Our response to securing long term resilience relating to Ofwat's IAP YKY.L2.A2 and draft determination

YorkshireWater

Contents

About this document

We submitted our PR19 business plan to Ofwat in September 2018. Ofwat reviewed the plan and published its initial assessment in January 2019. The assessment included a series of actions for Yorkshire Water to complete by 1 April 2019 along with several actions that required completion post 1 April 2019. This document responds to Ofwat's feedback regarding integrated resilience planning within our draft determination and the IAP requirement YKY.LR.A2 to submit an action plan to develop and implement a systems based approach to resilience in the round and ensure that the company can demonstrate in the future an integrated resilience framework.

Action IAP YKY.LR.A2

The company should provide a commitment that it will, by 22 August 2019, prepare and provide to us an action plan to develop and implement a systems based approach to resilience in the round and ensure that the company can demonstrate in the future an integrated resilience framework that underpins the company's operations and future plans showing a line of sight between risks to resilience, planned mitigations, package of outcomes and corporate governance.

Ofwat Draft determination text

In our initial assessment of plans, we were concerned that companies' plans lacked a clear line of sight between the identified risks to resilience, the proposed mitigations to tackle these risks, and how these mitigation plans were reflected as service improvements in the form of stretching performance commitments. In this context, we are intervening to ensure Yorkshire Water's asset health challenges are reflected in its outcomes and performance commitments, particularly in relation to the level of stretch of mains repairs, unplanned outage, sewer collapses and to the incentives attached to its treatment works compliance.

Our initial assessment of plans also noted that Yorkshire Water provided high level evidence linking priority risks to its systems and to groups of performance commitments. It also provided general descriptions and systems dashboards regarding plans to improve each system area and increase levels of maturity. However, Yorkshire Water provided insufficient evidence to demonstrate the benefit that specific investments have in mitigating quantified levels of risk (and/or in increasing system resilience) and supporting stable or improved commitment targets. We expect companies to address this and other issues associated with the way they integrate resilience across their business in the action plans that will be submitted by 22 August 2019 and in their

responses to the draft determinations in relation to specific investment proposals. We will consider the quality of companies' response in our final determinations.

Assurance of our response

Good assurance needs to be provided at the right time, be proportionate to the level of risk identified, ask the right questions and assess the quality of evidence supporting the statements made. Our assurance approach is risk based and aligned to the 'three levels of assurance' framework. This is best practice and is set out in Yorkshire Water's published Assurance Plan for 2018/19 and 2019/20.

The assurance process includes audit checks and challenges by information providers, publication managers and senior managers.

Our response has been subjected to review and sign-off through our internal level 1 and 2 assurance activities. This has tested completion and compliance of the information submitted in this document.

Introduction

This response is in two sections to meet these two specific Ofwat requirements within our draft determination and IAP:

1. **Line of sight between risks to resilience, planned mitigations; service improvements and corporate governance.** This section demonstrates that our plans set out a clear line of sight between identified risks to resilience, the proposed mitigations to tackle these risks, and how these mitigation plans are reflected as stretching service improvements in the relevant performance commitments;
2. **Systems based approach to resilience in the round action plan.** This section satisfies IAP action YKY.LR.A2 to prepare and provide an action plan to develop and implement a systems-based approach to resilience in the round and ensure the demonstration of an integrated resilience framework that underpins our operations and future plans. A first response was provided to part of this action in our IAP response in April 2019.

The two sections provide detailed responses on the two Ofwat requirements. In addition, we want to re-emphasise the importance of the holistic framework that we have developed and implemented to underpin our PR19 business plan.

As set out in our long-term strategy, feedback from our customers and other stakeholders emphasised that we must deliver our core services differently, focusing on a holistic and sustainable approach. We have made significant steps in understanding the broad range of impacts that our activities have. This has been achieved through both the implementation of our Six Capitals Approach and our Total Impact and Value Assessment.

These methods for assessing and quantifying our impacts allow us to view our activities through a sustainability lens. This means we understand the impact our activities have on the environment and societal perceptions of us. We believe that having this understanding and being seen to act upon it are essential to both ensure ongoing legitimacy and enhance resilience.

These foundations work alongside our already implemented resilience framework. Ofwat's approach to "Resilience in the Round" provides useful focus on influencing factors such as corporate and financial resilience. However, we believe that a more comprehensive approach is needed. In particular, resilience must be linked to the full breadth of systems, processes, assets and governance that shape delivered performance on a day to day basis. As a result, we have developed a new cutting-edge whole business resilience framework. The resilience framework helps us quantify the resilience of all our activities through a robust and comprehensive evidence-based assessment. The result is an approach that:

- Informs better decision making by helping us improve how we measure and track our resilience, ensuring 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 and other stakeholders about the resilience we provide to them and the impact of our activities and investments.
- Advances best practice within the water industry and more widely.

As set out in our dedicated web page www.yorkshirewater.com/resilience.

Annex 1 provides a further summary of the long-term strategy context to our approach to resilience.

Annex 2, Ensuring our Resilience Framework and Decision Making Frameworks work in tandem, discusses future developments to our state-of-the-art tools to embed resilience in corporate decision making and governance.

Section 1

Line of sight between risks to resilience, planned mitigations, service improvements and corporate governance.

Introduction

This section sets out the line of sight between risks to resilience, our planned mitigations and associated service improvements in our plan. In addition to explaining the various components of our resilience framework, specific examples are provided to show the resilience framework in operation. The clear line of sight that Ofwat requires comes from the links between our Resilience Framework and our Decision Making Framework, with its integrated Six Capitals approach, as set out in our PR19 business plan submission. Annex 2, Ensuring our Resilience Framework and Decision Making Frameworks work in tandem, provides more detail on our future developments to further enhance this integration. We provide an overview of how resilience is "baked into" our Corporate Governance approach.

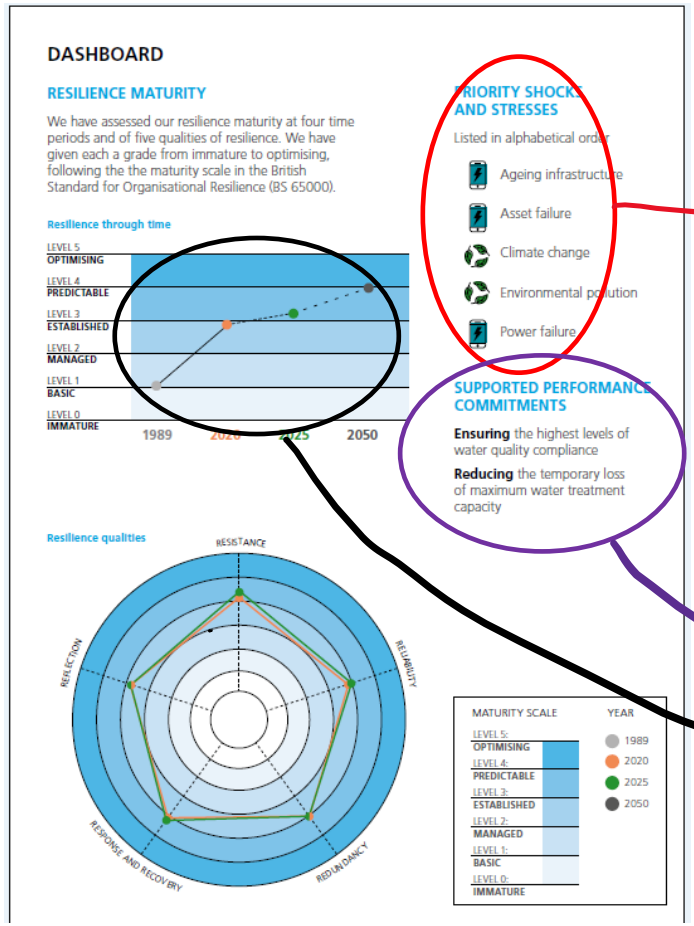
Line of sight between risks to resilience, our planned mitigations and associated service improvements in our plan.

