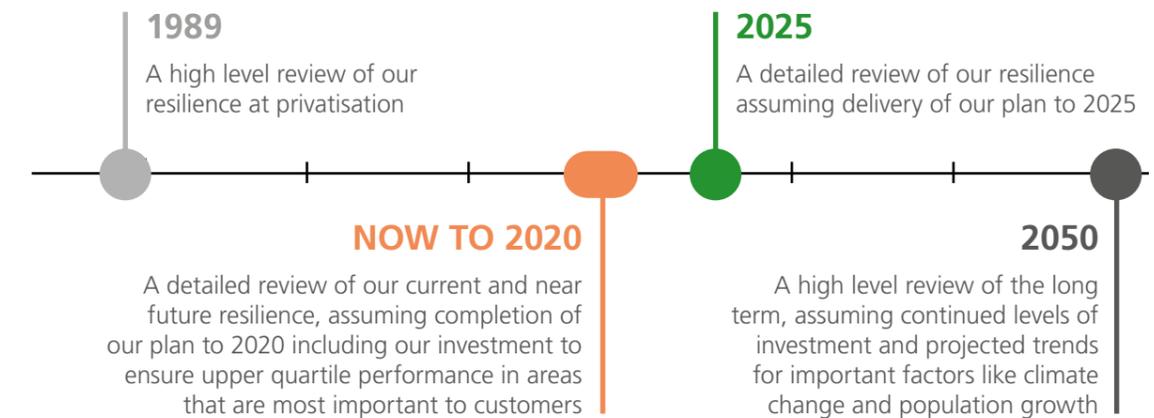
It is important to note varying levels of robustness in resilience assessments which can be misleading in suggesting relative maturity which does not exist in practice. We have taken a conservative approach to ensure under rather than over statement of our resilience, and to support our drive for continued improvement.

Our strategic company-wide assessment using our new framework has been extensive and led by third parties to ensure an accurate and complete picture. A large programme of internal stakeholder engagement was undertaken, including over 40 workshops and interviews with colleagues across operational, financial and corporate parts of the business. A comprehensive database has been developed to record current and planned activities against the five qualities of resilience, which formed the evidence base for the maturity assessment.



ASSESSING OUR RESILIENCE OVER TIME

Our assessment covers different timescales to provide a long term view of resilience. This helps us ensure our business plan and long term strategy are effective for securing resilience of water and wastewater services for customers today as well as in the future. The four timescales assessed are:



DETAILED RESILIENCE ASSESSMENTS

The resilience framework provides the strategic view across all parts of our business and services, allowing comparison and informing strategic decisions. This is supported with a broad range of detailed resilience assessments to give a depth of understanding in priority areas, including for example:

- Financial modelling to ensure the short and long term financial viability of the business.
- Assessments on the impact of climate change, population growth and industrial water needs to inform a Water Resources Management Plan which ensures we can continue to balance supply and demand.
- Detailed reviews of the resilience of our water and wastewater infrastructure with the support of expert consultants at Stantec.
- Emergency planning exercises with various partners to test and develop the readiness of our operations.

These detailed assessments have shaped our new business plan and specific proposals within it. To complement this, the findings of the new resilience framework were discussed with the Board and the colleagues leading the development of the business plan to check that the balance of the final plan is appropriate from the resilience perspective.

More details of these assessments can be found in the appendix, in the relevant sections to which each assessment relates.

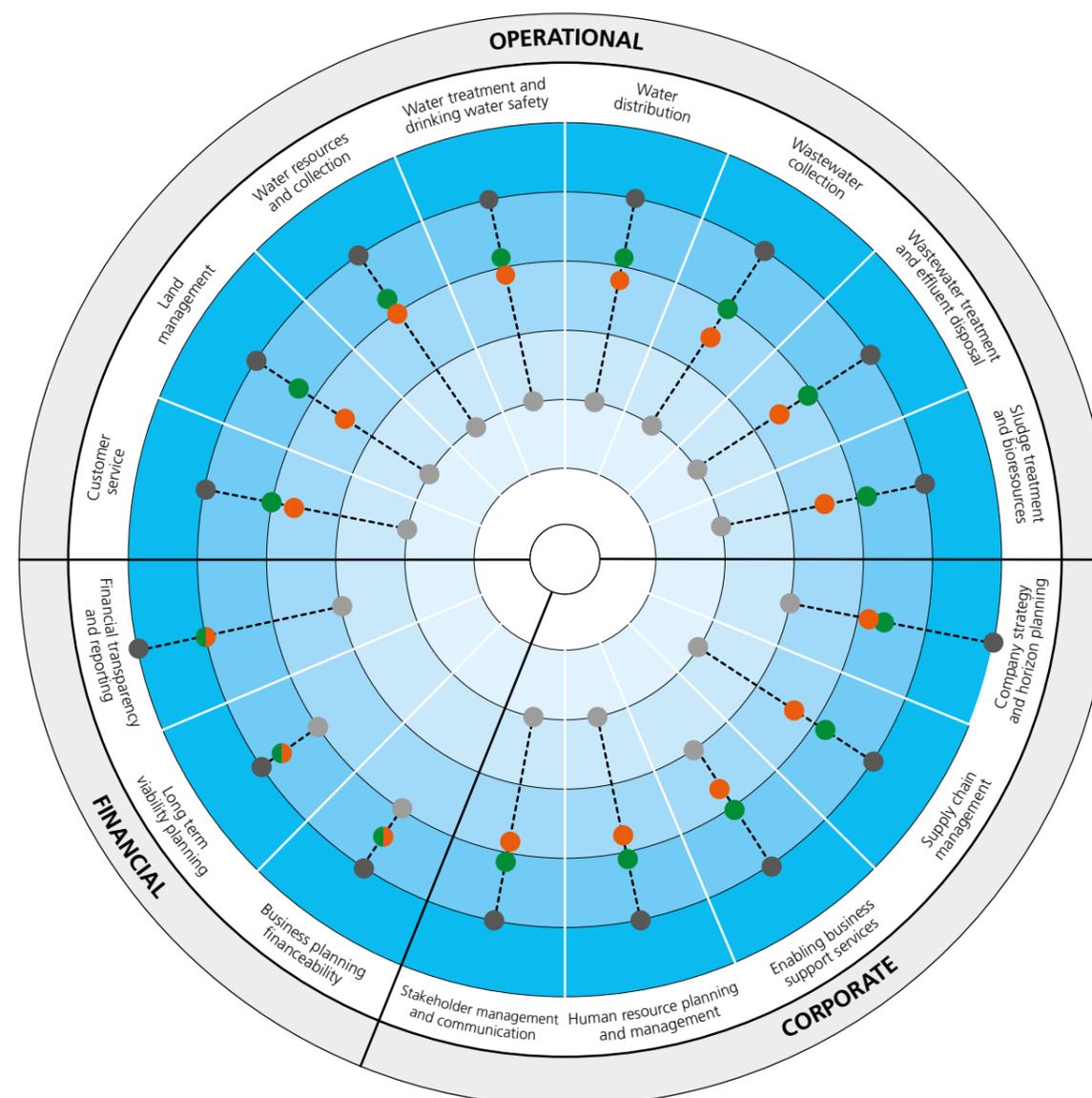
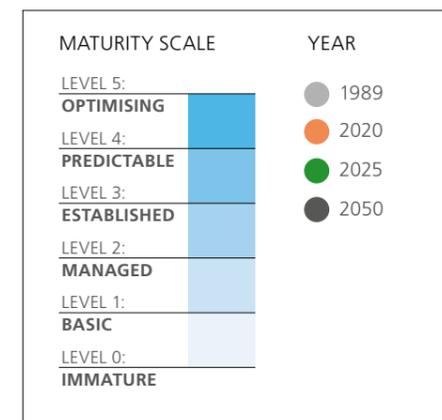
3

