

7. Resilience and asset health for the North West

7.1 Key messages

- **UUW has an active, adaptive approach to securing resilience:** We adopt an efficient and low regrets approach to short-term interventions, protecting customers and the environment from unacceptable service losses. We keep options open for optimising longer-term investments, using adaptive systems that are tolerant to change.
- **We routinely apply a systems approach to operational resilience:** We look beyond our own assets to take account of cascade failures and interdependent services in our decisions. Delivering our resilience action plan has enabled us to secure performance and increase our resilience to a broad range of shocks and stresses. We strive for continuous improvement from our strong position during AMP7, learning lessons, developing our thinking and benchmarking against other utilities and sectors. We have developed our approach to systems resilience to include a review step, ensuring lessons are learnt from past events and incidents to further enhance our resilience, as demonstrated in learning the lessons from the 2018 'Beast of the East' event that ensured rapid restoration of services during the December 2022 freeze thaw event.
- **We understand our assets and systems:** Our mature data and information systems enable us to maintain a balanced approach to delivering our asset management plans. This approach is third-party assured, as evidenced by our ISO certification, the Asset Management Maturity Assessment (AMMA) and other external assurance. Our thought leadership in asset health and systems resilience demonstrates our understanding of how healthy assets enable resilient systems.
- **We have mature risk and resilience governance across our business:** Our corporate resilience approach, delivered through the alignment of our risk management processes from field to board ensures that decisions at all levels of our business help to deliver our strategic ambitions. The transparency of objectives through our integrated risk management framework helps us to deliver effective decisions within the board-approved risk appetite, maintaining our sound financial resilience.
- **Our plan for AMP8 will deliver improved resilience from both base and enhancement expenditure:** We have invested in innovative approaches to better understand and manage our asset base. Our industry leading understanding of our assets, as assessed by the AMMA, indicates that over time we should shift the balance of interventions towards asset renewal, informed from our investment in situational awareness. Delivering our plan will enable us to continue to maintain sound financial and corporate resilience, while helping to build a stronger North West. Our AMP8 plan delivers substantial investment in improving resilience through targeting both base and enhancement expenditure to reduce the risk of service failures.

7.2 Structure

This chapter is structured as follows:

- **Section 7.4** describes our approach to delivering resilience.
- **Section 7.5** establishes the vision, direction, and objectives that we aim to deliver to secure resilience and asset health.
- **Section 7.6** sets out our methodology for managing operational resilience.
- **Section 7.7** describes our approach to Corporate Resilience and how we are adapting to changing demands.
- **Section 7.8** details our Financial Resilience and how we maintain a sound financial standing

Supplementary documents to support this chapter are *UUW40 - Operational resilience and asset health – our approach*, *UUW42 Corporate approach to resilience* and *UUW68 – Financial resilience*.

7.3 Overview

UUW has robust corporate structures, vision and values to support the delivery of our resilience strategy. Our corporate approach secures our financial resilience, which underpins our ability to deliver our investment plans and absorb disruption. We are operationally resilient to a wide range of shocks and stresses, ensuring the continued provision of water and wastewater services to customers and businesses in the North West.

This chapter demonstrates how our plans have developed as risk profiles evolve, new threats and opportunities emerge, and regulations change. We continue to enhance our asset information and decision-making processes, targeting cost-beneficial investment to secure resilience and service improvements.

We describe how our business plan will deliver service resilience, taking a systems approach and building upon previous investments, while facing into future challenges, ensuring that over the short, medium and long-term we continue to deliver service and environmental enhancements that customers can afford.

Taking a systems approach to resilience enables us to understand the interactions and impacts that individual parts of the system have on each other and to identify optimal interventions quickly and efficiently. This means assessing the entire value chain, including suppliers and utilities as well as the company's asset base and services.

We continue to pursue an adaptive approach to securing long-term resilience; we account for uncertainty in our long-term planning by providing adaptive systems that are tolerant to change, while protecting customers and the environment from unacceptable service loss. We look beyond our own assets to take account of cascade failure risks and interdependent services in our decision making, targeting an efficient and low regrets approach in the shorter term, keeping options open for the longer term. This approach is informed by regional stakeholder insight and reflects stakeholder priorities, contributing to building the region's resilience.

Our mature risk and resilience governance provides clear alignment and integration between decisions across the business. The alignment of our risk management processes from field to board ensures that decisions at all levels of our business help us to meet our strategic ambitions and deliver within the board-approved strategic risk appetite, enabling effective risk management across our business. Our resilience plan directly faces into the climate and affordability challenges, balancing the competing priorities for enhanced service and environmental performance, whilst acknowledging the inter-generational fairness needed when investing in our existing asset base.

Our approach to managing our asset base will continue to deliver an appropriate blend of asset rehabilitation, renewal and operational interventions to target cost effective resilience now and into the future. Over recent asset management periods we have invested in improved performance monitoring, asset information systems and decision support tools, and response and recovery capabilities. This approach has more effectively improved our resilience in the round, as evidenced in our supply interruptions performance, reduced risk from single points of water service failure and capability to recover from significant shocks such as the December 2022 freeze thaw event. By investing in innovative approaches to better understand our assets, we have developed an industry leading understanding of our asset base, as assessed by the Asset Management Maturity Assessment (AMMA). Our improved understanding helps us to ensure that the correct investment decisions are made that maximise value. From this improved position we determine that in future investment periods we see the need for more focus on asset replacement, which we explain later in this chapter.

In AMP8 we plan to continue our balanced approach to delivering short-term action in response to risk and acute shocks with the need to assess and prepare for chronic challenges such as climate change and demographic movements, and the challenge of affordability today and for future generations. We plan to deliver significant resilience and asset health benefit from both our base and enhancement expenditure, securing current levels of service resilience and preparing for future impacts.

Our proposed investment plans continue to build on our historic philosophy, taking a risk based approach to securing prudent levels of resistance, redundancy, reliability and response and recovery capabilities in securing resilience in the round, while continuing to develop our asset information and systems to inform these choices to maximise the value delivered.

7.4 Our approach to delivering resilience

7.4.1 Delivering resilience

Our resilience framework helps us to deliver corporate, financial and operational resilience. Our approach is adaptive to change and is supported by the communities we serve.

Our strategy is to maintain a multi-layered approach to resilience, reducing potential single points of failure at an organisational, system and asset level. This approach has evolved from the original Cabinet Office 4Rs model first published in 2011 in their 'Keeping the country running'¹ document. The original model explains how resilience needs to be secured via the right mix of resistance, redundancy, reliability and response and recovery capabilities. There is more detail on this below. Our model includes an additional fifth 'R' standing for review, to account for learning from issues and incidents. This approach helps us to prioritise investment to secure the most cost beneficial risk reduction, updating strategies when we assess potential diminishing returns. This ensures that resilience is delivered 'in the round', providing greater service security to a broader range of shocks and stresses than localised solutions. We use our understanding of system interactions to model and anticipate cascade failures and develop appropriate strategies to absorb, react and recover.

We have assessed future credible pathways to help us plan for uncertainty in key drivers including climate and demographic change. This planning helps us to anticipate impacts and develop strategies that can be implemented in a timely way, maximising the value from our investment strategies as we approach decision points on our adaptive plans.

We have engaged with customers to understand their priorities for service resilience and tested our delivery plans with them. Customers broadly support investment in improving current performance, but not at the expense of long-term resilience. They expect an improving natural environment and a secure water supply, now and for the future, taking the challenge of climate change into account. Customer service priorities are represented in our value framework, we have used this to inform our plans for securing resilience in AMP8 and beyond. Details on our approach to climate change can be found in Section 7.6: Operational resilience below and in our Climate Change Adaptation Report². Details of customer engagement and how customers support our plan can be found in Chapter 3.

Our past strategic decisions have secured a solid resilience foundation. Delivering significant investment across our asset base; providing resistance to security threats; improved asset reliability; efficient levels of redundancy; along with enhanced response and recovery capabilities. This can be seen in our response to the extreme weather incidents seen in recent years, most notably 2018 and 2022. We have continued to mature and build upon this solid foundation, delivering against our resilience action plan through AMP7, ensuring that once a level of resilience has been secured, our processes ensure that it is retained.

We have continued to improve our understanding of our asset base, with progress on the relationships between asset performance, condition and the service provided, as recognised in Ofwat's AMMA assessment as the highest scoring company for asset information³. Additionally, we have continued to mature our understanding of systems interdependencies, creating system maps and tools to inform the development of strategies.