The specific solutions in our plan have been prioritised as they are the most efficient means of achieving multiple benefits, for example service improvements and resilience benefits. As an example, the implementation of our 'Calm Networks' programme, to manage pressure in the distribution network, will have benefits to leakage but also increases overall resilience of the network, reducing the number of burst mains and service failures.

Our PR19 business plan was built using our new Decision Making Framework. We combine specific input parameters from our customers, reflecting their priorities and the value they place on service improvements with the detailed requirements from Ofwat's methodology and our statutory duties. The interventions made by Ofwat to add new upper quartile targets and over-write information on incentive rates will mean that a refresh of the detailed planning approach is required for our plan to deliver the final determination.

We have included four examples to show our resilience framework in operation. Figure 1, Resilience dashboards and line of sight between risks to resilience, planning mitigations and service improvements, provides a schematic overview of how our

resilience dashboards are used to build up the information we use. Table 1 Sets out the four specific examples of the line of sight between risks to resilience, planned mitigations and service improvements. The examples were selected to show information across a range of wholesale price controls and resilience systems; and a range of of wholesale price controls and resilience systems; and a range of interventions demonstrating the components of infrastructure resilience from the Cabinet Office ‘s “Keeping the Country Running: Natural Hazards and Infrastructure”.



Resilience system	Risks to resilience (top 5 per system)	Planned mitigations Totex	Service area (performance commitment)	Performance improvement in AMP7 plan		Resilience maturity change over period	
				2019/20	2024/25	2020	2025
Water Treatment and Drinking Water Safety	• Aging infrastructure • Asset Failure • Climate change • Environmental pollution • Power failure	£95.09m Water treatment base maintenance investment	Temporary loss of maximum water treatment capacity (YKY_XX_**Unplanned outage**)	8.00% of peak week capacity –	2.34% of peak week capacity	Level 2 established	Level 2 Established
Water	• Aging Infrastructure	£101.18m Distribution	Repairing water mains	264.80/1000km	164.1 / 1000km	Level 2	Level 2

Figure 1: Resilience dashboards and line of sight between risks to resilience, planning mitigations and service improvements

Table 1: Examples of the line of sight between risk to resilience; planned mitigations and service improvement

Resilience system	Risks to resilience (top 5 per system)	Planned mitigations Capex	Service area (performance commitment)	Performance improvement in AMP7 plan		Resilience maturity change over period	
				2019/20	2024/25	2020	2025
Water Treatment and Drinking Water Safety	• Aging infrastructure • Asset Failure • Climate change • Environmental pollution • Power failure	£95.09m Water treatment base maintenance investment Example: **Reliability – Maintenance** to ensure assets are functioning as designed and ready when called upon **Resistance – protecting critical assets** to maintain services despite extreme weather events	Temporary loss of maximum water treatment capacity (YKY_23 **Unplanned outage**)	8.00% of peak week capacity –	2.34% of peak week capacity	Level 2 established	Level 2 established
Water Distribution	• Aging Infrastructure • Asset Failure • Extreme cold • Heatwave and drought • Population growth	£113.65m Distribution base maintenance; structural mains base maintenance and communication pipes Example: **Redundancy – Enhancing network capacity and flexibility** so we have options to ensure continued service when something fails	Repairing water mains (YKY_24 **Mains Repairs**) Reducing supply interruptions (YKY_21 **Water Supply Interruptions**	264.80/1000km	164.1/1000km	Level 2 established	Level 2 established

Resilience system	Risks to resilience (top 5 per system)	Planned mitigations Totex capex	Service area (performance commitment)	Performance improvement in AMP7 plan		Resilience maturity change over period	
				2019/20	2024/25	2020	2025
Wastewater collection	• Aging Infrastructure • Asset Failure • Change in customer behaviour and expectations • Extreme rainfall • Population growth	£358.84m Drainage area studies; external flooding; Internal flooding hydraulic; Resilience (Hull); Sewerage base maintenance; sewerage other infrastructure; sewerage supply demand Example: **Resistance – sewer demand management** by reducing the amount of rainwater entering the network and working with customers to reduce sewer abuse **Redundancy – Multi-agency partnerships** to deliver a joined-up approach to long-term planning and preparedness, for example on flood management **Response and Recovery – collaboration** with other agencies to ensure a joined-up emergency response. Real time monitoring and control to see and manage our assets	Reducing the number of times sewers collapse (YKY_33 **Sewer collapses**); Reducing flooding from sewers of homes and businesses (YKY_XX **Internal sewer flooding**); Reducing flooding from the sewers of public spaces (YKY_31 **External sewer flooding**)	Sewer collapses		Level 2 established	Level 2 established (improvement within category)
				26.36/1000km	13.67/1000km		
				Internal sewer flooding			
				582/10,000 sewer connections	323/10,000 sewer connections		
				External sewer flooding			
				7,566	5,675		

Resilience system	Risks to resilience (top 5 per system)	Planned mitigations Totex capex	Service area (performance commitment)	Performance improvement in AMP7 plan		Resilience maturity change over period	
				2019/20	2024/25	2020	2025
Wastewater treatment and effluent disposal	• Aging Infrastructure • Asset Failure • Extreme rainfall • Population growth • Skills shortage	£960.11m Sewage Treatment base maintenance; sewage treatment quality Example – **Reliability – Diversity, training and development** of our workforce to ensure agility, competence and expertise **Reflection – Risk and resilience committee** to ensure regular, ongoing Board and senior manager oversight and direction	Meeting the requirements of our effluent discharge permits (YKY_32 **Treatment Works Compliance**)	98.09%	100%	Level 2 established	Level 2 established (improvement within category)

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Corporate Governance

Our Corporate Risk Committee has evolved to become the Corporate Risk and Resilience Committee. This ensures appropriate focus and ongoing ownership of resilience at the highest levels in our business. The Risk and Resilience Committee is revising the existing corporate risk and resilience assessment methodology to a new format based on our Six Capitals approach for AMP7. This will ensure that as risks are evaluated and mitigated. Consideration will be given to social, natural, intellectual and human capital as well as financial and manufactured capital. A risk appetite will be set by the Board for each of the capitals and the quantified level of risk will be monitored and managed against these. This process is supported by the introduction of new corporate risk management software. Existing corporate risks will be re-assessed against the new six capitals risk matrix.

The Risk and Resilience Committee will oversee the implementation of our Resilience in the Round Action Plan.

Our Integrated Management System (IMS) comprises of our Quality Management System, Environmental Management System, Asset Management System and our Health and Safety Management System. The IMS has been developed to meet the requirements of the relevant individual ISO Standards alongside the guidance of BS65000 Organisational Resilience (2014).

A continual programme of internal audits and site inspections make sure that we meet the requirements of all these standards and maintains its resilience through the effective management of our assets. Where actions are required these are time bound, tracked internally with the necessary steps taken and feedback provided, ensuring a proactive stance on organisational learning and resilience.

Case Studies

We provide two detailed case studies in Annex 3, showing how our plan has addressed risks to resilience, interventions and resulting service improvements. These provide “deep dives” of our thinking summarised at a higher level in Table 1.

Operational resilience at water supply system level

- Demonstrates performance (service level) and resilience metrics associated with individual water supply systems.

- Vulnerability assessments completed to allow the ranking of sites to prioritise interventions.
- The review informs both the short term (AMP6 and 7) and longer term (AMP8 and beyond) intervention plans to improve resilience and service.
- Stretching service measures set for the future, and longer-term risks to resilience identified.