OUR PLAN TO MAINTAIN AND ENHANCE RESILIENCE

Working with the resilience experts at Arup, we have developed a cutting-edge framework that provides a repeatable process to assess and quantify the resilience of every part of our business and the services we provide. The diagram below shows the headline findings. A more detailed breakdown for each business function is provided in the appendix.

Our assessment shows our plan will maintain and improve resilience over time, despite increasing pressure from climate change, population growth and other factors which would erode resilience if we did not act.

The maturity and rate of improvement varies depending on the combination of shocks and stresses facing that part of the business, and the potential for mitigating actions and supporting levels of investment.



DELIVERING FOR AND WITH CUSTOMERS AND STAKEHOLDERS

Customers and stakeholders have three essential roles in working with us to ensure the resilience of water and wastewater services in Yorkshire:

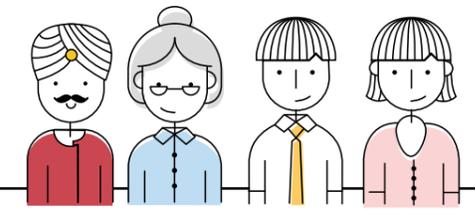
- Co-creating the plans and strategy to deliver customer priorities for resilience
- Approving that our plan meets their resilience needs and expectations
- Co-delivering parts of the plan with customer participation to aid resilience, for example by using water and sewers wisely.

We have undertaken extensive and innovative customer engagement and research to inform our latest five year plan and 25-year strategy. We have gone further than ever before to get a deep understanding of our customers' needs and wants, and their relationship with water and our services. We have examined resilience throughout our customer engagement programme over the last two years to fully understand how customers view our current and future performance, both in isolation and relative to the service other water customers receive.

Overall, customer feedback has been very positive. From a survey of nearly 2,000 household customers, 86% confirmed they are supportive or very supportive of our final business plan. 72% of customers also told us that they were confident or very confident that our plan would cope with future challenges like population growth and climate change. We have confirmed with our customers that our plan will provide the right level of reliable and good quality service at a cost they are willing to pay.

The diagram below shows the aspects of our services which are most important to customers for resilience. Customers consistently tell us the most important issue is being able to receive reliable, uninterrupted services. They have told us to prioritise the reduction of leakage, pollution incidents and sewer flooding. These priorities are shaping our current activities and future plans with extra investment to these areas to significantly improve service.

We show how we have responded to customers priorities later in this section and in the appendix. As part of this, we show how we are substantially growing our programmes to support customers to co-deliver and participate in water resilience in Yorkshire.



OUR APPROACH TO CUSTOMER AND STAKEHOLDER ENGAGEMENT

We have worked with customers and stakeholders in many different ways including research projects, monthly customer trackers, focus groups, round table events with our and stakeholder briefing sessions. Using innovative charrettes we engage with various customers and stakeholders to collaboratively design a vision for future infrastructure schemes to improve resilience.

We have created an online community of over 1,000 customers who regularly provide comments and take part in research on a host of different subjects related to topics like customer service, reporting, our plans for the future, and the way in which we communicate with them. These engagements have given us a much-improved insight into the diverse and changing needs of our customers and stakeholders.

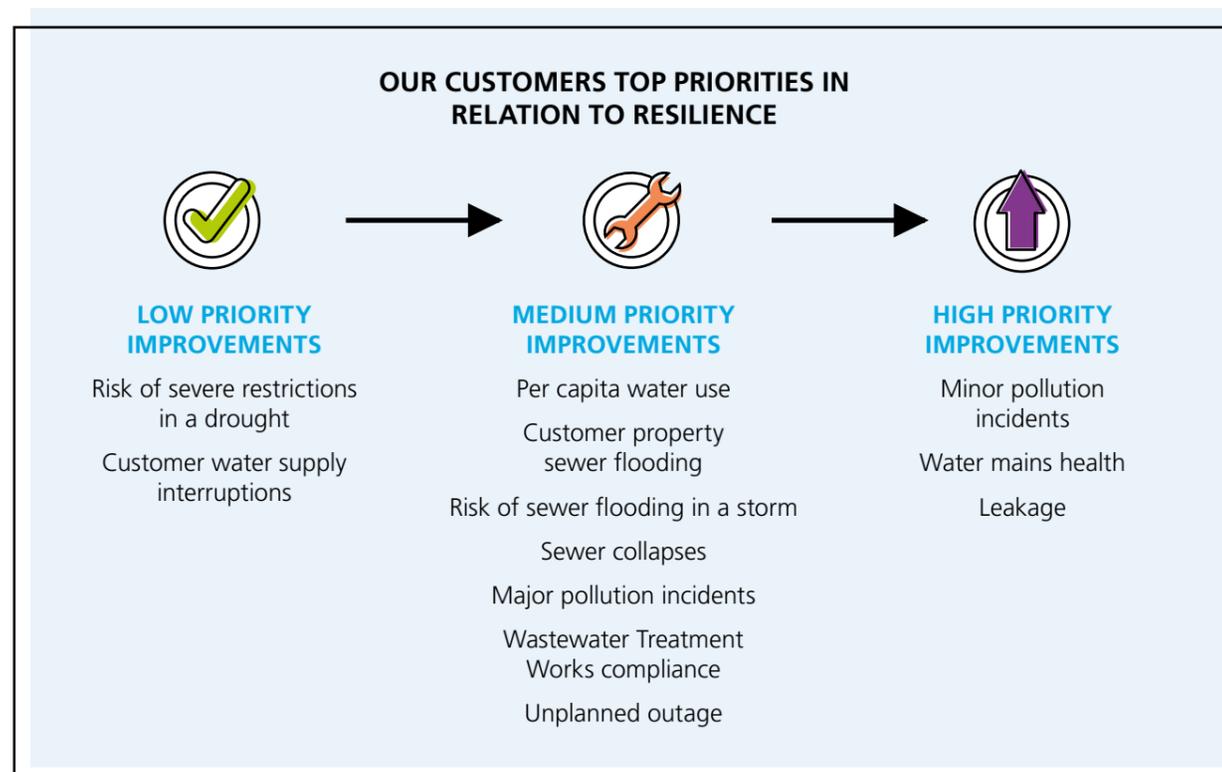
We have developed bespoke plans for the communication of resilience issues such as climate change, extreme cold and flooding. We use stakeholder mapping to understand the customers and stakeholders affected by each issue and tailor our engagement channels based on their circumstances and needs.