In AMP7 we have prioritised investment in innovative approaches to better understand our asset base; investing in advanced monetary and data analysis to better understand real time performance of our assets and enable a step change in the forecasting of asset health and performance to enable more precise asset planning and investment in AMP8. Our industry leading understanding of our assets, as assessed by the AMMA, tells us that during AMP8 we need to transition to a strategy with additional asset renewal, informed from our investment in situational awareness.

¹ [gov.uk/government/publications/keeping-the-country-running-natural-hazards-and-infrastructure](https://www.gov.uk/government/publications/keeping-the-country-running-natural-hazards-and-infrastructure)

² [unitedutilities.com/corporate/responsibility/environment/climate-change/climate-change-adaptation/](https://www.unitedutilities.com/corporate/responsibility/environment/climate-change/climate-change-adaptation/)

³ [ofwat.gov.uk/publication/asset-management-maturity-assessment-insights-and-recommendations/](https://www.ofwat.gov.uk/publication/asset-management-maturity-assessment-insights-and-recommendations/)

We continue to engage with external bodies, such as the National Infrastructure Commission (NIC), to ensure that we are aligned to best practice in the development of our strategic thinking for operational resilience and specifically for asset health.

Our approach to understanding future resilience risks and to securing stable asset health are fundamental elements of our asset lifecycle management plan, which is certified to ISO55001.

Details of our risk and resilience framework and a summary of our approach to securing corporate, financial and operational resilience can be found below, including how this approach is embedded within our future strategies.

7.4.2 Resilience in the round

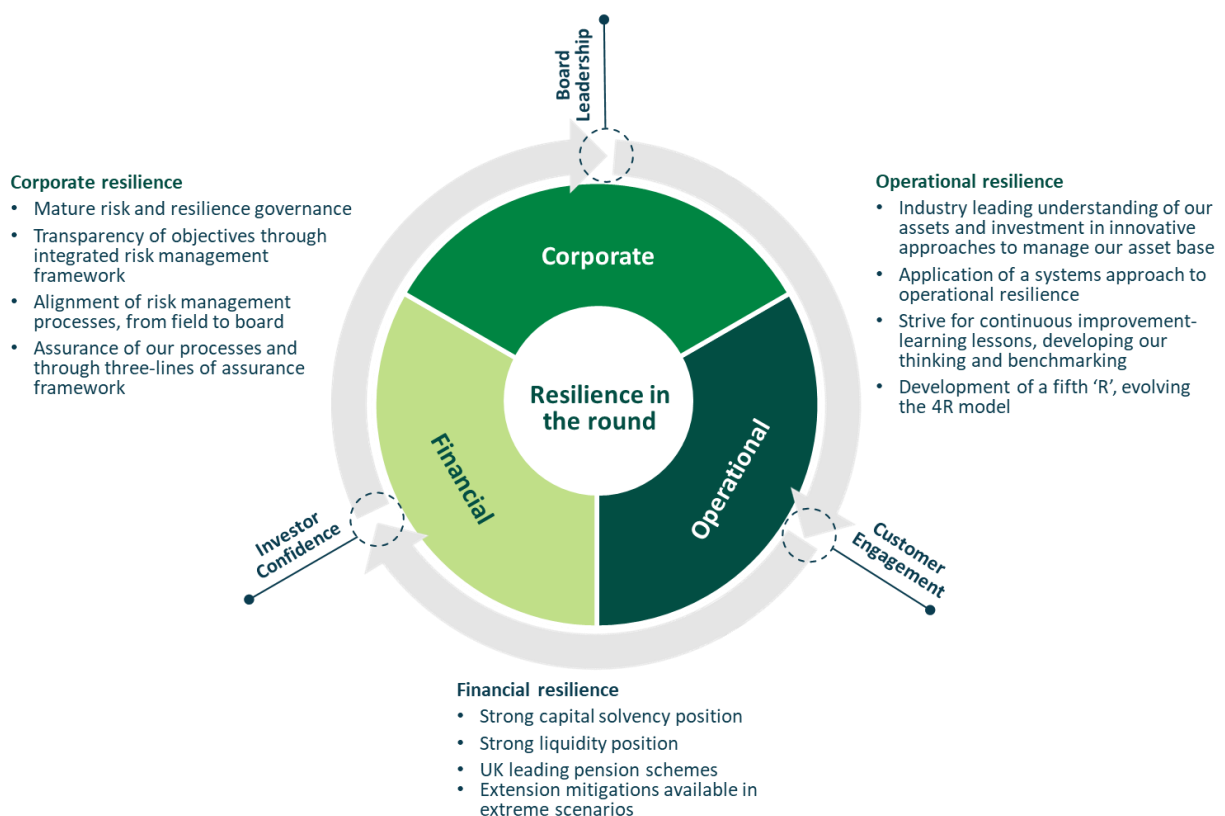
Operational performance is intrinsically linked to financial and corporate performance. We consider them equally impacted and ensure that they are considered alongside each other to avoid focusing on single issues. This has provided a solid basis to build greater resilience into our services, with a focus on further developing our systems-based resilience approach. We will continue to adapt our resilience strategy in AMP8 and over the long-term to evolve our approach further, delivering a stronger North West.

We are continuing to enhance our services, securing performance improvements and maintaining and increasing our resilience to a broad range of current and future shocks and stresses.

We are striving for continuous improvement during AMP7; learning lessons, developing our thinking and benchmarking against other utilities and sectors. Our plan centres on continually improving and embedding our approach to resilience. Our areas of focus include awareness and management of our interdependencies, further governance and risk improvements, adaptive planning and further developing our six capitals approach to better understand value, dependencies and impacts. We summarise our AMP7 improvement action plan in Section 7.6 of this chapter and how in completing this work we have improved our understanding of risk and secured improvements to our resilience in the round.

Figure 7-1, below, demonstrates how we deliver overall resilience through our corporate, financial and operational resilience providing multiple controls, all working together to support service delivery. These operate to provide multiple barriers to shocks helping to prevent them causing customer or environmental disruption.

Figure 7-1: How we deliver resilience in the round



In providing **corporate resilience** we ensure appropriate governance, accountability and assurance to provide the direction, resource and capability needed to secure resilient services for customers. Strong corporate resilience ensures a diverse and secure supply chain, with the capability to foresee and to endure shocks and stresses. It helps us to make sure that we have the right workforce, skills, capability, and structures needed to provide our services now and in the future. Section 7.7 of this chapter covers corporate resilience in more detail along with supplementary document *UUW42 – Corporate resilience*.

In maintaining **resilient finances**, we ensure that we have the capability to absorb cost shocks, such as post event recovery, or financial market changes. Section 7.8 of this chapter summarises our approach to financial resilience and more depth is provided in Chapter 9 and supplementary document *UUW68 – Financial resilience*.

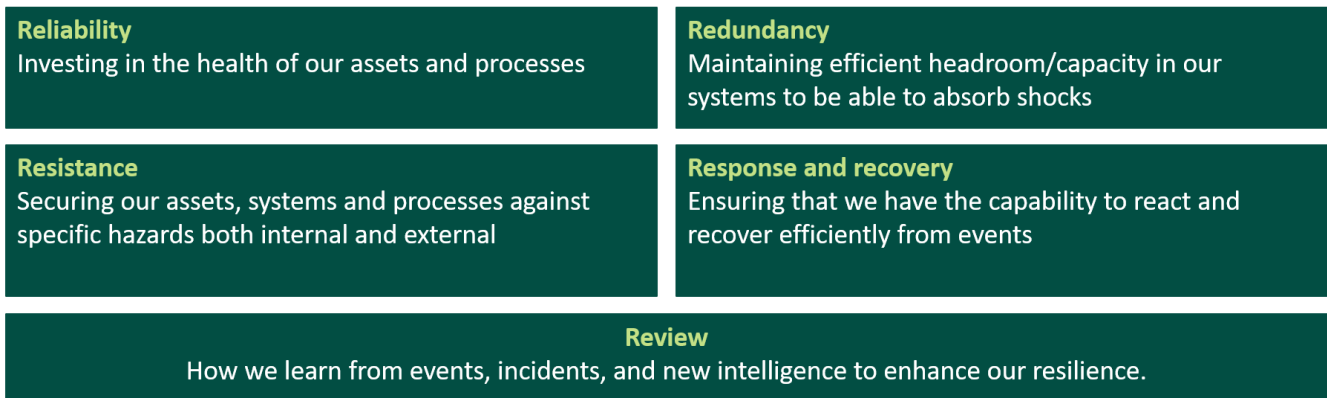
Securing **operational resilience** is the culmination of good corporate and financial resilience. It helps us to ensure that people, processes and systems can provide services under normal demand and during times of stress. Section 7.6 of this chapter outlines our approach to operational resilience and is covered in more detail in supplementary document *UUW40 - Operational resilience and asset health – our approach*.