Living with Water Partnership; Water resilience in Hull and Haltemprice

- Water resilience is important in Hull and Haltemprice due to a greater flood risk than other areas of the region, this results from both physical geography and socio-economic factors, which mean that communities in Hull are less equipped to respond and recover to significant shocks such as flooding.
- A pioneering collaborative approach to water resilience – The Living with Water Partnership (www.LivingWithWater.co.uk) formed.
- The Living with Water Partnership is a blueprint for resilience and social contract and showcases a way of working that would be relevant to all catchments in Yorkshire.
- A focus of the Living with Water Partnership is enhancing community resilience to flooding through education, cohesion and global collaboration and learning.
- Communities will be involved in the development and deployment of interventions. Flood risk reduction interventions will be integrated with intervention plans for housing, transport, regeneration and place-making. This is only possible through working in Partnership and aligning the outcomes of multiple organisations.

Section 2

Action plan for our systems based approach to resilience in the round

Introduction

Section 1 explained the new capabilities that we have developed and how they have already been deployed in the development of our PR19 business plan. We recognise that our deployment of these new capabilities is the first stage and we will continue to enhance and refine our approach as the resilience framework operates during the AMP period. Our focus in this section is to explain our action plan to ensure that our customers gain the maximum benefit from these new capabilities.

Our action plan includes activities to improve our approach and line of sight to build upon the strong foundations of our detailed resilience reviews. These activities will bring coherence, improve governance, better articulate the costs and benefits of resilience, enable us to report accurately on our resilience and should drive more effective, future-proofed decision making. Our resilience framework that was developed prior to the submission of our PR19 business plan will continue to be reviewed and revised to better meet our evolving understanding of resilience.

The resilience action plan Table 2, Resilience in the Round Action Plan Theme Descriptions and Figure 2 Resilience in the Round Action Plan focusses on the systems, processes and governance that will be enhanced to ensure a clear line of sight between identified resilience risks, planned interventions, service improvement and corporate governance. It does not provide detailed action plans for each individual resilience system, although it does touch on further actions to better understand some of the specific risks (shocks and stresses to those systems). The following sections are a high level description each of the resilience action plan themes, within in Figure 2, Resilience in the Round Action Plan Theme Descriptions

Corporate Governance

We explained above how our corporate governance has started to change. The actions arising in this regard are:

- Corporate Risk and Resilience Committee established

- Risk and resilience assessment methodology evolved to a new format based on the Six Capitals approach for AMP7
- Risk appetite set by the Board for each of our Six Capitals
- Risk and Resilience Committee to oversee the implementation of the resilience action plan.

Line of sight between risks to resilience, planned interventions and service improvements

In section one, we demonstrated through our resilience framework and the associated dashboards that we have linked our performance commitments to the 16 identified resilience systems. Annex 2, Ensuring our Resilience Framework and Decision Making Frameworks work in tandem, discusses our future enhancements to complete the integration of a new resilience tool with our Decision Making Framework system. This facilitates greater integration between the resilience framework and the Decision Making Framework and our bespoke Six Capitals approach to ensure the risk calculation for resilience aligns with our existing corporate methodology.

The actions arising from this alignment of frameworks are detailed in Table 2. Resilience in the Round Action Plan Theme Descriptions.

Risks to resilience – climate change and extreme weather

Our publication Water Resilience in Yorkshire, August 2018, www.yorkshirewater.com/resilience, highlighted climate change and extreme weather is one of the most serious threats to our long-term resilience. We have been at the forefront of climate risk understanding for many years, we have included climate change in our Water Resource Management Plans since the 1990s. However, we are not complacent. The drought in the summer of 2018 and the impacts on our performance and operating budgets, is the new normal. The latest climate change projections show that we can expect a summer like 2018 every other year by the 2050s. We have carried out several assessments to inform our PR19 business plan and have engaged in national and international efforts to advance our understanding, including:

- Guidelines from the Task Force on Climate Related Financial Disclosures, 2017.
- Yorkshire Water's Resilience Framework, Arup 2018.
- Yorkshire Water's maturity assessment against BSI Organisational Resilience, 2018.
- Benchmarking Yorkshire Water's adaptive capacity, 2016

The above assessments have been combined into a climate risk action plan with four themes, governance, strategy, risk management and metrics. One key action is to

update our Climate Change Risk Assessment using the latest set of UK climate projections, and to use our Decision Making Framework to quantify our climate risk in financial and service impact terms where possible.

Inclusion of the climate risk action plan in our Resilience Action Plan, means that it will have oversight from the Corporate Risk and Resilience Committee and visibility and support at Board level.

Ongoing development of our Resilience Framework

Our approach to resilience will continue to evolve over time with the latest evidence and understanding and also 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. We 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 findings.

Table 2: Resilience in the Round Action Plan Theme Descriptions

Resilience Action Plan Theme	Action	Completion Date	Description
Corporate Governance	Establish Corporate Risk and Resilience Committee	Complete	The Corporate Risk Committee evolved to become the Corporate Risk and Resilience Committee, ensuing ownership of resilience at the highest level in our business.
	Revise corporate risk and resilience assessment methodology based on 6 capitals approach	December 2019	The Risk and Resilience Committee has agreed to revise the existing corporate risk and resilience assessment methodology to a new format based on the 6 capitals approach for AMP7. This will ensure that as risk are evaluated and mitigated, consideration will be given to social, natural, intellectual and human as well as financial and manufactured capital.
	Reassessment of existing corporate risks based on the 6 capital methodology	March 2020	Reassess all existing corporate risks in line with the new 6 Capitals methodology
	Set risk appetite for the 6 capitals	September 2020	A risk appetite will be sent by the Board for each of the capitals and quantified level of risk will monitored and managed against these.
	Install new corporate risk management software	November 2019	Introduction of new corporate risk management software to support the new approach.
	Integrated Management System annual review, including BS65000 (2014) Organisational Resilience	Annual Review	Yorkshire Water's Integrated Management System (IMS) has been developed to meet the requirements of ISO Standards for Quality; Environmental; Asset; Health and Safety and Resilience Management. An annual review is completed to ensure continuous improvement.
	Completion of 15 recommendations from the Emergency Planning College (EPC)	October 2019	The Emergency Planning College (EPC) carried out an external assessment against BS65000 (2014) Organisational Resilience. There were 15 actions identified, which are now completed or in the process of delivery.
	Risk and Resilience Committee to oversee the implementation of the Resilience in the Round action plan	Annual review	Annual review and progress report on the delivery of the action plan

Resilience Action Plan Theme	Action	Completion Date	Description
Line of sight between risks to resilience, planned interventions and service improvements	Alignment of 6 Capitals risk appetite with resilience framework maturity assessment	December 2020	Development of a new risk methodology will require that we understand the alignment between this and the resilience maturity assessment (and resilience maturity appetite) set out in the Resilience in the Round Framework.
	Integration of a new resilience tool with our Decision Making Framework	February 2020	Integration of a new resilience tool with our Decision Making Framework system, allowing integration between the DMF and our 6 Capitals Approach to ensure risk calculation for resilience aligns with our existing corporate methodology. This action is split into an appraisal and recommendation phase.
	Develop intervention plans for 16 resilience systems, to maintain or enhance resilience and deliver stretching service targets.	March 2023	Taking account of the shocks and stresses identified for each system, the associated Performance Commitments, the resilience maturity assessment, along with our stretching long term Performance Commitment profiles and our risk and resilience appetite, develop action plans to deliver stretching service improvements and maintain or enhance our resilience. The intervention plans will be assessed against the six capitals approach.
	Intervention plans feed into PR24 plan	2023/24	The intervention plans will form the basis of our resilience and service plan in PR24.
Risks to Resilience – Climate change and extreme weather	Update Climate Change Risk assessment	December 2019	Update Climate Change Risk Assessment using the latest using latest climate projections.
	Climate Change Strategy review and update	March 2020	Review the strategy based on the latest information from the Climate Change Risk Assessment and best practice.
	APR111 report production and submission	June 2020	Reporting to DEFRA under the third round of the climate change adaptation reporting power.
	Use the Decision Making Framework to quantify our climate risk in financial and service impacts where possible	March 2021	The integration of a new resilience tool with the Decision Making Framework will allow us to quantify our Climate risks in financial and service terms.
	Production of Flood Resilience Strategy	October 2019	Set out our current and future approach to Flood Resilience
	Update of Engineering Specification V20 (for AMP7)	July 2019	The update of the Engineering Specification will embed the requirement for resilience to extreme weather risk assessment for all the Capital interventions we carry out in AMP7.