We have a process in place to review and improve bespoke communication plans based on learnings from previous events and external benchmarking such as other water companies and the Water UK Communications group. Our risk matrix allows us to track reputational risk and mitigation measures, which informs decision making at board level.

Our education programme gives us the opportunity to proactively engage with our customers and stakeholders through school and community visits on our sites. We have been raising awareness and promoting behavioural change through knowledge sharing on topics such as the value of water, water conservation, capital scheme interruption, and blockage. We will continue to work with our customers to reduce water use at homes and businesses. In addition, we will work with our customers to stop improper use of our sewers, making sure that only flushable things go down the drain.

To strengthen our resilience in the long term, we have set ourselves performance commitments to work with customers and stakeholders to co-develop solutions and continue to deliver engagement programmes to raise awareness of the value of water and our services. We also plan to improve our segmentation model of customers making better use of data, helping us gain insights about our customers and tailor our services to meet their needs.

We will continue our extensive programme of customer research and include younger customer groups to encourage future engagement and cooperation in addressing our future challenges.



OPERATIONAL ACTIVITIES

MAINTAINING AND ENHANCING WATER SERVICES

Yorkshire’s public water service is highly resilient, with the ultimate measure being our long-standing absence of widespread interruptions. We have had no hosepipe bans or other widespread restrictions to our water supplies since the drought in 1995 and 1996. That is despite several more extreme dry periods since then. We have also maintained water supplies throughout severe floods and cold snaps in Yorkshire over recent years, with only a very small proportion of customers interrupted during the hard winter and dry summer experienced in 2018. We learn from these events and revise our Incident Management Plans to help us respond quickly and safely to any kind of disruption.

We have a nationally leading level of resilience because of the flexibility we built into Yorkshire’s water supply network, and through our mature and tested operational procedures and emergency planning.

The independent work for Water UK’s Water Resources Long Term Planning Framework report, published in late 2016, stated we plan “to a higher level of resilience than any other part of the country” and only Southern Water and ourselves “plan for resilience to droughts that are worse than those seen in the historic record”.

The assessments we have completed for our Water Resources Management Plan (WRMP) show a long term challenge to our ability to maintain the supply demand balance. This is primarily a consequence of climate change, and also population growth. Our Big Goal for water is to meet the needs of the growing population without taking more from the environment by substantially reducing demand. This is the most sustainable long term approach and it delivers multiple benefits to our customers. We also have a range of new supply options should they become essential. Read more details about our WRMP in the case study on the opposite page.



WHAT IS 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.

Ofwat Delivering Water 2020: Our final methodology for the 2019 price review, 2017

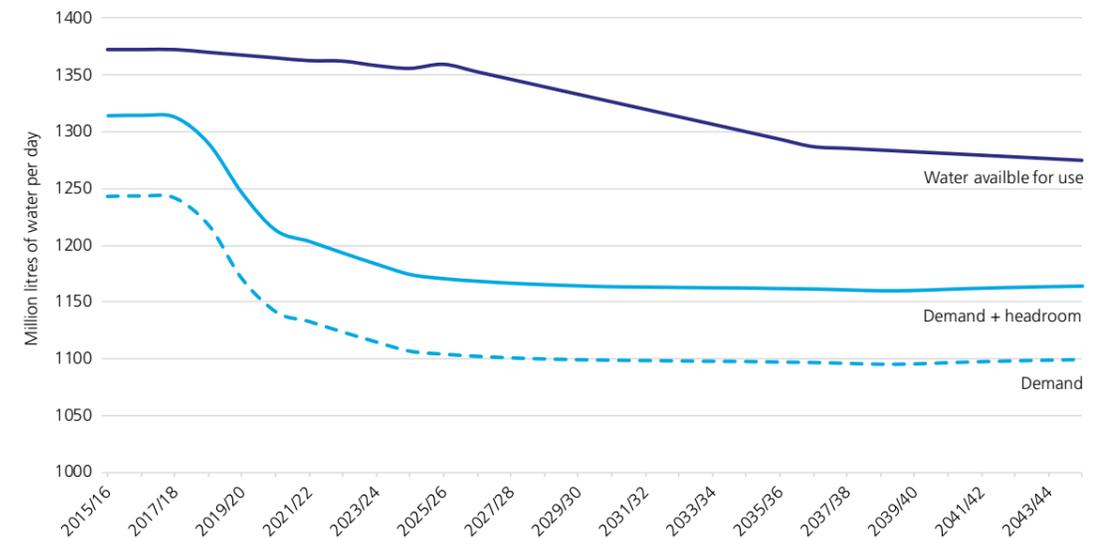
COMPANY INCIDENT MANAGEMENT PLANS

We have demonstrated a strong ability to respond to, and recover from, severe events like flooding, heavy storms or extreme temperatures.

For example, during the most recent winter storms, the “Beast from the East”, we maintained water supplies to more than 99% of our customers. In their review of our performance, Ofwat concluded that we “performed well...but there is still room for improvement”. Ofwat noted how we learned from past events, deployed extra resources and proactively communicated with customers.

We have learnt from these events and we are revising our Incident Management Plans which help us respond quickly and safely to any kind of disruption. These plans are central to our resilience strategy and enhance our company-wide resilience.

THE WATER SUPPLY DEMAND BALANCE



Our assessment of the future supply demand balance in Yorkshire, after we apply our management plan to ensure resilience.*

CASE STUDY WATER RESOURCES MANAGEMENT PLAN (WRMP)

We update our WRMP every five years to ensure we are always responding to the latest evidence. Our WRMP 2019 will help us ensure that our customers get what they have told us is their highest priority – a reliable and sustainable supply of good quality, clean water. The plan describes how we will ensure we have sufficient water to supply our customers, in the face of future challenges such as climate change, population growth and environmental pressures.

The key challenges that we identify and address in our latest WRMP, are:

- A Yorkshire population that is projected to increase by one million by 2045.
- A projected loss of 100 million litres per day of supply by 2045, due to climate change.
- Ongoing need to reduce the amount we abstract to protect the environment.
- Ensuring that we can continue to provide high levels of resilience and meet our agreed levels of service, against a backdrop of maintaining bills at a level that is affordable for all our customers.

Our WRMP19 indicates a risk of a deficit during the 25-year planning period. This is predominantly due to the forecasted impact of climate change on deployable output.

Our preferred solution to meet this forecast deficit is to reduce leakage by 40% by 2025. We will also investigate two new supply options which will provide additional resilience.

The supply options are scheduled for implementation in 2022/23 and 2025/26, provided the results of the investigations determine that the licences are sustainable.

In selecting our preferred plan, we have chosen a solution that minimises environmental risks, meets customer and regulatory preferences and is flexible and sustainable in an uncertain future. This is in line with the needs we, our customers and our stakeholders identify as priorities in our new long term strategy for Yorkshire Water.