Our resilience strategy has evolved over time and in response to improved intelligence, threats, trends, and emerging risks as we mature our approach to operational resilience. This approach is detailed in our 2017 paper – *Measuring Resilience in the Water Industry*⁴. This approach provides better overall systems resilience than simply focusing on asset reliability. We firmly believe that is not good practice to only invest in a more reliable system, while neglecting the capacity to respond and recover from an incident, or to implement insufficient resistance to malicious threats. Our investment plans have, therefore, flexed as we have targeted asset cohorts or prioritised interventions to deliver the most efficient and effective improvements in overall resilience.

Our strategy has been to invest in improving our understanding of how systems, and the assets within them operate, investing in deployed sensors and artificial intelligence as well as the supporting processes and procedures so that we have a much better understanding of where best to target investment in asset replacement. This approach ensures that best value options are selected, delivering a more reliable system. This methodology is explored further in the Section Operational resilience.

Building on the well-established 4R model, first developed by the Cabinet Office in 2010, we have evolved our risk and resilience framework to include ‘review’ as a fifth ‘R’. We recognise that threats evolve, and we will continue to identify emerging risks; therefore, we must continuously review our risk exposure and learn lessons from incidents and near misses. We target this learning both internally and across other sectors both in the UK and internationally. Examples of this approach are our regular reviews of the National Risk Register⁵ and active engagement in resilience exercises such as operation. This includes a national exercise, conducted in 2023, testing the response to a widespread loss of power, and the corresponding review into the interdependencies across all of the UK’s important infrastructure assets led by the Cabinet Office. Figure 7-2 below summarises the 5 R model.

Figure 7-2:- Our '5R' model of resilience

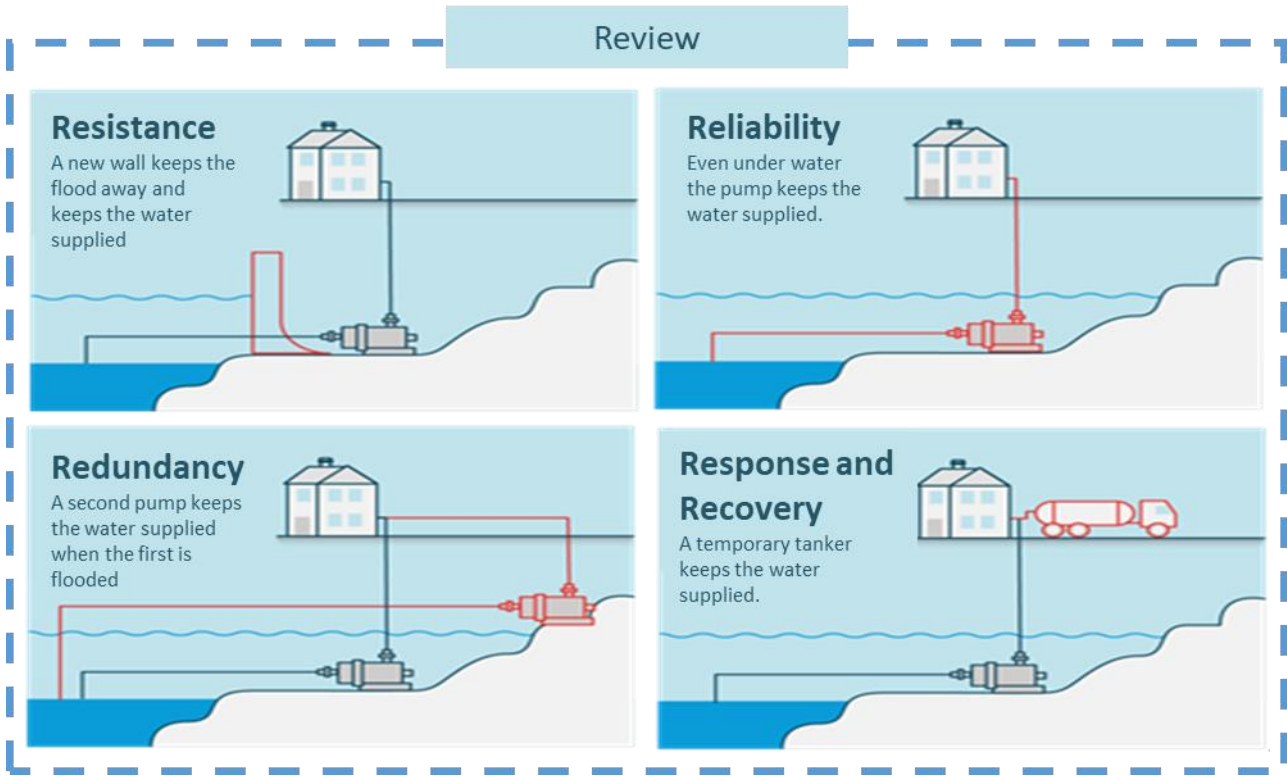


⁴ unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/looking-to-the-future/measuring-resilience-in-the-water-industry_final.pdf

⁵ <https://www.gov.uk/government/publications/national-risk-register-2023>

In **Figure 7-3** below we show examples of how the model can be applied, in this example to a water booster pumping station experiencing a flooding event. This indicates intervention strategies for each of the different ‘R’s, where the fifth R would involve post incident assessment to evaluate which of the four strategies provides the most cost beneficial resilience against flooding.

Figure 7-3: How each of the 5Rs could provide resilience of water supplies to flooding



Fundamentally our 5R model is based on the original Cabinet Office 4R model discussed above. The valuable addition of a fifth 'R' underlines the importance of learning lessons from past events (from a company, industry, and an external perspective) but means improved intelligence can influence efficient investment decisions.

For example, following historic freeze thaw events and disruption to dependant services from storms such as Desmond and Arwen we now deploy contracted emergency generators proactively to known points of risk, and top up stored water systems on receipt of adverse weather forecasts. Additionally, in developing our understanding of asset criticality to services and the systems in which they operate we have been able to identify the highest risk sections of our networks and develop interventions to efficiently mitigate the risks, including cross connections to enable response and recovery from neighbouring systems.

Our 2023 corporate audit by Jacobs confirmed that we continue to deliver appropriate levels of resilience in response to external factors such as climate change, as well as the expectations of customers, stakeholders and regulators. See supplementary document *UUW40 - Operational resilience and asset health – our approach* for more details.

This adaptive approach has led to significant resilience improvements with investment across the full range of the 5Rs helping us to secure resilience in the round effectively and at a price that customers can afford. This is demonstrated in our ongoing improving trend in operational performance and continued achievement of our industry frontier pollution incident performance.

7.4.3 Improving resilience

Through reforms to water sector regulation, Ofwat has been instrumental in enabling the evolution of our resilience strategy. In particular, the focus on outcomes and innovation rather than outputs has helped us to target resources on the right interventions to improve resilience outcomes. We have been able to innovate in areas that we would not traditionally have considered.

Examples of this improvement are investments in the Integrated Control Centre (ICC) and alternative supply vehicles (ASVs.) Our ICC is fundamental to how we respond and recover in the event of an incident. These teams provide a full informed view of how the water, wastewater and bioresources functions are performing, in real time. Incidents are able to be responded to in a timely and coordinated way, collaborating effectively with our partners to use an approach that prioritises our resources and minimises the impact to customers and the environment. This provides us with much improved situational awareness, helping us to anticipate problems and rapidly respond bringing the right resources to bear quickly and efficiently.

Our fleet of ASVs, positioned at strategic locations across the region, are capable of transporting and injecting potable water into the network. A total of 47 tankers make up the fleet of various sizes to suit the mix of urban and rural areas of our region. The ASVs have a combined capacity of over 1.2 million litres of potable water. This provides a cost-effective method of mitigating service failures across the region, rather than more capital intensive, localised solutions.

These investments allow performance to be enhanced, while asset health data capture is improved to support the targeting of future asset replacement; evidenced in our continued performance improvements.

We demonstrated the effectiveness of our resilience strategy in our ability to plan for, endure and recover from major incidents in the recent freeze thaw events of 2022 and 2018. During the 2018 'Beast from the East' event, we limited impacts to customers compared to other companies that were equally affected⁶. In the more recent freeze thaw event in 2022 we again demonstrated a high degree of resilience despite record levels of demand during the height of the event⁷.