Resilience Framework Development	Update whole business resilience assessment	2023/24	Review our Resilience in the Round Framework and methodology and review our resilience maturity assessment
	Verification of assessment by Independent expert	2023/24	Validate our assessment, learning from best practice

Resilience Action Plan Theme	Action	2019 / 2020													2020 / 21				2021 / 22				2022 / 23				2023/24	2024/25
			Quarter 1			Quarter 2			Quarter 3			Quarter 4			Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4		
		March	April	May	June	July	August	September	October	November	December	January	February	March														
Corporate Governance	Revise corporate risk and resilience assessment methodology based on the Six Capitals approach																											
	Reassessment of existing corporate risks against the new Six Capital Framework scale																											
	Set risk appetite for each of the six capitals																											
	Assessment of risks (including resilience) against the risk appetite																											
	New corporate risk management software																											
	Completion of 15 recommendations from Emergency Planning College (EPC) assessment against BS65000 (2014) Organisational Resilience																											
Line of sight between risks to resilience, planned interventions and service improvements	Alignment of six capitals risk appetite with resilience framework maturity assessment																											
	Resilience tool integration with DMF - appraisal																											
	Resilience tool integration with DMF - recommendation																											
	16 resilience systems - review long term Performance Commitment profiles; resilience maturity assessment and risk appetite																											
	Intervention plan development and assessment against 6 capitals approach using Decision Making Framework																											
	Inclusion of intervention plans in PR24 process																											
Risks to resilience - climate change and extreme weather	Update of company wide severe weather plan																											
	Update Climate Change Risk Assessment																											
	Climate change strategy review and update																											
	ARPIII report production and submission																											
	Use Decision Making Framework (DMF) to quantify our climate risk in financial and service impacts where possible																											
	Production of flood resilience strategy																											
	Update of Engineering specification V20 (for AMP7) to embed requriement for resilience to extreme weather risk assessment																											
Resilience framework development	Update whole-business resilience assessment and report																											
	Verification of assessment by independent expert																											

Figure 2: Resilience in the Round Action Plan

Conclusion

We have a line of sight between our risks to resilience, intervention plans and delivery of service improvement. This is overseen by our corporate governance approach in this area. Our action plan lays out how we intend to strengthen, improve and report on this line of sight in the future. It ensures that we can demonstrate a systems-based approach to resilience in the round and ensure that the company can demonstrate in the future an integrated resilience framework that underpins our operations and future plans showing a line of sight between risks to resilience, planned mitigations, package of outcomes and corporate governance.

Annex 1

Long term strategy context to our approach to resilience

Our maturing thinking on resilience is hard to articulate in isolation as it is an inherent part of our long-term strategy. To set the context around the resilience action plan, it is necessary to explain the development of our long-term strategy holistically. In our PR19 business plan we described the role we play as a private company, delivering a public service to customers who cannot choose their service provider. We described these three parts to the character of our business in our PR19 business plan (Figure 1):

- Providing essential **public** water services means we need to plan into the long term to be completely reliable and resilient.
- As a **commercial** company aware of our costs, we are efficient and offer value for money. To do this we are consistently innovating, using markets and data to understand and exceed customer expectations.
- We have **societal** responsibilities, most of our customers cannot choose who serve them and we must respect the communities we serve.

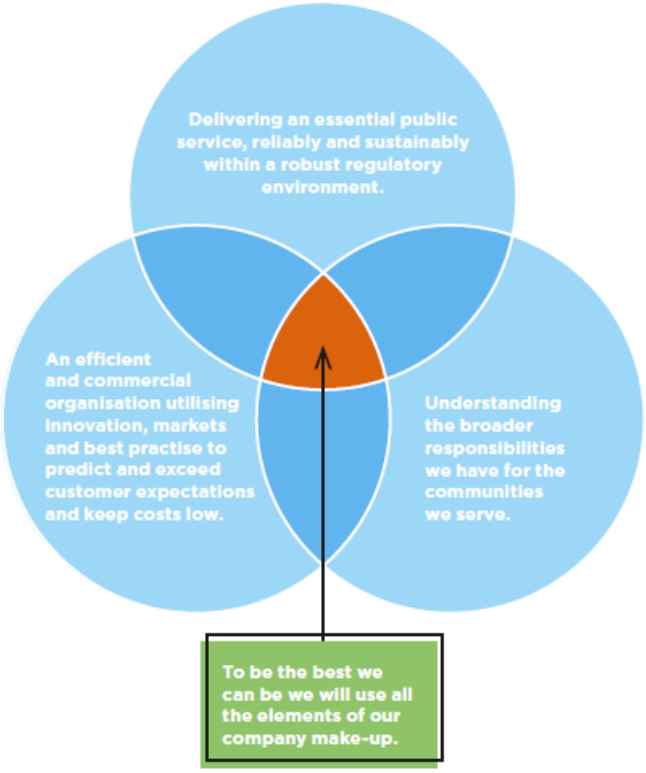

Figure 1 The characteristics of our business

To be resilient and to support thriving communities and the environment in Yorkshire, we need to operate in the “mid-zone”, optimising all the elements of our company make up. We have systemised our ability to measure how we are performing in this regard through the implementation of the Decision Making Framework and our Six Capitals approach (Figure 2 and 3).

Figure 2 Yorkshire Water’s six capitals approach

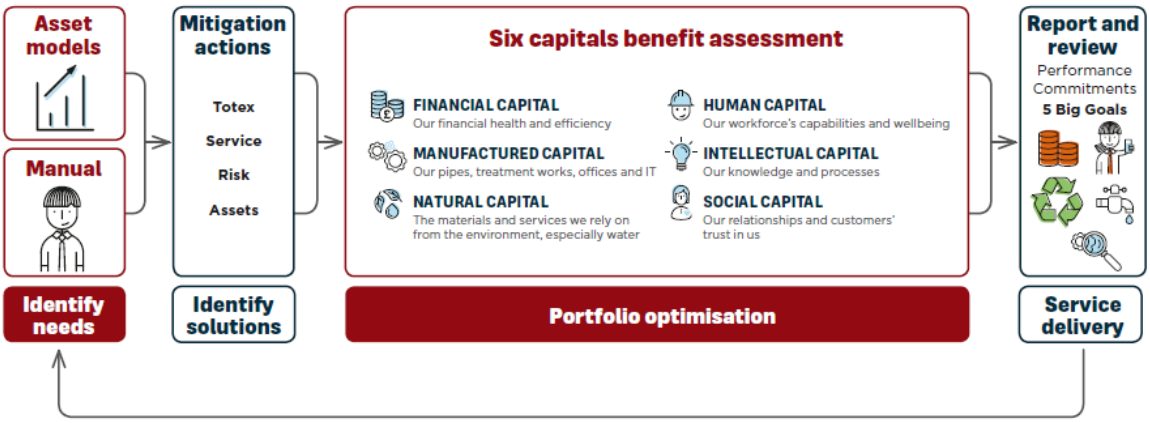

Figure 3 Shows the application of the Six Capitals approach in our business planning.