* Please note this is from our latest draft WRMP. The final version will be available on our website soon, at www.yorkshirewater.com/resources





Working with customers to be more water efficient

We have been helping customers use water wisely for a long time but we also need to show that we are reducing our water use. For example, we are reducing leakage by 40% and will implement a package of water saving activities at our operational sites.

We introduced a performance commitment in 2015 to monitor average use across the region, known as Per Capita Consumption (PCC). We and our customers have been successful in reducing PCC, being one of the lowest in the country. As well as reducing leakage, we are going to implement a number of initiatives to help reduce customer water use even more, such as:

- Increasing the amount of education we provide by expanding our education programmes about using water (and also sewers) wisely.
- Proactively encouraging 100,000 customers to switch to a water meter where they will financially benefit from having one, as well as continuing to offer free meter installation for any customer that wants this. Water meters encourage more water efficient behaviours.
- Undertaking water audits and piloting the professional installation of water saving measures in homes so we can go further than we currently do through our provision of free basic kits for customers to install themselves.

- Working with large industrial water consumers to be more water efficient and switch to lower grades of water where potable water is not needed. For example at our flagship project to demonstrate circular economy principles at our Esholt treatment works. For further details, refer to our case study on page 34.

During times of drought, and also extreme cold when pipes are prone to bursting in homes and businesses, we escalate our engagement to curb the large increase in customer demand that we typically see in these periods.

We are using latest technology to support the targeting of tailored messages to local communities. Providing locally specific messages helps secure higher levels of engagement, which in turn supports resilience by using water more wisely. We are improving our segmentation model of customers, helping us to better understand our diverse range of customers so we can tailor our services and communications to meet their needs and achieve effective behaviour change. We are also using this approach to develop our thinking on wastewater services, for example around a number of steps to encourage more sustainable use of sewers.

Managing land to protect water resilience

The condition and management of the land from which we source water to supply customers is critical to the resilience of our water service. The quality of the water that comes from many of Yorkshire’s source catchments is deteriorating. This forces substantial operational and capital investment at the treatment works to ensure we can provide safe and wholesome water at customers’ taps, driving up financial and environmental costs and increasing operational complexity, thereby challenging our resilience.

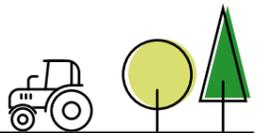
Looking to the longer term, excessive pollution could force us to abandon sources of water and, if this happens on a large scale, it would threaten the resilience of water supplies. Furthermore, a range of research by us and others shows we should plan for increasing pressure on Yorkshire’s source catchments from the changing climate and current land management practices. A healthy natural environment is better able to withstand the changing climate and other pressures.

We have been responding to these resilience risks over recent years by working innovatively with many partners. Together, we have developed and matured techniques to protect and restore parts of Yorkshire’s natural environment. This helps protect water quality, restore the water table and deliver other benefits for society such as recreation, biodiversity and carbon storage. These activities go hand in hand with our work to reduce flood risk by ‘slowing the flow’ in upstream catchments, which we show in the appendix.

We have long standing programmes both on the substantial land estate we own, and also working with other land owners. More recently we have significantly enhanced and expanded these programmes. For example we have introduced a new industry-leading regime for our farm tenancies called ‘Beyond Nature’. Now rolled out to six of our farms and growing, we work in partnership to agree and deliver a sustainable management plan for the farm which generates food and income for the farmer, while better protecting the environment to secure the required water and other social benefits.

Water trading and supporting national water resilience

Water resilience is a national challenge, especially in south east England where it is drier and more densely populated. We are taking action to support national resilience over the long term and this is where water trading can help. We have a long-standing trade agreement to import water from Severn Trent in South Yorkshire, and also a small export to Anglian Water. To inform our latest Water Resources Management Plan we have completed a detailed assessment of trading opportunities and engaged with a range of potential trading partners. This has not identified any immediately cost effective opportunities for further trading, but over the long term we want Yorkshire to become self-sufficient for water by helping customers use less and investing to dramatically reduce leakage as we have described above. This would allow us to end our import from Severn Trent to support national resilience by enabling them to divert that water to where it is needed most, perhaps enabling water movement further south.



PROTECTING SOILS TO SUPPORT WATER QUALITY AND CARBON SEQUESTRATION

- ‘Beyond Nature’ sustainable farm tenancies at Humberstone Bank Farm, and at another six farms with more to come.
- Working with others such as the National Trust to deliver catchment management programmes that restore our precious habitats and prevent pollution from fertilisers and pesticides.
- Collaborating with farmers and food producers through the Sustainable Futures initiative to encourage sustainable farming approaches that maintain and improve soil health.

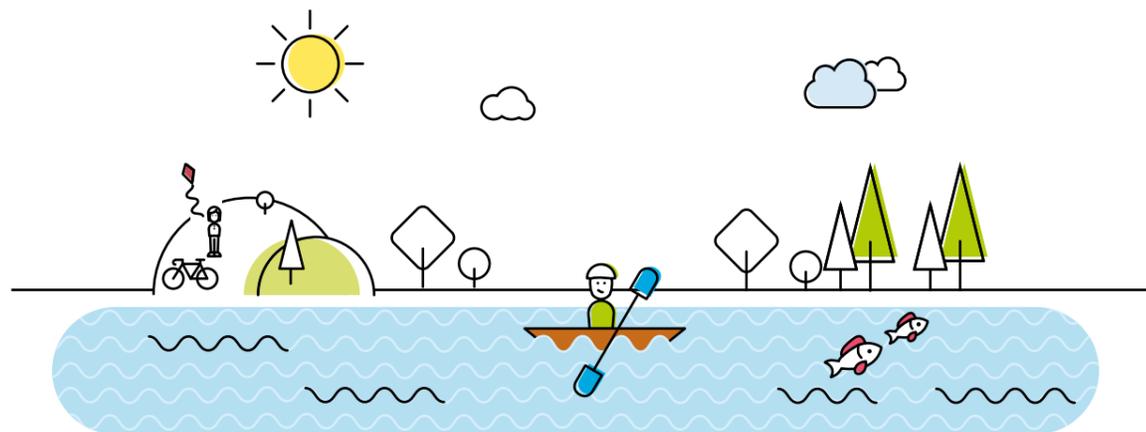
MAINTAINING AND ENHANCING WASTEWATER SERVICES

The quality of Yorkshire’s rivers and coasts has been transformed over recent decades to their healthiest condition since the industrial revolution. This is an outcome of our substantial investments in wastewater treatment, fish passage and river restoration, along with further action by many others. This is important to resilience because healthy water environments are better able to withstand shocks and stresses from pollution, climate change and other pressures. In turn, this supports the resilience of public water services because we rely on clean water from the environment.

We know there is more to do, and we have to maintain wastewater standards for the growing population. We are increasingly adopting an innovative and broad portfolio of approaches to better protect the water environment. For example, helping to improve rivers without the need for costly capital investment at wastewater treatment works. We explore this in more detail in the Wastewater Treatment section in the appendix to this report.