Further examples of the effectiveness of our resilience strategy and practices are outlined below:

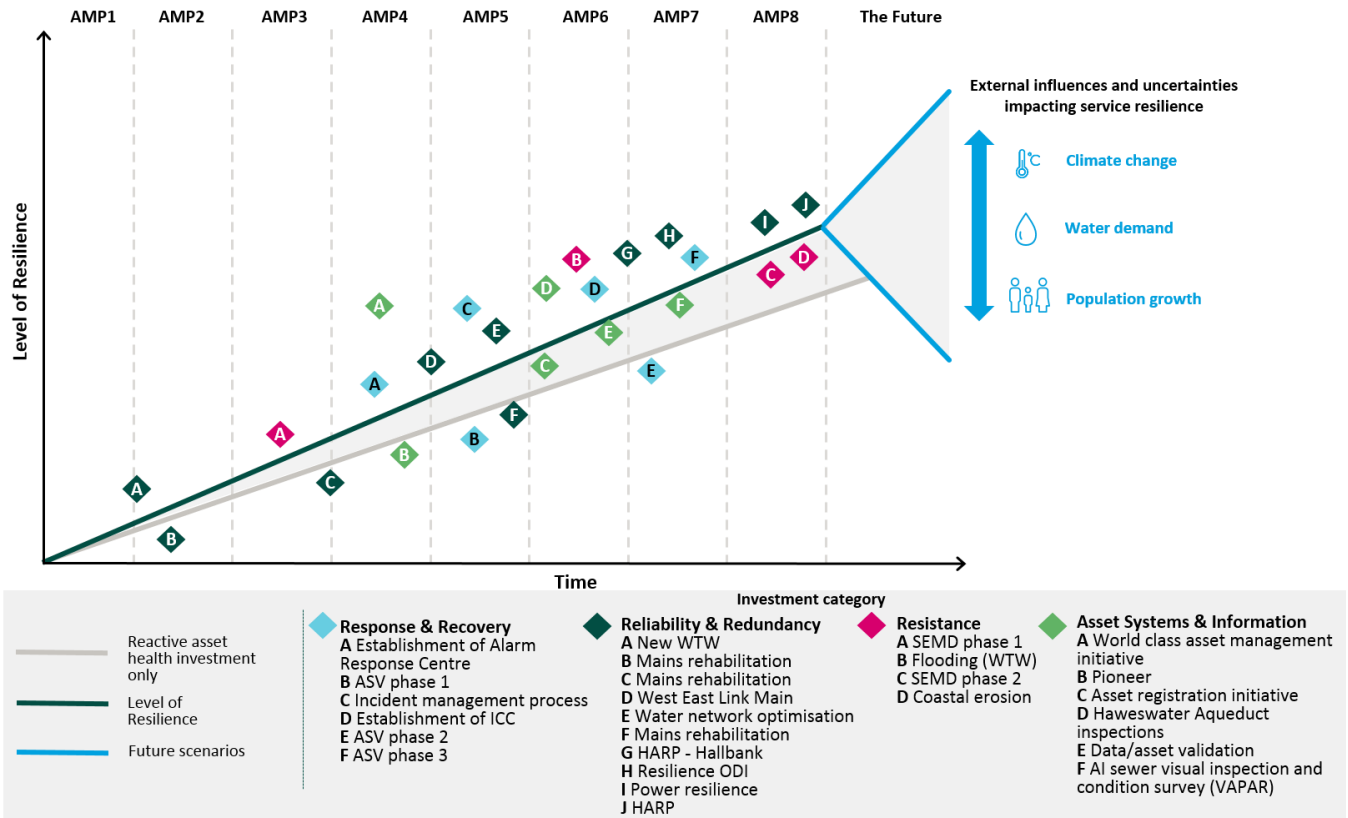
- **Artificial intelligence for sewer condition assessment-** further improving our sewer deterioration models for assessing future investment needs, both at a strategic and operational level. The rapid provision of good quality information across the sewer network, allowed improved operational decision-making. For full details see the case study in Section 2.8.10 of supplementary document *UUW40 - Operational resilience and asset health – our approach*.
- **Water mains modelling deterioration in support of leakage detection-** the development of enhanced leakage models that can be rapidly applied in areas identified by operational analysts for leakage detection, allowing improved decision-making operationally. For full details see the case study in Section 2.8.10 of supplementary document *UUW40 - Operational resilience and asset health – our approach*
- **Water service resilience-** improving our asset information, including the cascade system dependencies, has enabled us to identify key vulnerable points with regard to securing service resilience. This process is at the heart of our AMP7 water service resilience investment strategy. Having identified vulnerable points or systems we have been able to target investment to address the specific risk, for example constructing cross connections between neighbouring systems and delivering a reduction in risk of customer water supply service days lost per year.

Figure 7-4 below illustrates how our resilience has improved as a result of our strategic investments over time. It shows how our investments have evolved to reflect threats such as the changing national security picture, increasing risk of coastal or fluvial flooding and opportunities such as our water mains rehabilitation undertakings. It shows how our horizon scanning activities feed into the development of our future delivery strategies, identifying external influences and uncertainties and how these may impact our current level of resilience, should they not be fully exploited or mitigated. We recognise that there are extreme scenarios that have the potential to threaten our resilience.

⁶ ofwat.gov.uk/wp-content/uploads/2018/06/Thaw-report-FINAL.pdf

⁷ unitedutilities.com/contentassets/706b59b346d64fa7bcd56e94177b6946/freeze-thaw-2022-uu-response---final-28-feb-2023.pdf

Figure 7-4: Resilience investment timeline



In order to help us to mitigate the risk of reducing future resilience we have developed a company-wide horizon scanning and PESTLE⁸ process assessing future and emerging risks. This is embedded within our ISO 55001 certified Asset Lifecycle Management (ALM) processes. Our horizon scanning process ensures that emerging risks and opportunities are discussed and disseminated across the business so that impact assessments are completed at an enterprise level rather than within disciplines. Examples of risks include assessment of climate change impacts and the creation of common consistent drivers for change that all business units take account of when considering climate change and responses to more acute risks such as reservoir safety. Further information on our approach can be found in Section 4.4 of supplementary document *UUW40 - Operational resilience and asset health – our approach*.

7.4.4 Stakeholder support for our resilience approach

We actively engage with stakeholders to understand what matters most to them to create long-term value for all. Engaging with stakeholders across our region enables us to identify shared solutions to shared challenges, delivering a stronger, greener and healthier North West. An example of this approach is our partnership with the Greater Manchester combined Authority (GMCA), the Environment Agency (EA), and ourselves to build an integrated water management plan⁹. Additionally through our engagement with the Greater Manchester strategic infrastructure board¹⁰ we will identify opportunities to work together with other infrastructure providers to create multiple benefits.

7.4.5 Customer support for our resilience and asset health approach

Understanding customer views is essential for both testing our resilience strategy and assuring that we have the right plan that serves the people who pay for it, now and into the future.

⁸ Review of Political, Economic, Societal, Technological, Legislative and Environmental risks and opportunities

⁹ <https://www.greatermanchester-ca.gov.uk/what-we-do/planning-and-housing/integrated-water-management-plan/>

¹⁰ <https://www.greatermanchester-ca.gov.uk/what-we-do/planning-and-housing/strategic-infrastructure/greater-manchester-strategic-infrastructure-board-gmsib-terms-of-reference/>

It is critical that we talk to customers about our current and long-term plans and ambitions to gather a broad range of opinions and insight. Engaging with customers on these topics can be quite complex, a mix of quantitative research with qualitative discussion has enabled us to gain valuable insight.

When customers were asked about what they believe our strategic priorities to be, of the more discretionary investment opportunities, protecting the environment, meeting future challenges such as climate change and preventing pollution have a high combined importance. This combination makes 'current and future environmental concerns' the second most important combined priority after safe drinking water. We have used these findings to help inform our AMP8 plan and long-term strategies, in particular the shift in asset renewals in AMP8.

7.4.6 Resilience and asset health research

- **Customer priorities research¹¹ and long-term synthesis**- this demonstrated strong links to asset health in that minimum service expectations like safe and reliable drinking water is key. Priorities tracking over time indicates leakage reduction and consumption, as well as investing in long-term asset health will always be important to customers.
- **Long-term research customer priorities synthesis¹²**- key findings include leakage and asset health are a key priority for customers and this is likely to increase over time, as affordability concerns lessen.
- **Long-term research immersive ambitions research¹³**- the majority of customers believe action should be taken now to improve things for the future, particularly with core service aspects such as maintaining pipes and pumps. Customer views are to explore investment beyond 'no regrets' approach, taking more of a proactive approach. There is an over-arching message that asset health is important to invest in and short-term fixes will not solve everything. In terms of intergenerational fairness, customers were almost unanimous in their view that early investment was appropriate to prepare the infrastructure required to meet the challenges of the future.