Figure 4 Totex Hierarchy of Interventions

Underpinning the Decision Making Framework is our Service Measure and Valuation Framework. This identifies the reasons we need to invest and the value of doing so (based on customers priorities and valuations). It allows us to link expenditure to service and understand the benefits of our programme at a much more detailed level. The benefits are measured and valued according to the different service impacts on natural, social, human, financial and manufactured capitals. Figure 5 shows an example of how a service measure translates to a benefit impact.

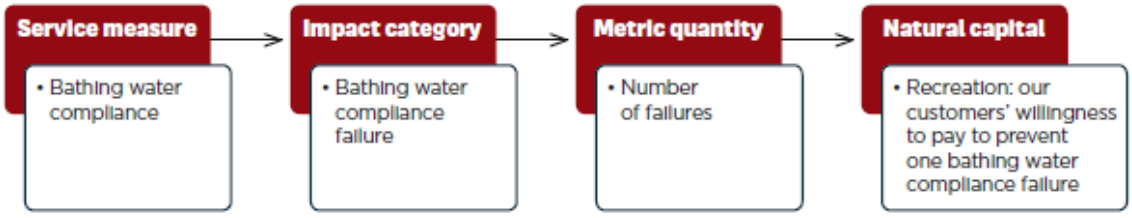

Figure 5 Translation of a service measure to a benefit impact

The five qualities of resilience included in our resilience framework are listed below. In the Cabinet Office publication "keeping the Country Running – Natural Hazards and Infrastructure" (2011), the Cabinet Office shared a model of the four components of effective infrastructure resilience. We embedded this model in our planning approach

and developed the best practice model by adding a fifth quality of resilience, 'Reflection'. Our five qualities of resilience are:

1. Resistance: Protection to withstand a hazard (e.g. a flood wall)
2. Reliability: The ability of an asset to operate in a range of conditions (e.g. asset design)
3. Redundancy: Designing capacity into a system (e.g. back up pumps)
4. Response and Recovery: Enabling fast and effective response to, and recovery from, an event (e.g. emergency planning)
5. Reflection: Continuously evolving as a result of learning from past experiences (e.g. raising actions in an incident review)

As can be seen from the examples shown in column "planned mitigations'' of Table 1, Examples of the Line of sight between risk to resilience; planned mitigations and service improvement, (''), we include aspects from all the five qualities of resilience in our intervention plans. Two case studies in (Annex 3) further demonstrate the application of the five qualities of resilience in our intervention activities.
We have developed two frameworks, Resilience Framework and Decision Making Framework that allow us to ingrate the management of resilience into our day to day business activities and governance processes. The benefits brought by this approach are the alignment of our understanding of our risks to service and resilience, the optimum mix of interventions to maintain and enhance service and resilience and the ability to measure the impact of these interventions in terms of:

- Service improvements
- Resilience improvements
- Monitoring against risk and resilience appetite

The frameworks mean that we can have active dialogue with customers about our resilience and service. Operational and longer-term planning decisions can be made with customers, service and resilience as inherent considerations.

Annex 2

Ensuring our Resilience Framework and Decision Making Frameworks work in tandem

We map the line of sight from risks to resilience, planned mitigations and service improvements through our Resilience Framework and our Decision Making Framework. This approach will be placed at the heart of our regular dialogue with customers on resilience and it will ensure an integrated approach to managing resilience risks throughout our business. Resilience is part of our day to day decision making, not a once off planning activity that gets looked at in detail once every five years.

Details of our action plan in section 2 explained how we will develop our thinking in this area. We will complete the integration of our new resilience tool with our Decision Making Framework system, allowing integration between the Decision Making Framework and our bespoke methodologies including the Service Measure Framework and Six Capitals approach to ensure the risk calculation for resilience aligns with our existing corporate methodology. This is illustrated in Figure 1, Integration of new resilience tool with existing Decision Making Framework to ensure the risk calculation for resilience aligns with our existing corporate methodology and also in Figure G, Integration of our Resilience Framework with our Decision Making Framework and integrated six capitals approach

Table 1 gives the description and opportunities of each of the components of the integration of our Resilience Framework with our Decision Making Framework and integrated six capitals approach.

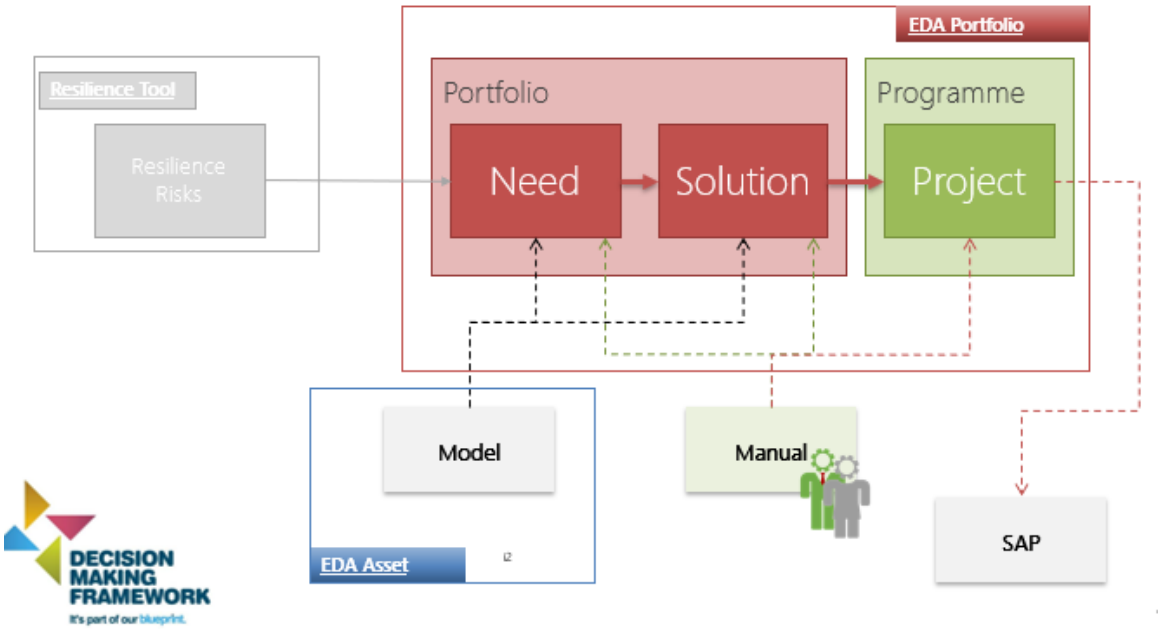

Figure 1 Integration of new resilience tool with existing Decision Making Framework to ensure the risk calculation for resilience aligns with our existing corporate methodology

Table 1 Description and opportunity of the components of Integration of our Resilience Framework with our Decision Making Framework and integrated six capitals approach

Frameworks		Component	Description	Opportunity
Resilience Framework		16 Resilience Systems Shocks and Stresses	Identification of the shocks and stresses impacting each of our 16 Resilience systems – i.e. risks to resilience	We understand the risks to our resilience now and in the future
Resilience Framework	Decision Making Framework	Associated Performance Commitments	Our Performance Commitments have been aligned to our 16 Resilience systems	Understanding current (associated Performance Commitments) and future performance requirements (Long term performance commitment profiles) alongside our existing maturity assessment and our risk and resilience appetite facilitates development of the required outcomes (service and risk)
Resilience Framework	Decision Making Framework	Maturity Assessment	Assessment of the level of maturity for each of our 16 resilience systems	
Resilience Framework	Decision Making Framework	Long term performance commitment profiles	For each Performance Commitment, creation of a long term service profile	
Resilience Framework	Decision Making Framework	Resilience appetite	Determination of the appropriate level of maturity for each system. Informed by the corporate risk appetite.	
	Decision Making Framework	Intervention Plan	The plan of activities required to deliver service improvements and resilience in line with the resilience and risk appetites	Multi-benefit Intervention Plans, that deliver and support both stretching service improvements and resilience (the outcomes) can be assessed against and optimised using our Six Capitals approach (including natural and social capitals). These intervention plans inform current operational activity and long term planning. We understand the costs and benefits associated with service and resilience maintenance and improvement.
	Decision Making Framework	Six Capitals Assessment	Assessment of the benefits including natural, social, human and intellectual capital associated with the Intervention Plans. Intervention plans are optimised based on this measurement of benefit	
		Service Improvement	An improvement in the level of service received by our customers; communities and the environment	Customers; communities and the environment benefit from improved service.