Customer behaviours

Customers can also support resilient wastewater services by helping to prevent sewer blockages. We are encouraging customers to think about what they put down the toilets and drains. We have run a successful pilot in Bradford that is harnessing the biofuel potential of waste cooking oil, while protecting local sewers and increasing the resilience of the public sewerage system. The scheme involves asking local residents to collect their waste cooking oil in tubs rather than pouring it down the sink. The containers are collected from residents’ doorsteps, with the cooking oil sold to renewable energy companies to refine and turn into carbon neutral bio fuel. In return, the local community centre benefits from income from the energy generation. We are expanding this approach to other communities because the pilot has been so successful in reducing sewer blockages.



BY APRIL 2020...

We will have delivered a total of **440km of river improvement activities**, including **97.6km of improved river** through **13 fish passage schemes**.

We will maintain this performance and go notably further by potentially **improving 767km of river by 2025**. The exact number will depend on the final details of our environment programme which is being agreed with our regulators.



PROTECTING COMMUNITIES FROM FLOODING

- Working in partnership to plant one million trees across Yorkshire over the next ten years, along with other natural ‘slow the flow’ techniques like leaky dams. This has already started with thousands of trees planted in the Calder Valley.
- Working with the Living With Water partnership to deliver ‘blue and green’ solutions to manage flood risk in Hull and Haltemprice.
- Collaborating with the Environment Agency and Local Authorities to ensure a joined-up approach to emergency incidents and long term plans, and co-funding interventions where appropriate.
- Investing to resolve flooding issues across Yorkshire, using traditional approaches as well as innovative ones like keeping storm water out of the sewers and using other Sustainable Drainage Solutions (SuDS).
- Working with the Environment Agency and Defra to examine the use of our reservoirs to help flood management while understanding the wider implications that changes in reservoir operation could have on water supply in Yorkshire.
- Through our Drainage Area Plans and Strategic Drainage Management Plans we are further developing our leading approach to drainage modelling to inform risk-based plans and improve our resilience.

Collaborating to reduce the risk and impact of flooding

Yorkshire communities have experienced the damage, distress and health impacts of numerous flood events in recent years. Flooding is complex to manage, coming from multiple sources and managed by multiple agencies. Our role is to provide the public drainage network and collaborate with other flood management agencies to support a joined-up approach to both short term incidents and long term plans. Customers highlight it is a priority for us to improve resilience to sewer flooding, and we recognise our role in supporting the improved management of overall flood risk.

We collaborate with many organisations to effectively manage flooding in Yorkshire, including the Environment Agency, Highways Authorities, Internal Drainage Boards and Local Authorities. We share equipment and resources to ensure an effective response to emergencies, and we also hold training exercises together to practice how we are best responding. To inform joined-up long term plans for Yorkshire we share our data, risk information and investment plans, and we work increasingly closely when investing in solutions.

By working with others and using storm water management techniques like Sustainable Drainage Systems (SuDS), we are reducing flood risk and protecting the finite capacity of our sewers by reducing the amount of surface water entering them – a form of demand management.

One example of our approach is in and around Hull, where we have been instrumental in establishing the partnership approach which is essential to effectively and efficiently managing the substantial flood risk facing local communities. The Living With Water Partnership is a ground-breaking initiative with the Environment Agency, Hull City Council and East Riding of Yorkshire Council who share a vision to enhance resilience for the area at the same time as growing wider social value, by managing water on the surface using ‘blue and green’ infrastructure techniques. Together we are pooling resources and thinking innovatively to resolve long standing problems.

The partnership is working with the Rockefeller Foundation to trial a global standard for the assessment of water resilience of urban systems, from which we will extend the learning to communities across Yorkshire.

As part of our work in Hull, we have introduced innovative new charrettes as a way to engage customers and stakeholders on resilience at the local community level. This is something that has been hard to achieve in the past but the charrettes have been effective in actively engaging local communities to help people truly understand threats and opportunities, and their role in the response. The local insight has helped shape effective plans and will help ensure a more efficient and effective response in practice.

Managing land to reduce flood risk

A healthy natural environment is able to hold storm water upstream and reduce the risk of flooding. Conversely, increasing urban development leads to an increase in the amount of paved-over land. Agricultural practices can result in overgrazing. Both reduce the ability of water to percolate into the ground and can lead to rapid water run off which overloads the drainage system and causes flooding. Effective land management is at the heart of our flagship partnership scheme in Hull. We are also implementing natural capital approaches across Yorkshire, in which we apply collaborative and sustainable methods that offer multiple benefits to our customers and wider society. We are planting one million trees over the next ten years in a bid to reduce flood risk while also offsetting carbon emissions and supporting the creation of a Northern Forest. We have already started planting in the Calder Valley through a partnership with the White Rose Forest and others, where a healthy and resilient natural environment is being created to help keep water out of harm’s way. We explore this in more detail in the Land Management section in the appendix to this report.

OUR BIORESOURCES RESILIENCE TOOL

Experience has shown us that a combination of events can severely impact treatment capacity and efficiency. Yorkshire Water’s bioresources capacity has been impacted with reliability, flooding and safety issues. We are embracing the use of new markets to shape our approach and enhance resilience while driving down costs.

The future is increasingly changing and unpredictable. Acute shocks such as extreme weather events and chronic stresses such as ageing assets need to be modelled. A combination of historic analysis and future forecasting informs the events that our bioresources strategy will need to weather.

We have built a resilience model to examine and analyse the impact of potential events on our overall ability to provide a treatment service. This model examines potential impact events and allows us to consider the impact of different options to mitigate against these events.

Enhancing energy resilience and reducing carbon emissions

The movement and treatment of water is energy intensive, and therefore carbon intensive. The substantial improvements we have made to protect the water environment has involved large scale engineering solutions which use lots of concrete, metal and energy, which result in carbon emissions. To be resilient, we are reducing our greenhouse gas emissions to play our part in minimising future climate change. This is one of our greatest long term risks as we fundamentally rely on the weather. Our action here also helps us be more resilient by reducing our need for energy and other materials which have volatile and increasing prices, and for which supplies can be interrupted.

We have already reduced our operational emissions by around a third over the last ten years by becoming more energy efficient and generating more of our own energy from cost effective renewable energy.

In particular, we have invested to divert sewage sludge from landfill or incineration and instead reuse it by creating energy from the calorific content of human waste. This is a great demonstration of circular economies in action. We are going further with a stretching performance commitment to reduce carbon emissions.

As well as continuing to reduce our operational emissions we have started to reduce the emissions associated with the concrete, metal and other materials we use to maintain and enhance our infrastructure. We are also getting a better understanding of the carbon stored in our peat and wood land and how we can use our land management programmes to store more carbon over time. Our performance commitment complements our efforts to work more innovatively and collaboratively to find more effective and affordable ways of delivering, improving and securing our services. We explore this in more detail in the Bioresources section in the appendix to this report.