7.4.7 Climate change resilience research

Through customer priorities research¹⁴, we saw that customers see climate change as a high priority and feel a proactive approach to tackling it is needed. Customers recognised that climate change is present in the here and now, that there is a potential for a more adverse future and that future generations could bear the greatest impacts.

Through our power resilience enhancement claim we are proactively investing against future supply issues exacerbated by extreme weather in part caused by climate change. Full details can be found in the Power resilience enhancement claim in supplementary document *UUW67*.

7.5 Our resilience ambitions

7.5.1 Our vision and purpose

Providing resilient water and waste water services to customers across the North West is fundamental to ensuring that United Utilities can deliver on its core purpose - to provide great water for a stronger, greener and healthier North West - now and in the future.

Our plan to secure resilience and asset health underpins the delivery of our strategic objectives. Securing corporate, financial and operational resilience is directly aligned to our purpose, core values and strategic priorities. This provides the framework, corporate structure and governance to ensure that our plans are delivering the right levels of service resilience that customers can afford, today and for tomorrow.

¹¹ Impact Research on behalf of United Utilities, [Customer Priorities](#), December 2021

¹² SHED Research Consulting on behalf of United Utilities, [LTDS: Customer Insight Synthesis](#), February 2023

¹³ PwC on behalf of United Utilities, [Long Term Delivery Strategy Ambition Testing](#), April 2023

¹⁴ DJS Research on behalf of United Utilities, [Climate Change and Resilience](#), January 2021

Further detail of our AMP8 plan and long-term strategic plans by price control can be found in Sections 7-11 of supplementary documents *UUW40 - Operational resilience and asset health – our approach*, *UUW56 - wastewater network plus price control* and *UUW57 - Water network plus price control*.

7.5.2 Resilience targets and ambitions

To support the delivery of our strategic priorities and alignment to our purpose we have developed a range of resilience targets and ambitions that our AMP8 and long-term plans aim to deliver. Setting long-term targets and ambitions ensures that our plans and decision making is aligned to the business objectives and delivers improved customer service at an efficient cost.

We account for the need to be resilient to both acute shocks and chronic stresses over the short and long term. Our targets and ambitions are a blend of AMP8 action and long-term strategic ambitions. We will frequently review our performance against our targets, as well as the targets themselves, remaining agile to new and emerging risks and customer priorities.

7.5.3 Our long-term strategy

In order to secure enduring service resilience and asset health it is imperative that we take a long-term view as well as remaining agile and responsive to immediate needs.

Chronic stresses such as climatic and demographic changes influence decisions over decades rather than over five-year asset management cycles. In the short term their effects can often be absorbed within the existing system. However, this can erode current levels of resilience and can require significantly more investment to recover from than a prudent proactive investment strategy would.

The asset base that we operate and maintain is largely very long-life, with design ages of new assets up to 120 years in the case of major aqueducts. This means that the decisions we make today need to take account of likely future conditions.

Investment strategies in major critical infrastructure often require many years of development to confirm appropriate solutions, to gain planning permission and to construct. An example of this is our Haweswater Aqueduct Resilience Project (HARP), our initial investigations began in the early 2000's and we plan to have replaced the most critical sections of the aqueduct by 2032/33, having built a 55km long major aqueduct in 2010 to enable us to take the existing aqueduct out of service for inspection, the first time since it was commissioned in the 1950's.

It is only in taking a long-term perspective on risk and asset health requirements, accounting for a range of likely futures and demand uncertainty, that we can plan to secure enduring resilience. This approach is fundamental to the development of our Long term delivery strategy which is summarised below and can be found in full in *UUW12 - Long term delivery strategy*.

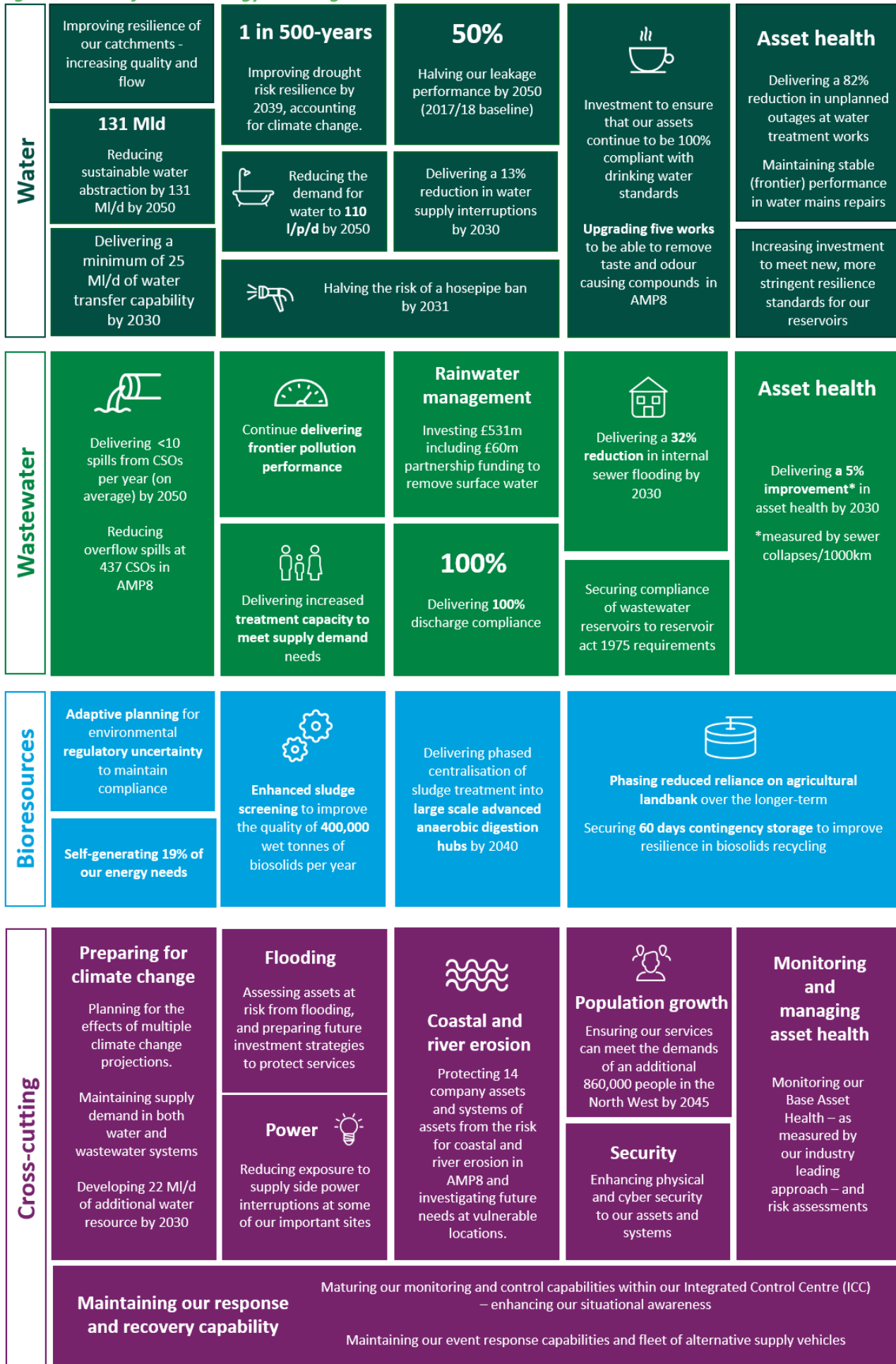
7.5.4 Our future strategy summary

To support the delivery of our ambitions and objectives we have set stretching future performance targets that go beyond the traditional regulatory planning horizons. In setting long-term targets we can ensure that short-term investment decisions are made within the context of our long-term strategic ambitions, aligning in AMP investment to meet future resilience requirements.

A summary of our plan is included below in plan this represents a selection of our entire AMP8 and long-term plans focusing on the aspects of our plan that will secure resilience and asset health.

In Figure 7-5, we summarise our future strategy and targets.

Figure 7-5: Our future strategy and targets



7.5.5 Our Long Term Delivery Strategy

The LTDS outlines our long-term vision and ambition and the challenges and drivers for change which are likely to impact our services over the next 25 years. This includes threats to securing our immediate and long-term business and service resilience.

Scenarios and stress testing have enabled us to test our strategies to ensure that we are delivering the best value and lowest regrets options. This includes developing scenarios to account for uncertainty and sets out how we might adapt programmes in the future to meet long-term ambitions under different circumstances. For example, with respect to our water resource scenario testing, we have identified low regrets investment to enable us to respond to and support national water resource needs. Potential further investment has been phased into an alternative pathway in AMP9 to be determined once we have certainty on the outcome of regional reconciliation for water resources. Additionally we have chosen to defer investment in flood protection at some sites, on the basis that there is pending new information due for publication next year as part of the National Flood Risk Assessment (NaFRA).