Annex 3

Case Studies

Case Study One – Operational Resilience at water supply system level

We have outlined the activity that was undertaken with Arup (our service provider) in developing our Resilience Framework. To support this activity and allow us to understand in detail our resilience at water supply system level, we worked with International Consultancy, Stantec on an approach that allows a consistent means of assessment of operational resilience using a whole system approach. We have completed a detailed assessment of 17 of our water supply systems, which is 50-60% of the population of our water supply operational area.

Vulnerability assessments have been completed to allow the ranking of these sites to prioritise interventions. The assessments considered the following key service indicators and risk factors:

- Properties at risk.
- Equivalent no. of properties without alternative supply.
- System redundancy shortfall (percentage of customers who can be supplied from elsewhere).
- “Survival” time (time supplies can be maintained using storage and rezoning (hours).
- Likelihood of outage exceeding “survival” time (during next 10 years).
- Customer minutes lost impact **YKY_21 Water Supply Interruptions**
- Current reliability (based on annual unplanned outage volume) **YKY_23 Unplanned Outage.**
- Safe restart (is the site able to run to waste to allow safe restart).
- Overall resilience risk ranking (within the 17 systems reviewed).

The outputs from this assessment fed into our PR19 intervention plans. We will complete the review of the remaining systems and identify a range of potential solutions for investigation and optioneering during AMP7 to provide inputs into our intervention plans for PR24 and beyond.

Water supply system resilience dashboards have been created to allow ease of review and integration of outputs. See Figure 1 Example of water supply resilience dashboard. Thresholds and descriptors have been set up within the dashboard, which can be

modified to reflect any current or future agreed standards or strategic principles. The dashboard views allow quick and easy identification of any current and future shortfalls, and a risk-based approach to delivering resilient services in the long term.

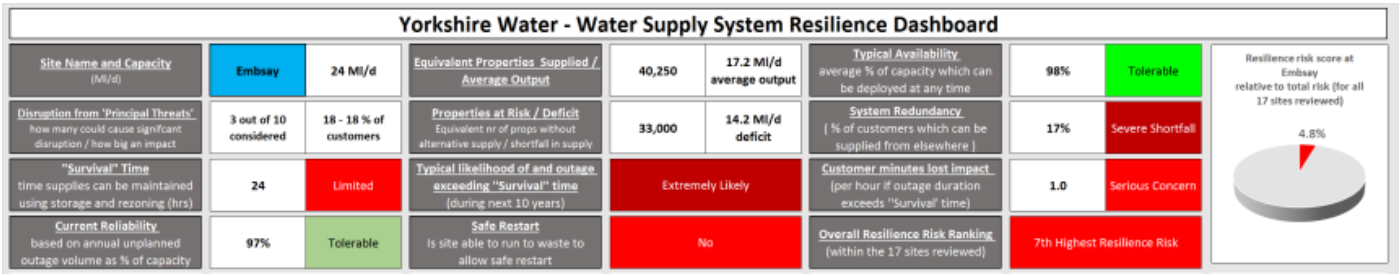

Figure 1 Example of water supply resilience dashboard

Potential solutions to resilience shortfalls are displayed on a source to tap schematic which allows the visualisation of potential connectivity between and within water supply systems. These can then be compared for the system under consideration, and across all systems to identify an optimal approach to enhancing resilience. The schematic shown in Figure 2, Chellow Water Supply System: Overview of potential interventions to improve resilience, provides an overview of the potential interventions identified which would improve the resilience of the Chellow (Bradford) water supply system. The outputs provided provide a diverse range of options for mitigation and it may be on further examination that combinations of options over time provide the optimal solution, especially when looked at in conjunction with those for adjacent areas.

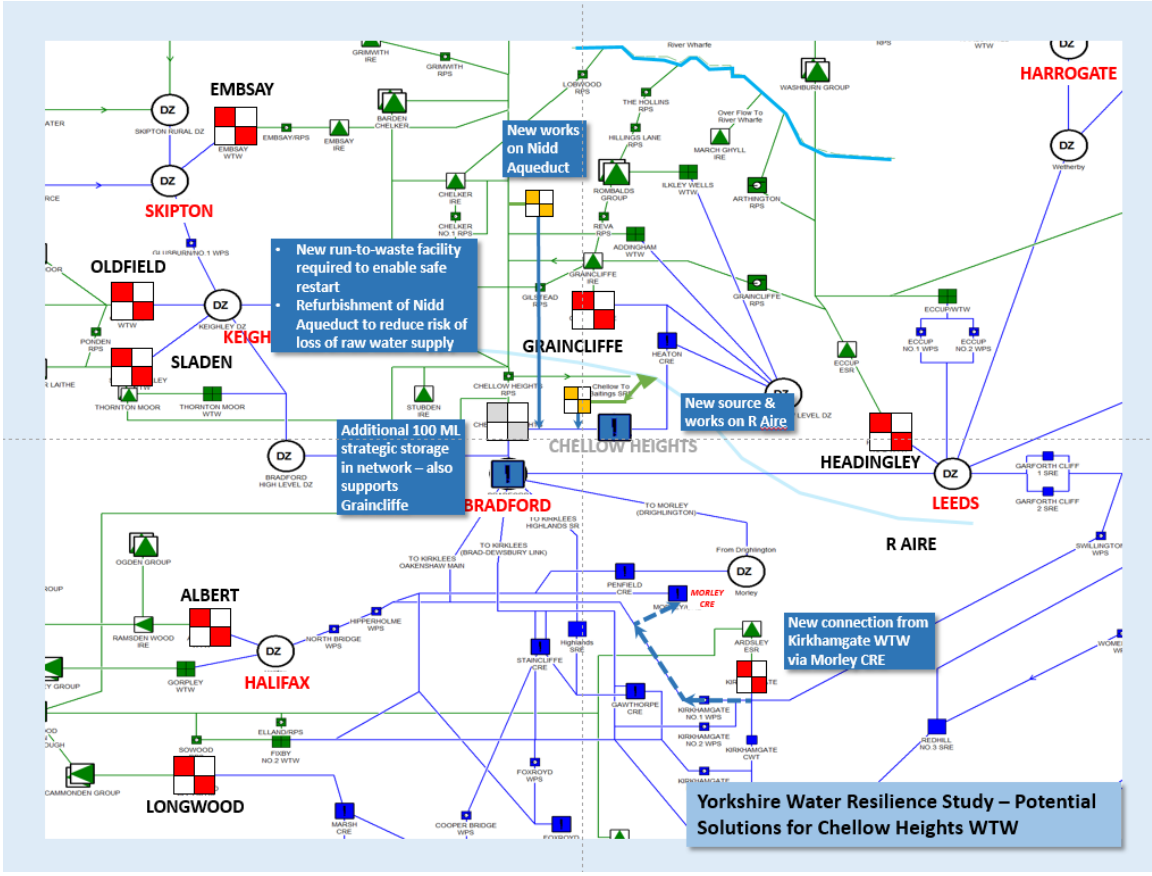

Figure 2 Chellow Water Supply System: Overview of potential interventions to improve resilience

The review informs both the short term and longer-term intervention plans to improve resilience and service. We have identified key actions which will allow us to deliver more reliable and resilient water production in the short term, contributing to the delivery of stretching performance commitments in AMP7. This approach is focused on the key areas of maintenance and the prevention of and recovery from equipment failure to improve reliability, including:

- Good practice in maintaining assets, for dosing systems and monitoring and control systems.
- Pro-active preventative replacement strategies and / or fail safe back up facilities to reduce risk.
- Improved reliability and use of on-line monitoring systems to improve responsiveness.
- Developing a plan to retro-fit run to waste systems on all water treatment works.