Aerial view of Esholt wastewater treatment works in Bradford

CASE STUDY

INNOVATING TO GET MORE, WITH LESS – DEVELOPING THE CIRCULAR ECONOMY IN PRACTICE

We are driving innovation across all areas of our business so that we can continue to deliver high quality services to our customers at an affordable price and without harming the environment. This is increasingly important with the mix of pressures shaping our services, such as the changing climate and growing population.

One example of our approach is our vision to make Esholt wastewater treatment works a leading demonstration of the circular economy in practice. Esholt is one of our biggest sites, covering 120 hectares and serving 750,000 people in West Yorkshire. We are taking a phased approach to create more value from underutilised resources on the site, including sewage, energy, heat, water and land.

Energy from human waste

While delivering a major upgrade of the site’s treatment capabilities to better protect river life, we also invested in a range of renewable energy facilities that have the capacity to make the site almost entirely self-sufficient for its large energy needs. Most of the energy is generated by digesting the flow of human waste received at the site.

Recovering brownfield land and old filter media

Upgrades at the site made redundant 13 hectares of operational land which contained 500,000 tonnes of filter media. The cost of demolishing the old assets on the land and disposing of the filter media was estimated at £20 million. To avoid the financially and environmentally unaffordable approach we investigated alternatives, confirming the filter media could be processed for recycling as an aggregate for use in construction. For example, 25,000 tonnes were used in the development of a nearby train station.

Supporting green economic growth

We have worked in partnership to develop exciting plans for Esholt. Brownfield land can be redeveloped for highly sustainable homes and light industry which can use spare heat and wastewater from the treatment works. Green areas of the site can be further opened up to improve benefits for the local community. We have recently published proposals for the next phase of work at Esholt, including plans for super-water efficient homes. We are consulting the local community and stakeholders to shape the right detailed approach.



CRITICAL ENABLING ACTIVITIES

Our resilience framework incorporates all the enabling functions that are essential to the ongoing running of the business and the public services we provide. We examine some of the top priorities here, with a comprehensive overview in the appendix.

Ensuring a resilient workforce

Water and wastewater services would not function without the people that work for us, both directly indirectly. We ensure the resilience of our workforce in many ways to ensure we can safely, efficiently and effectively deliver our activities today and into the long term. Below, we provide some highlights of latest developments and future plans.

We have a culture where safety is the top priority in everything we do. We have delivered an extensive behavioural engagement programme that has included training and development, and the introduction of 10 Life Saving Rules. Through the continued work on our Health and Safety Improvement Plan, we have implemented a new incident investigation and lessons learned process to enable us to better learn from, and prevent reoccurrence of, accidents. In addition, improvements were made in assessing our operational safety risks through the introduction of a mobile 'Point of Work Risk Assessment' phone app.

In-keeping with national trends, we are observing skills shortages in Science, Technology, Engineering and Maths (STEM). These skills are important to our increasingly technical operations. This skill shortage will get worse in coming years as more of our workforce reaches retirement age, possibly resulting in a loss of knowledge and experience if we do not act. We are proactively addressing this problem through a range of measures, including our graduate scheme and the major expansion of our apprenticeship programme. We are also collaborating with partners to address the national skills gap, for example by supporting the recent establishment of the Energy and Utility Skills Network. We also have extensive resource planning including progression and succession plans.



WHAT IS CORPORATE RESILIENCE?

Corporate Resilience: The ability of an organisation's governance, accountability and assurance processes to help avoid, cope with and recover from disruption and to anticipate trends and variability in all aspects of risk to delivery of services.

**Ofwat Delivering Water 2020:
Our final methodology for the
2019 price review, 2017**

Following learning from past events, we have taken various measures to support our agility during emergencies. We have:

- Plans for events where a large proportion of colleagues would be absent, like a flu pandemic.
- Increased the number of Citrix IT licences that enable colleagues to work remotely.
- Options to bring in agency staff or to redirect resources with cross-skilling of roles.

Diversity is important to the resilience of our operations, and to a cohesive civil society. We were amongst the first in the UK, and the first in the water sector, to secure the National Equality Standard, providing an independent assessment of our progress and plans in this area. We have a cross-business diversity group managing programmes of work to improve our diversity across four priorities: ability, ethnicity, gender and sexuality.

Ensuring a resilient supply chain

We have a mature process and risk model for the assessment and management of our increasingly complex supply chain which we use to source a wide range of critical materials and services. Subject matter experts lead our approach to priority categories of procurement, for example on energy and chemicals. The tendering process for any new purchase includes an extensive and tailored risk assessment and approvals process, and also market testing to ensure best service and price. Contracts are tailored to include relevant requirements to ensure legal compliance and best practice. During the life of a contract, there is ongoing engagement as well as monitoring through tailored Key Performance Indicators (KPIs).

Our procurement team monitor expenditure to manage exposure to any single supplier. We have reviewed many critical supplies for the reliability of the supply chain, identifying, for example, where we have single source supplies which present risk of interruption. In response to past events we have taken action to improve resilience, for example investigating our sources of critical chemicals to ensure alternative options can be procured should our standard source be disrupted. To support long term resilience we are driving up standards in our supply chains by embedding a range of sustainability checks in our standard process, for example insisting on the living wage and high levels of safety and environmental performance. With our increasing focus on carbon emissions, we have recently started to consider how we monitor and improve the emissions in our supply chain well beyond the main framework partners with which we have worked closely for many years. To ensure our resilient procurement, we continually review and enhance our process and risk model in response to latest internal needs and external developments.

Ensuring physical and digital security

We take an integrated approach to the security of our sites and systems because these are increasingly interrelated as we embed latest technologies to enhance service and drive cost efficiency. We have a long history of managing physical site security to ensure safety and resilience, and more recently we have adopted best practice approaches to manage increasing threats to our cyber security.

We use a three-levels security framework to govern cyber, information, communication, physical asset and personnel security. This framework involves the application of a risk management process and uses a security risk register to assess the criticality and the appropriate protection required. Business continuity plans are developed for critical activities. A cyclical programme of inspections is undertaken with established hazard reporting procedures. To ensure we follow best practice, our approach follows the requirements of ISO 22301 for Business Continuity and ISO 27001 for Information Security.

We are embedding Business Process Management (BPM) throughout our business and will shortly complete our major upgrade to the latest SAP S/4 HANA system – the first in the water industry to do this. These developments work together to support substantial advances in our corporate resilience by helping us ensure even more consistent and efficient management of data and application of clear processes.



STAKEHOLDER QUOTE

“Effectively securing the supply chain can be hard because vulnerabilities can be inherent, or introduced and exploited at any point in the supply chain. A vulnerable supply chain can cause damage and disruption.”

**The principles of supply chain security,
The National Cyber Security Centre,
January 2018**



FINANCIAL RESILIENCE AND TRANSPARENCY

Our assessment shows our financial processes are some of our most resilient, with mature and comprehensive governance.