Our long-term planning activity considers the uncertainty associated with particularly complex issues including climate change; population growth; technology; and abstraction reduction needs.

Planning for the long term allows us to deliver further environmental and social value, for example, through prioritising sustainable drainage and monitoring impacts before investing in more traditional assets; or carrying out modelling and investigations to ensure solutions are best value. Through this process we can have confidence that our investment through AMP8 is efficient and low regrets.

For more detail on our challenges and opportunities for our operations, our long-term ambitions and our purpose refer to Chapter 2 and *UUW12 Long term delivery strategy*.

7.5.6 Our AMP8 resilience and asset health plan summary

In this section we summarise how our ambitious AMP8 plans to secure enduring resilience and stable asset health are contributing to the delivery of our resilience targets and ambitions and our purpose and strategic objectives. We describe how investment of £2,765 million of base expenditure, combined with a £4,455 million investment to enhance services will deliver improved resilience.

In AMP8 we will continue to focus on:

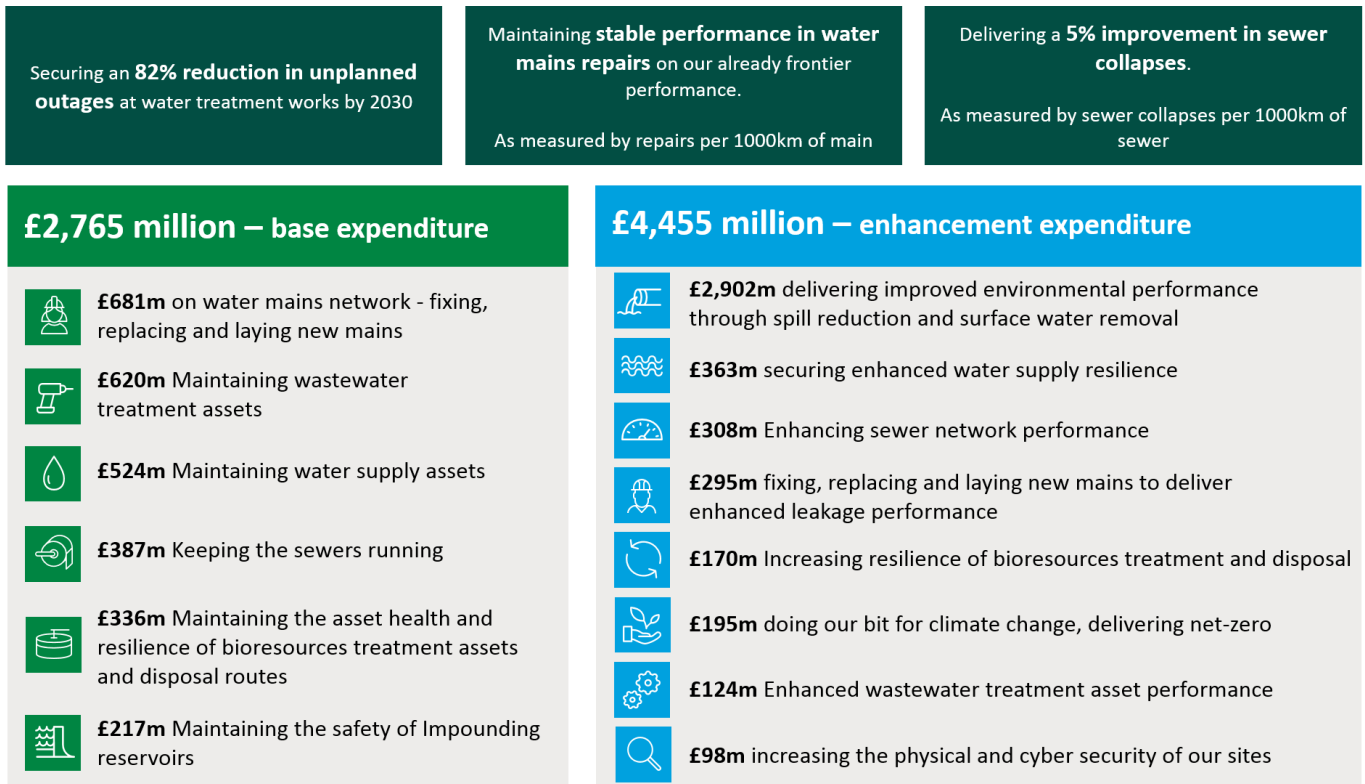
- Securing appropriate levels of asset resistance, reliability, redundancy and response and recovery capabilities that are efficient and agile to current and anticipated risks and service expectations;
- Continuing to improve asset information and decision-making processes so as to ensure that risks are fully understood at an asset and systems resolution;
- Improved accounting for interdependency and cascade failure risks; and,
- Developing tools to support identification of investment needs and the people and processes to deliver the required interventions.

We continue to balance the need to take short-term action in response to new and emerging risks as well as acute shocks, the need to assess and prepare for chronic challenges such as climate change and demographic movements, and the challenge of affordability today and for future generations.

Our AMP8 plan delivers substantial investment in improving resilience through targeting both base and enhancement expenditure to reduce the risk of service failures.

Figure 7-6, summarises our total investment plans for resilience and asset health, split between base expenditure and enhancement, and the performance levels that we expect to achieve against the AMP8 common asset health measures.

Figure 7-6: Our AMP8 plan in numbers



In addition to the common asset health performance commitments, Figure 7-7 below summarises some of the key projects and resilience programmes that we intend to deliver or, in the case of phased programmes, start in AMP8.

Figure 7-7: Key AMP8 resilience projects



7.6 Operational resilience

7.6.1 Asset management approach to resilience

Our asset management approach is cognisant of current and future resilience risks, balancing performance and resilience. We understand our current operational risks, their causes, how we should manage them and how continuous improvement reduces our risk profile.

Securing resilience addresses both the likelihood and the consequence of events. It can focus on risk reduction, i.e. preventing or reducing the likelihood of an event occurring, or it can be used to reduce the scale or duration of a consequence being experienced, or both.

Often there is a direct relationship between resilience investment strategies and performance commitments. Customer priorities and service valuations for the performance commitments are used to support the identification of resilience investment strategies, and the benefits of the resilience plans used to inform future performance commitment levels.

We have a mature approach to asset management that we call Asset Lifecycle Management (ALM). This has been independently certified to ISO 55001. Our ISO certified ALM process helps us to align asset management activities with corporate objectives, through our policies, strategies and plans. This ensures sustainable and efficient service delivery in line with legal and statutory commitments and the requirements of stakeholders.

The process of understanding our future demand is a key input to our long-term delivery strategies, identifying key drivers for change and supporting decisions on the need to develop alternative strategic pathways. Our approach incorporates a PESTLE horizon scanning process for assessing emerging and future risks. The PESTLE model covers Political, Environmental, Social, Technological, Legal and Economic drivers for change. Figure 7-8 illustrates how the PESTLE process flows into our approach for strategy development.

7.6.2 Our risk assessment process

Our business risk and resilience management process has been developed and assessed against the International Risk Management Standard ISO31001. Central to this process is our RADAR system which enables the recording, monitoring and reporting of strategic, tactical and operational level risks, along with their mitigating controls and actions.

Operational, bottom-up risks are identified, assessed and managed through our operational risk management system, myRisk. These risks are aggregated and reviewed to help inform the business risks managed in RADAR through regular six-monthly risk review sessions. This helps to ensure a golden thread exists from the board’s risk appetite through to the management of operational risks.

Proactive risk management

We work to avoid any disruption that negatively impacts customers or the environment now and in the future. We do this by proactively managing risk associated with our assets, systems and processes, with control and mitigation focusing on preventing or limiting problems, while maintaining the capacity to respond effectively.

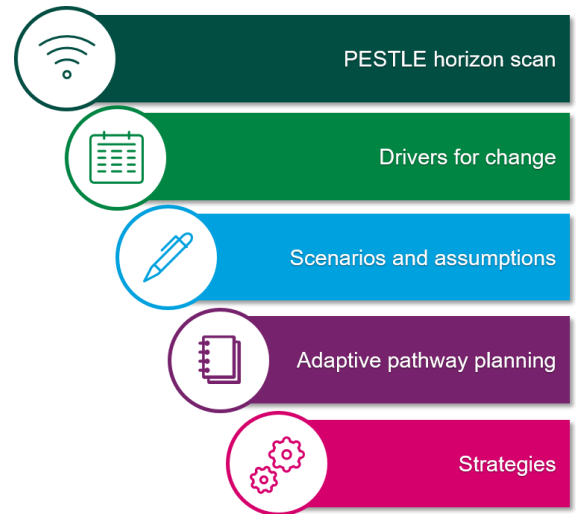
Many of our proactive risk management capabilities cut across multiple operational risks. We describe some of the most significant cross cutting capabilities below.