Figure 3, Extract from our Water Treatment Strategy demonstrating understanding of future risks to resilience and long term planning for service improvement, is an extract from our water treatment strategy and shows that we have set stretching service improvements for the future and have identified longer term risks to resilience, including deteriorating raw water quality. Our understanding of risks to resilience and stretching service improvement targets will inform our future intervention plans so we can ensure we meet our long term performance commitment forecasts into the future.

AMP7	AMP8	AMP9	AMP10	AMP11
• Zero unplanned shutdowns - Reduction of 80% to 150 pa. • WTW capable of treating all available resource to required standard - 40% of works to achieve maximum flow • Investigate remote monitoring and telemetry for raw water quality data – esp. colour/DOC • Investigate structural stability of Elvington weir – agree plan with EA • %age of useable headroom matched to demand centres or individual sites - WRMP • 100% WQ compliance - Achieve 99.97% Water Quality compliance • Investigate removal of DBPs at Longwood, Loxley • *Investigate removal of Metaldehyde at: Elvington, Acomb Landing, Huby,*	• Zero unplanned shutdowns - Reduce from 150 to 75 pa. • WTWs capable of treating all available resource to required standard - 75% of works to achieve maximum flow • %age of useable headroom matched to demand centres or individual sites - WRMP • 100% WQ compliance - Achieve 99.98% Water Quality compliance • 2no. Sites (Longwood, BMF) need DBP investment (based on current predictions) • *Removal of Metaldehyde at all sites (alternative sources / treatment)* • Nitrate treatment at Haisthorpe – subject to degree of success	• Zero unplanned shutdowns - Reduce from 75 - 50 pa. • WTWs capable of treating all available resource to required standard - 90% of works to achieve maximum flow • %age of useable headroom matched to demand centres or individual sites - WRMP • 100% WQ compliance - Achieve 99.99% Water Quality compliance • 2no. Sites (Fixby and BMF) need DBP investment (based on current trends) • Delivery of pesticide removal at Carlton Mill Lane – subject to outcome of source investigations in AMP7 WINEP • Potential further sub-regional	• Zero unplanned shutdowns - Reduce from 50 - 40 pa. • WTWs capable of treating all available resource to required standard - 95% of works to achieve maximum flow • %age of useable headroom matched to demand centres or individual sites - WRMP • 100% WQ compliance - Achieve 99.995% Water Quality compliance • 2no. Sites (Chellow (additional streams) and Albert) need DBP investment (based on current trends)	• Zero unplanned shutdowns - Reduce from 40 - 30 pa. • WTWs capable of treating all available resource to required standard - 95% of works to achieve maximum flow • %age of useable headroom matched to demand centres or individual sites - WRMP • 100% WQ compliance - Achieve 99.998% Water Quality compliance

Figure 3 Extract from our Water Treatment Strategy demonstrating understanding of future risks to resilience and long term planning for service improvement

Case Study Two – Living with Water Partnership; Water Resilience in Hull and Haltemprice

For a number of years we have been building a collaborative, resilience based approach to addressing the risks of flood risk in Hull and Haltemprice, through the development and activities of the Living With Water Partnership. We have taken a pioneering approach in Yorkshire which focusses on Hull and Haltemprice for the following reasons:

- Hull is at risk from flood events at multiple rainfall frequencies and from multiple sources.
- Has the highest total flood risk envelope outside the Thames Estuary.
- Communities here are amongst the most vulnerable to climate risks in the UK.

The risk in Hull and Haltemprice is greater than other areas of our region due to both physical geography and socio-economic factors, which mean that communities in Hull are less equipped to respond and recover to significant shock events, such as flooding. Within our PR19 plan, the activity delivered in Hull and Haltemprice will contribute to service improvements in the following areas:

- YKY_31 Internal sewer flooding
- YKY_35 External sewer flooding
- YKY_37 Surface water management
- YKY_07 Education
- YKY_01 Working with others

Topography

The topography around Hull and Haltemprice form a landscape like a bowl which inhibits the natural flow of surface water to the estuary. Parts of the River Hull and Holderness Drain are higher than the land to either side and the reclaimed land near the waterfront is higher than that to the north. Over 90% of the City of Hull is below sea level at high tide.

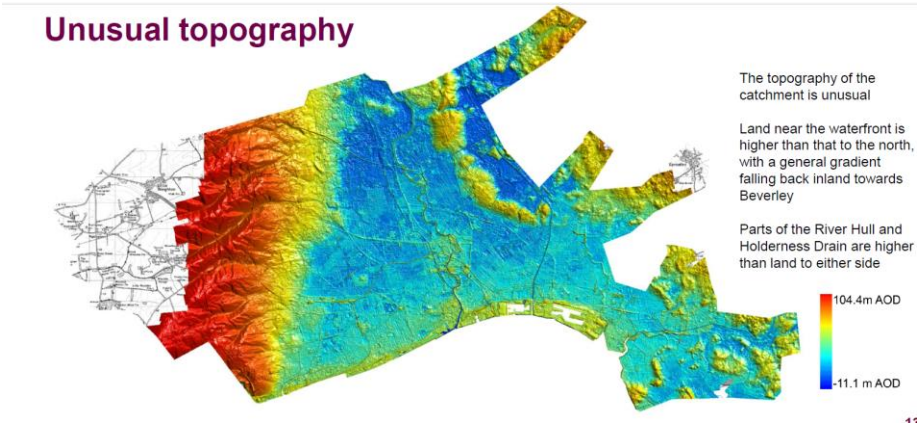

Figure 4 Map showing height of land in Hull and Haltemprice (low lying areas are shown in blues; note that the rivers and coastal frontage are generally higher than surrounding land)

Complex and integrated drainage system

A high proportion, 88%, of surface water flows from Hull and Haltemprice enter the combined sewer network. Most sewerage systems in the UK use rivers and watercourses to relieve pressure on the system in wet weather, allowing water to escape which alleviates property flooding. In Hull there are no relief points on the drainage network and increased pressure comes from both the topography of the catchment and the historic introduction of several significant watercourses into the sewers. All flows entering the sewer network, must be pumped out of the city.

Challenging environment for traditional Sustainable Drainage System (SuDS) features

A combination of soil type and high groundwater level means that infiltration is often not practical in Hull and Haltemprice. Impervious clay soils, few surface water systems into which SuDS features could drain and limited land all impact significantly on the viability and cost of SuDS implementation. Archaeological significance and a history of contaminated land are also known to drive higher costs of development in Hull and Haltemprice.