You can find out more detail on our financial resilience in our Annual Performance Report (APR) and Annual Report and Financial Statements (ARFS) at: www.yorkshirewater.com/reports

Customer affordability

Customers' willingness and ability to pay their water bill is essential to our long term resilience. We have consistently kept bills amongst the lowest in the industry in recent years, the second lowest at the time of writing. We lead the industry in our approach to debt management, proactively helping those struggling to pay through a range of support packages including our innovative social tariff. We also take effective action where customers won't pay. Through our customer engagement and research programmes we test customers' willingness to pay and perceptions of the value for money we provide. We consistently receive very high levels of support for our plans.

Financial resilience

We established a financing structure known as Whole Business Securitisation (WBS) in 2009. This supports our resilience by establishing protections to make the business more safe and reliable, for example limiting borrowings, dividends and the ability to lend money to others. The protections also require profits to more than cover the amount of interest that we pay. Lenders are therefore more prepared to offer lower rates of interest than would otherwise be the case, helping keep bills low for customers.

Gearing is important to our resilience because sufficient headroom is an important option should we need to borrow money to respond to unforeseen events. Conversely, raising debt is required to support our operational resilience by enabling sufficient investment in our assets. Our gearing is relatively high within the water industry. Levels of gearing are a choice about how we are financed, but this does not compromise our ability to be a high performing company.

We have taken measures to strengthen our financial resilience, including:

- Paying no and low levels of dividends to our shareholders in recent years. This is a standard part of our policy that ensures shareholder dividends are fair and appropriate.
- Releasing capital by selling other companies within the Kelda Group to which Yorkshire Water belongs.
- Reducing our interest costs by restructuring some of our borrowings.

We undertake extensive modelling and management controls to plan and externally confirm our financial resilience. This includes stress testing against very unlikely scenarios. We annually publish the results of our Long Term Viability (LTV) assessment in our annual accounts. In this assessment we consider our viability for up to nine years, through to the end of the current and next five year planning period. In our latest assessment we have again matured our approach to add further rigour. Looking ahead, we will be undertaking our LTV assessment at least twice a year, or sooner if certain triggers occur.

Ensuring trust through transparency

We have led the water industry in responding to recent challenges about complex financial structures that were eroding resilience by damaging the trust people have in us. One of our five Big Goals is to be open and transparent in everything we do. We have made substantial progress towards this over the last year and have plans to go even further.

We were the first to commit to closing our Cayman Island companies and simplifying our corporate structure. Other securitised water companies quickly followed our leadership. By the end of 2018, we will have completed the process to close our Cayman companies, and we are also reviewing options for our Jersey-based holding company.

For many years, executive pay and bonuses has been linked to performance on customer priorities, covering operational, environmental and social criteria as well as stable finances. We openly publish the decision making process for executive pay in our annual report.

We have increased both the volume of information we share and the clarity and assurance of what we share. Examples include:

- Engaging widely about our best practice three levels of assurance framework.
- Securing the Crystal Mark for plain English in our Annual Performance Report.
- Securing the Global Reporting Initiative Core Standard in our latest annual accounts to provide independent confirmation of our leadership in the transparent reporting of everything linked with our sustainability to give a rich view of the value we create.
- Working with the Open Data Institute to share operational data and inviting analysis to bring new ideas on how we can do things better. We have held successful hackathons and shared millions of lines of leakage data.

We have also improved our performance in Business in the Community's Corporate Responsibility Index, the UK's leading benchmark of responsible business. We have achieved five-star (top marks) performance for the last two years running.

CUSTOMER QUOTE

"I have no problem with them making a profit as long as they're delivering that service to us and it's good, and it's transparent and they treat the customers fairly and they keep their promises, that's all I'm bothered about"

A customer in Leeds

CUSTOMER QUOTE

"We would like to know the money they're spending, where is it going, what repairs are they doing to pipes and reservoirs, what condition are they in?"

A customer in Skipton

WHAT IS FINANCIAL RESILIENCE?

Financial resilience: The extent to which an organisation's financial arrangements enable it to avoid, cope with and recover from disruption.

Ofwat Delivering Water 2020: Our final methodology for the 2019 price review, 2017

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ASSURING OUR RESILIENCE

We have undertaken an integrated approach to the assurance of our resilience, following our model for three lines of defence. A range of different assurance activities have been undertaken to assess all aspects of our resilience. In addition to our ongoing internal assurance, we have undertaken a range of independent assessments to assure the effectiveness of our approach to resilience. Our most recent independent assessments include the following in 2018:

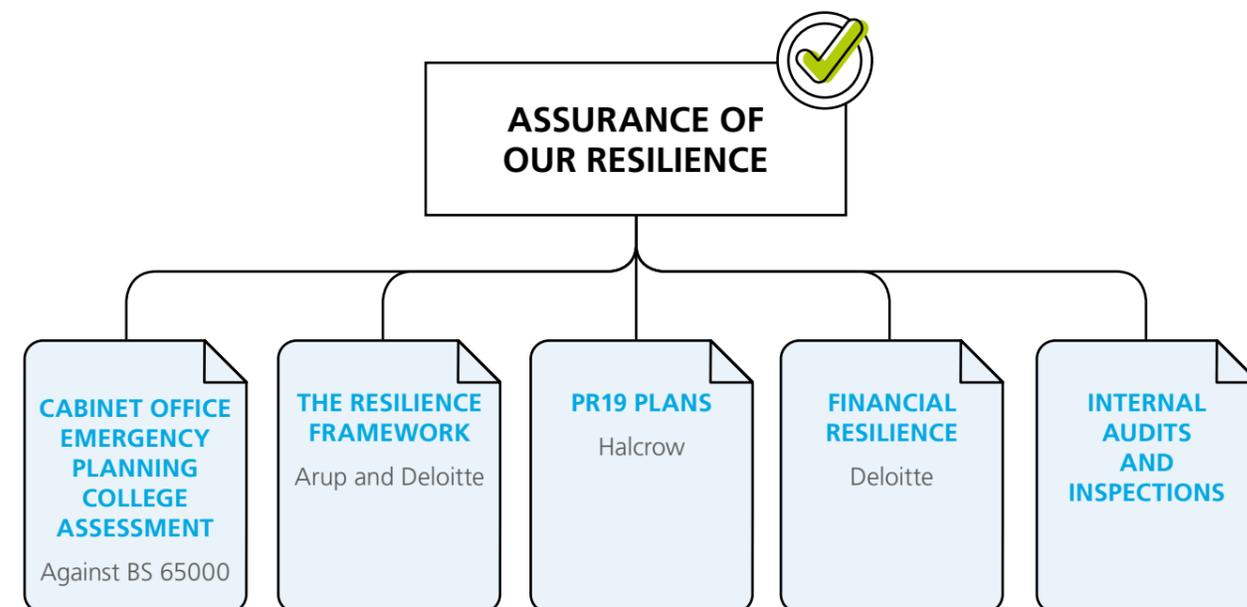
- Our technical auditor, Halcrow (now Jacobs) has audited how we approached resilience in our planning for each performance commitment and investment area.
- Our financial auditor, Deloitte has audited our financial resilience and our new resilience framework.
- The Cabinet Office Emergency Planning College has audited the maturity of our resilience to BS 65000.