7.6.3 Maintenance excellence

Our maintenance excellence strategy is about keeping our assets and equipment as safe, cost-effective and reliable as possible. An efficient maintenance strategy is vital for providing the high-quality services.

To achieve maintenance excellence, we aim to minimise asset failure and avoid expensive repairs or inefficient short-term fixes. We are doing this by optimising the scheduling of routine maintenance work, prioritising our most critical assets. We have dedicated teams working in new ways to prevent asset failure across the business. In recognition of our approach and progress we have made, we were awarded the 'Best Leadership for Reliability Uptime' Award in 2022 at the International Maintenance Conference.

Figure 7-8 How horizon scanning flows into our asset lifecycle management



The judging panel noted

“United Utilities, from the United Kingdom, was selected as an Uptime Award winner in the Best Leadership for Reliability Program category, as a way of recognising this organisation's intense effort to manage its assets from a Reliability culture.”

Across the business, there are a number of metrics we use to track success and areas for improvement via the maintenance excellence scorecard. More details are provided in Section 2.9.28 of supplementary document UUW40 - Operational resilience and asset health – our approach

7.6.4 Operational excellence

Operational excellence underpins operational resilience through driving improvement activities. We are embedding operational excellence across our organisation. As is illustrated in Figure 7-9 below, operational excellence means:

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

Figure 7-9: Operational excellence components



7.6.5 Learning from the past

We recognise the importance of understanding our track record, drivers, trends and forecasts. We have robust processes in place to ensure that opportunities are taken to learn, benchmark, forecast and identify resilience vulnerabilities, to reflect upon them and to embed where efficient. We understand that there is so much that can be learnt from the past, increasingly the past is becoming less of a predictor of the future, especially when considering exogenous factors.

Taking a long-term view, with regard to securing efficient resilience, requires us to face into the future. Increasingly we are required to manage greater levels of uncertainty than historic performance would have suggested, for example as a result of climate change. We are managing for this future uncertainty by acting on the best available evidence, and building long-term adaptive plans which account for the likely future scenarios. This enables us to make timely investment decisions to secure resilience.

7.6.6 Asset risk modelling

Future investment requirements may be different from those in the past and our PIONEER system is used to help identify these future peaks and troughs. We use PIONEER to support our capital maintenance planning through our ongoing relationship with Ovarro, one of the leading UK risk management consultants. Our continuous development of innovative models and approaches helps us to use asset, service and performance data to predict the long-term performance of company assets. The programme is used to test investment scenarios, service targets and intervention strategies to help us optimise our investment across our asset base.

In addition to supporting our longer-term asset management approach, PIONEER models have been used to target our successful Dynamic Network Management (DNM) sensor deployment across the wastewater network

in AMP7 and to build the proactive water mains programme for AMP8. This water network programme trades off future deterioration of individual mains with their risk of causing service disruptions, such as discoloured water contacts, interruptions and poor pressure as well as health measures such as bursts, fittings failures and leakage rates against the future costs of repair and replacement.

Our approach to asset risk modelling has led to significant improvements in risk reduction across many aspects of the company, in particular in addressing risks to water service resilience performance in AMP7;

- **Enhanced data capture and modelling** - capturing new asset information, including connectivity and dependency analysis to inform enhanced risk assessment;
- **Calculating a base level of system risk** – calculating risk of long-term interruptions to water supply, or of water quality, due to system failures. Expressed in terms of an annual risk of water supply service days lost; and,
- **Determining no regrets intervention strategies** - develop risk reduction and service restoration plans that target vulnerable points in the system, focusing initially on single points of failure. Identifying interventions such as cross connections and alternative supply arrangements that deliver highly beneficial resilience improvements.

Although we have a robust plan to avoid disruption and unpredictable events, incidents can happen. How quickly and effectively we respond to these events can impact the customer experience or environmental impact. Our Integrated Control Centre (ICC) is core to our response and recovery capability. The ICC provides situational awareness of how the water, wastewater and bioprocessing business streams are performing, in real time. This enables a timely and coordinated response, prioritising our resources to minimise the impacts.

Our incident management approach is aligned with best practice models used by the emergency services and other incident responders. We keep our processes under continuous review, incorporating learnings from previous incidents and active engagement in the development of best practice across the wider business continuity community. To help us respond to incidents, we have a comprehensive set of business continuity and contingency plans.

As part of our duties under the Civil Contingencies Act, we participate fully in Local Resilience Forums (LRFs). This relates to a number of risks and hazards that include water distribution planning, flooding, cold weather, heatwave, power disruption, and industrial process site risks that could impact on our operations. Activities include risk assessment, multi-agency training and exercising, plan development and joint incident response.

7.6.7 Managing operational risks

Our highest scored operational risks all have the potential to provide a major shock to the resilient delivery of our services. Some of these risks include an element of day-to-day performance but they all are associated with events that could lead to major disruption.

The current, highest scoring risks are mapped below in Figure 7-10. This figure shows that while many operational risks are largely within management control, some have a greater external component. These external risks require a comprehensive understanding of the broader systems we operate within to influence and manage them within our defined risk appetite.

The risks portrayed in Figure 7-10 below, have been identified via our corporate risk management process, and are governed and reviewed annually in line with our approach to corporate resilience. This process requires risk owners to review, refresh, and report on existing and new risks at least every six months to the group board, or when a risk materially changes. This includes a review of the existing controls and mitigation and their effectiveness.

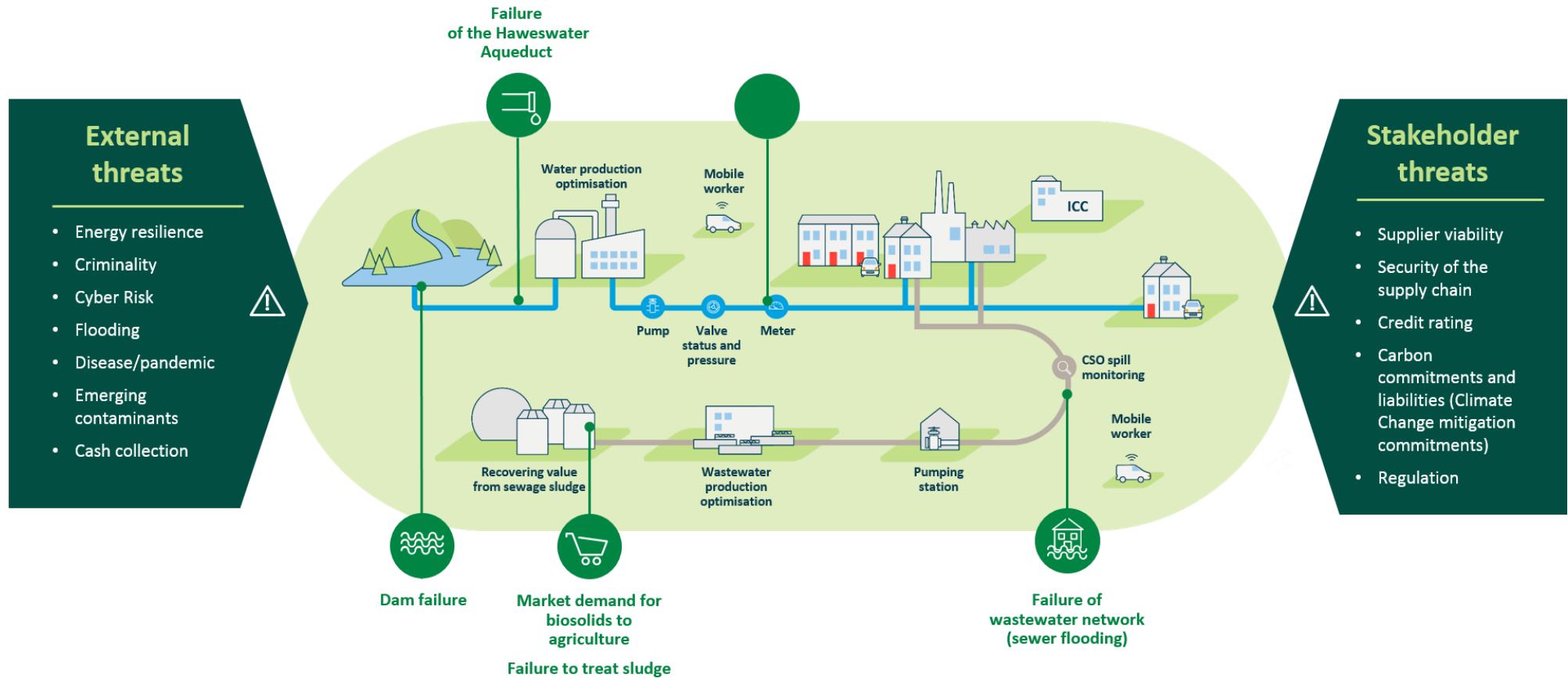
The highest scoring risks are included in our published Integrated Annual Report, which includes an assessment of how they are mitigated and controlled¹⁵.