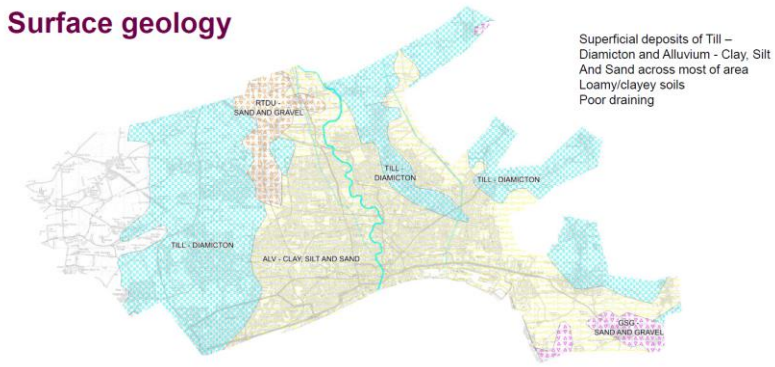

Figure 5 Surface geology showing extent of clay soils (in off white)

Socio-economic status[1]

In 2015, Hull was identified as the third most deprived Local Authority (LA) area in the UK. The average Gross Disposable Household Income (GDHI) is equivalent of £13,380 per head, compared to £16,365 per head regionally and £19,878 nationally. This makes communities less able to access flood mitigation measures and to respond and recover when flood events occur.

[1] *Ramsden, S (2019) Living with Water 2018 Baseline. University of Hull, Hull.*

The Humber is the largest trading estuary in the UK (by tonnage) and the fourth largest in northern Europe, *Avello et al (2019)*[2], with 14% of UK international trade handled by Humber ports (CWRF, 2018)[3]. The Humber ports supported more than 23,000 jobs in 2018. According to Hull City Council; the management of flood risk is a key factor in attracting and retaining large businesses to Hull. When considering the resilience risks in Hull associated with Flooding, impacts can be far more wide reaching than the city or the region; disruption caused by flooding can lead to impacts on the distribution of supplies to the NHS, 90% of UK NHS medical supplies come from Hull (CWRF, 2018).

Disproportionate risk of flooding

Hull and Haltemprice have a disproportionate flood risk when compared to other major populations in Yorkshire. Table 7 shows results from advanced modelling, that highlights the scale of surface water flood risk in Hull and Haltemprice during a 1 in 30 year rainfall event. Over 7% of the population (circa 22,000 properties) are impacted during an event of this return period.

Location	Population	Number of Properties Predicted to Flood in a 1in30 year rainfall event	Percentage of Population	Sewer Length (km)	1in30 year risk/sewer length ratio
Leeds	800,000	9511	1.19%	3561	2.7
Sheffield	580,000	5660	0.98%	2366	2.4
Hull	300,000	22035	7.35%	1677	13.1

Table 1 Comparative flood risk in Hull compared to other regional cities

In summary, there are a number of factors that make the resilience challenge in Hull, greater than in other areas of our region:

- Topography.
- Geology.
- Multiple flood risk sources – fluvial, pluvial, tidal, ground water.
- Socio-economic status.
- Interconnected drainage system.

In response to these factors a pioneering approach was developed and the "Living With Water Partnership" formed (www.LivingwithWater.co.uk). The Living with Water

[2] *City Water Resilience Approach: City Characterisation Report Hull. Arup, SIWI, The Resilience Shift, The Rockefeller Foundation, London*
[3] *Simkins et al (2018) Hull CWRF Background Report. Arup, SIWI, The Resilience Shift, The Rockefeller Foundation, London*

Partnership is a blueprint for resilience and social contract and showcases a way of working that would be relevant to all catchments in Yorkshire.
Annex 2 contains further information on some of the projects that the Living with Water Partnership have delivered in order to enhance community resilience to flooding through education; cohesion and global collaboration and learning**.** The partnership continues to work towards developing and delivering physical interventions to reduce flood risk. It is recognised that given the complexity of the flood risk factors, the suite of solutions required is also likely to be complex and therefore more likely to be successful if the interventions are integrated into the fabric of the city and our partners long term plans. This means that the communities will be closely involved in the development and deployment of interventions as well as integrating flood risk reduction interventions with those focussed on housing, transport, growth and place making. Therefore, having a set of adaptive and flexible solutions means that benefits can be maximised when opportunities to deploy become available, potential triggered by a complementary intervention such as regeneration. Collaborative delivery of flood management facilitates industry-leading opportunities to maximise broader benefits, interdependencies between systems and financial efficiency across city and regional responses. Joint-funded and multi-benefit projects and Living with water sponsored schemes have today returned a matched funded ratio of 4:1.

Sharing insight, understanding and development of solutions across regional flood authorities allows both social and economic improvement to be considered alongside potential flood alleviation schemes. This in turn allows the opportunity to positively enhance local policy development (including planning and development legislation), shared resource efficiencies (watercourse maintenance & joint-commissioning) and long-term regeneration planning with flood resilience retained firmly as a central pre-requisite concept.

Information on projects delivered to enhance community resilience to flooding through education; cohesion and global collaboration and learning

Education in Schools

Living with Water Assembly
The assembly includes a recap of the water cycle, a description and explanation of flooding, a role play activity and a video which demonstrates how the Living with Water partners are joining forces to put in place flooding resilience and how the community can be involved in preparing and planning for flooding events.

Living with Water Classroom based workshops
This one hour workshop provides a series of activities that allow pupils to consider the implications of flooding in their local area. There are four planned activities; a practical activity based on the water cycle, an investigation looking at the rate of water flow through different materials, a discussion about the importance of having a family flood plan and a decision-making activity based on a planned flooding kit.

YorkshireWater EAST RIDING OF YORKSHIRE COUNCIL Environment Agency Hull City Council

UNIVERSITY OF HULL

Living with Water Cluster delivering six PhDs covering a range of topics across environment, computer science, geography and life sciences.

1. **Living with water: perceptions of floods and flood risk in Hull past/present/future**
2. **Assessing the psychological and physiological impacts of training on Category 1 flood emergency responders and using them to design optimal flood training protocols**
3. **Living with water: using the Internet of Things and big data to dynamically map flood risk**
4. **Channel-floodplain interactions during flood events: energy and momentum exchange**
5. **Flood Management: Optimising design to reduce geomorphic impact**

In addition to the PhDs we also have a masters student who'd like to work with LWW to carry out a project which will help us to better understand the contents of the filled in watercourses throughout Hull.

Andrew Walker is also working with Hull University to look at flood storage via increase in organic material in the Hull Catchment, we're linking in with this.

YorkshireWater EAST RIDING OF YORKSHIRE COUNCIL Environment Agency Hull City Council

TWENTY65

The University Of Sheffield.

Water is the foundation of society. It sustains life, fuels agriculture and food production, supports our economy, and is crucial to the natural environment.
So how do we build resilience, efficiency and adaptability into our systems, networks and catchments to ensure we all receive clean water, sustainably, by the year 2065?
TWENTY65 are working in partnership across the water sector to tailor water systems so that they positively impact health, the environment, the economy and society.

In Hull the Mobilising Citizens for Adaptation (MOCA) study will focus on rain water harvesting and reuse, identifying the behaviours and factors that are linked to the effective use of assets such as water butts.

The outputs of this study will be critical in informing our future strategies for source control and water reuse in Hull and Haltemprice.

YorkshireWater EAST RIDING OF YORKSHIRE COUNCIL Environment Agency Hull City Council

A RIBA competition to address the challenges of 'Living with Water' on behalf of Hull City Council, sought innovative water-resilient design ideas for a major residential-led redevelopment of Humber Quays West and Hull Arena – two of the city's most prestigious locations that are ripe for regeneration

City Water Resilience Assessment

Hull was one of five global cities selected to support the development of the CWRA alongside Mexico City, Cape Town, Oman and Miami.

Hull was selected to be part of this project due to the complex flooding risks to the city and the strong partnership that is working towards tackling this.

The CWRA responds to a demand for innovative approaches and tools that help cities build water resilience at the urban scale. The approach is the result of fieldwork and desktop research, collaborative partnership with subject matter experts, and direct engagement with city partners.

The CWRA outlines a process for developing urban water resilience and provides a suite of tool to help cities grow their capacity to survive and thrive in the face of water-related shocks and stresses.

A Collaborative Approach