We also deliver an internal rolling programme of audits and inspections which examine a broad range of resilience matters. To ensure quality, we comply with a range of best practice international standards including ISO 9001 and ISO 14001 for quality and environmental management systems.

All these audits concluded that Yorkshire Water has an effective approach to resilience, with areas of strength and best practice. The audits also suggested areas for continued improvement which have been, or are being, actioned.

Our Board has discussed our resilience and taken steps to ensure our plan and long term strategy will maintain appropriate levels of resilience.

We are embedding our new approach in our standard business processes, which we discuss further in the next section.



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CONTINUING TO DEVELOP OUR APPROACH

Resilience is a long standing priority for us and our customers. Managing resilience is not new to us. Our approach to resilience will continue to evolve over time with latest evidence and understanding, and in response to societal expectations and customers' wants and needs. We drive continual improvement through a plan-do-check-act process embedded throughout our management systems and company approach. Here, we share some of our plans.

MAINTAINING AND ENHANCING OUR RESILIENCE

A range of pressures would erode our resilience if we did not act, for example, our ageing asset base, the growing and ageing population, the changing climate, and escalating cyber security threats. We have taken these matters into account when developing our new business plan and long term strategy to ensure our investment choices and operational approach will efficiently and effectively maintain resilience, and enhance it in priority areas. Moreover, we are not waiting until 2020 to take further action, we have already escalated our efforts. This is confirmed through the quantified resilience scores that our new resilience framework enables. We show these scores and provide a comprehensive overview of how we manage resilience in the appendix that accompanies this publication.

Some resilience highlights of our plan include:

- Dramatically improving water efficiency to ensure a resilient public supply without harming the environment. For example, we are investing to reduce leakage by 40% and increasing the support we provide to customers to help them save water.
- Opening our bioresources function up to the market to introduce new ways of working that reduce cost while improving the resilience and quality of service.
- Working with the environment and a wide range of partners to reduce flood risk in Yorkshire and ensure the resilience of our drainage and sanitation service. For example, we are applying Natural Capital approaches in rural and urban areas to hold water out of harm's way while delivering many wider benefits for society.
- Further enhancing our systems from cyber attack while continuing to embrace latest technologies like the latest SAP S/4 HANA system and our bespoke six capitals Decision Making Framework, as well as thousands of remote monitors on our networks. These investments enhance our management and application of data to inform agile, quality decisions and interventions.
- Ensuring the long term stability of our finances, for example by simplifying our financial structures and working with our shareholders and investors to be fair and transparent.



FINANCIAL CAPITAL
Our financial health and efficiency



MANUFACTURED CAPITAL
Our pipes, treatment works, offices and IT



NATURAL CAPITAL
The materials and services we rely on from the environment, especially water



HUMAN CAPITAL
Our workforce's capabilities and wellbeing



INTELLECTUAL CAPITAL
Our knowledge and processes



SOCIAL CAPITAL
Our relationships and customers trust in us

The six capitals

CASE STUDY
ASSESSING OUR IMPACT AND APPLYING OUR SIX CAPITALS APPROACH

We use a six capitals framework to gain a broad view of the threats and opportunities facing our services and the wider value we create for society. We apply this fresh insight to shape our current approach and future strategy to ensure our services are resilient and we are maximising our potential contribution to society, the economy and the environment.

What are the six capitals?

In traditional economics, the term 'financial capital' is often used to describe the assets held by an organisation or individual, the value of which is expressed in terms of currency. However, financial capital does not represent everything that is important to a healthy and prosperous society, for example water, wellbeing or knowhow. To develop sustainable accounting processes that better reflect these critical considerations, we recognise six forms of 'capital'.

We have developed the concept of the capitals into a decision making process that works for our business. We have examined our impacts and dependencies across the capitals, assessing a range of economic, environmental and social attributes associated with our activities. By quantifying our negative and positive impacts across the capitals we are basing our strategy on a rich understanding so that we can ensure the resilience of our business and public services.

In many cases, impacts can be expressed in monetary terms to allow direct comparison and greater insight into the importance of non-financial impacts. This supports resilience by helping us to identify opportunities to provide greater value for money and better outcomes for the society we serve.

We have used the capitals approach to monitor and report on the impacts of our work, from individual project level up to our long term strategy and five year business plan; and to support our decision-making processes in many areas of the business. More information on how we use the capitals, including case studies and a full business-wide impact assessment, can be found at www.yorkshirewater.com/capitals

In our new resilience framework we have considered how we can apply our capitals approach to help us quantify the impact of our resilience on our services, and the communities we serve; and the impact of different approaches on our resilience. As part of our continuing development, we will continue to apply our capitals framework: expanding and refining our approach to support greater resilience.



FURTHER MATURING OUR INTERNAL GOVERNANCE OF RESILIENCE

Our latest advances in resilience will deliver lasting benefits to our business and services. It will also enable us to further enhance our governance of resilience and ensure ongoing improvement over time. To support this, we have embedded the best practice BS 65000 into our Integrated Management System (IMS). This ensures resilience is always a priority in our policies and our internal audits. In addition, the cyclical nature of our business planning supports the ongoing evolution of our approach to ensure our investment and operational activity is always based on latest evidence, best practice and potential innovation.

We are reviewing our approach to the governance of resilience and embedding the use and review of our new whole-business resilience framework to shape our strategy, investments and operations.

Following recent discussions with our Board and Risk Committee, we are expanding the Risk Committee to become the Risk and Resilience Committee. This will ensure ongoing ownership and alignment at the highest levels in our business.

COLLABORATING TO CONTINUE DEVELOPING BEST PRACTICE

To develop resilience in the water sector and to advance our approach in Yorkshire, we will continue to learn from other leaders, share our learning and facilitate debate. We will work with national water industry working groups to support the development of a sectoral approach to resilience. We have published this report of the methodology and findings of our new leading resilience framework to contribute to this process.

We are also collaborating internationally to deliver a peer reviewed global view of water sector resilience best practices and future innovation opportunities. This project is being led by experts from Cranfield University with Water Research Foundation and collaborators from international water companies.

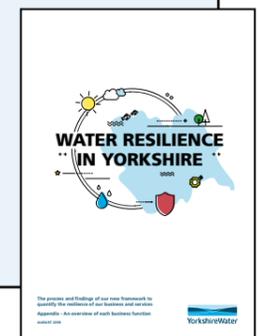
CONTINUING TO ASSESS OUR RESILIENCE AND OPENLY SHARE OUR PERFORMANCE

We will regularly update our whole-business resilience assessment and we will continue to ask independent experts to challenge and verify our approach and findings. As part of our Big Goal to be open and transparent, we will regularly report on our progress and the findings.

FURTHER READING

A separate appendix document provides a detailed, systematic overview of the resilience of each part of our business, including the interdependence mapping we have undertaken as part of our "systems thinking".

The appendix is available on our website at www.yorkshirewater.com/resilience



We invite feedback to help us advance our approach to resilience in Yorkshire and we welcome opportunities to support the development of a national standard in the water sector.

Please get in touch with your feedback and questions.

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