¹⁵ unitedutilities.annualreport2023.com/media/2monspzj/31404-united-utilities-ar-2023-fully-linked-singles.pdf

7.6.8 Managing our biggest operational risks

Each of the highest scoring operational risks are described below along with a brief description of how we use our resilience strategy to help to manage the risk.

Figure 7-10: Key risks (BURA) mapped to a source tap layout



Key operational risks are further summarised below

Figure 7-11 Key operational risks

Key



Top risks relative to likelihood and impact



High impact, low likelihood events

Criminality	Dam failure	Cyber	Wastewater network failure
<p>Risk exposure: A significant asset to be compromised as a result of criminality leading to loss of supply, contamination and/or pollution.</p> <p>Control/mitigation: A risk-based protection of assets in line with regulatory security requirements and close liaison with the relevant government agencies.</p>	<p>Risk exposure: Uncontrolled release of a significant volume of water from reservoirs due to flood damage, overtopping, earthquake or erosion leading to catastrophic impacts downstream.</p> <p>Control/mitigation: Each reservoir is regularly inspected by engineers. Where appropriate, risk reduction interventions are implemented through a prioritised investment programme.</p>	<p>Risk exposure: Data and technology assets compromised due to malicious or accidental activity, leading to a major impact to key business processes and operations.</p> <p>Control/mitigation: Multiple layers of control, including a secure perimeter, segmented internal network zones, access controls, constant monitoring and forensic response capability.</p>	<p>Risk exposure: Blockages, operational issues or inadequate hydraulic capacity relative to population growth, extreme weather, asset health, and legal/regulatory change, resulting in storm overflow activations, sewer flooding and environmental damage.</p> <p>Control/mitigation: Preventative maintenance and inspection regimes, customer campaigns, sewer rehabilitation programme and Better Rivers programme.</p>
Recycling of biosolids to agriculture	Failure to treat sludge	Failure of the Haweswater Aqueduct	Water sufficiency
<p>Risk exposure: Represents various scenarios including operational failures, increased restrictions or a total ban of recycling biosolids to agriculture related to the Farming Rules for Water regulations and the increasing threat to recycling biosolids to land.</p> <p>Control/mitigation: Treatment, sampling and testing regimes ensure that sludge meets acceptable standards for application with service level agreements between departments. We work closely with farmers, land owners and contractors to ensure regulations such as Farming Rules for Water and the standard operating procedures are met.</p>	<p>Risk exposure: Relates to the interdependency between wastewater and bioresources treatment due to changing demographics, asset health and legislative/regulatory change such as the Industrial Emissions Directive (IED) now applying to biological treatment of sewage sludge.</p> <p>Control/mitigation: We manage our capacity via a Throughput, Reliability, Availability and Maintainability (T-RAM) approach. We also undertake a digester and tank cleaning programme, regular testing and analysis of sludge and balance capacity and demand through the bioresources production planning team.</p>	<p>Risk exposure: The Haweswater Aqueduct is a key asset with current low resilience due to deterioration, with failure potentially resulting in water quality issues and/or supply interruptions to a large proportion of the United Utilities customer base.</p> <p>Control/mitigation: A capital project to replace the tunnel sections of the aqueduct has already commenced with the completion in November 2020 of one section. The remaining sections are due to be replaced as part of Haweswater Aqueduct Resilience Programme (HARP).</p>	<p>Risk exposure: Water sufficiency is one of the most sensitive risks to climate change, with the increased frequency of hot and dry weather being evidence of changing circumstances. Extended periods of low rainfall and exceptionally hot weather, with accompanying increased customer demand, impacts our water resources which can result in the need to implement water use restrictions.</p> <p>Control/mitigation: We produce a Water Resources Management Plan (WRMP) every five years, which forecasts future demand and water availability adjusted for climate change. A statutory Drought Plan is also developed every five years, setting out the actions we will take in a drought.</p>

7.6.9 Causal factors – asset health, demographic and climate change

The following section details how we are managing three of the biggest causal factors that impact our operational resilience, asset health, demographic and climate change. Each of these drivers has widespread impacts across much of our operation, with predicted growth in the impacts over time.

7.6.10 Asset health

A common causal factor that underpins many of our largest operational risks is the health of our assets. In this section we detail our approach to managing asset health and identify the drivers that are leading to our increased focus in our AMP8 plan on asset renewal as the most cost-effective approach for further service risk reduction across much of our asset base.

We have historically flexed our approach to managing and improving operational resilience through improving reliability, redundancy, and response and recovery as appropriate. Our improving operational performance trends demonstrate this. However, our growing understanding of our assets means that we have more confidence about when and where investment in renewals is the most effective and efficient way of improving reliability.

Healthy assets are essential to delivering high-quality water and wastewater services to customers as well as for meeting our statutory obligations to the environment. The health of an asset is determined by its Wellness or the ability of an asset to deliver its function under normal conditions, its Life expectancy of the period of time over which an asset can deliver its function under and outside of normal conditions, and its Fitness or the ability of an asset to deliver normal conditions, considering external pressures and forcing factors from its environment.

Healthy assets enable us to sustain and enhance our performance and to be resilient to, and recover quickly from, external shocks and stresses. Emerging challenges, such as climate change, potential new contaminant risks and demographic change, place additional demands on our asset base so we must embrace innovation to protect water quality and the environment for the long term. Our commitment to sustainability means we must balance short, medium and long-term needs to safeguard the future and to balance costs fairly between generations.

We use three primary concepts to consider measurement of asset health; these are outlined in our well-received submission to Ofwat's Future Ideas Lab¹⁶. For long-term planning, it is the life expectancy measures that are most critical. This is why we have developed our Base Asset Health (BAH) metric to help understand and communicate the impact of different investment plans upon the underlying health of our assets.

Asset replacement

Our risk-based investment strategy, supported by our Asset Management system, will continue to recognise the importance of asset replacement as a key risk mitigation tool. This is necessary for all assets, from those with shorter asset lives or enhanced obsolescence rates such as monitoring and control equipment, through to longer life infrastructure assets such as sewers and mains.

For some asset types, direct replacement can be the least cost-effective approach, for example our bioresources business has always considered the wider system context in the planning of asset maintenance. Due to legislative and technological improvements over the lifecycle of a typical bioresources facility like-for-like replacement has rarely been the optimal solution. Consolidation of facilities and replacement with enhanced technologies, typically has been the most cost-effective approach to maintaining treatment capacity. Our regional bioresources treatment facility located in Manchester is a good example of replacement of aging facilities with larger, centralised, modern equivalent asset.

A recent example of where we considered asset replacement as part of a wider water supply strategy is our West Cumbria Supplies project. This project has replaced three older water treatment works with significant capital maintenance needs with single new works located in Cumbria. Treatment process redundancy has been incorporated through multiple treatment streams so future maintenance and asset replacement can be performed effectively. Space within the works has been provided to allow an additional treatment stage of clarification to be installed if it is required in the future to address raw water quality deterioration. The project

¹⁶ ofwat.gov.uk/wp-content/uploads/2021/04/United-Utilities-Asset-Health-Framework-Future-Ideas-Lab.pdf

has enabled us to develop a widespread, integrated monitoring and control capability that we intend to use as a blueprint for future developments.

Targeting asset health improvements include the delivery of our section 19 undertakings in earlier AMPs to replace unlined cast iron mains which, due to failing asset health, posed a water quality risk as well as contributed to poor leakage and supply resilience risks. Investment rates in long life infrastructure assets need to be considered over an equally long term.

Conversely, large scale enhancement programmes, particularly on our wastewater treatment assets have left us with many sites with modern tertiary treatment coupled with inlet and primary treatment processes approaching end of life. We intend to take the opportunity through our investments in AMP8 to resolve some of these legacy issues, delivering integrated solutions where clear cost efficiencies are identified.

Our AMP8 plan includes a significant increase in water mains renewal to support the delivery of our 50 per cent leakage reduction by 2050, and targeted investment in sewer rising mains, improving base asset health.

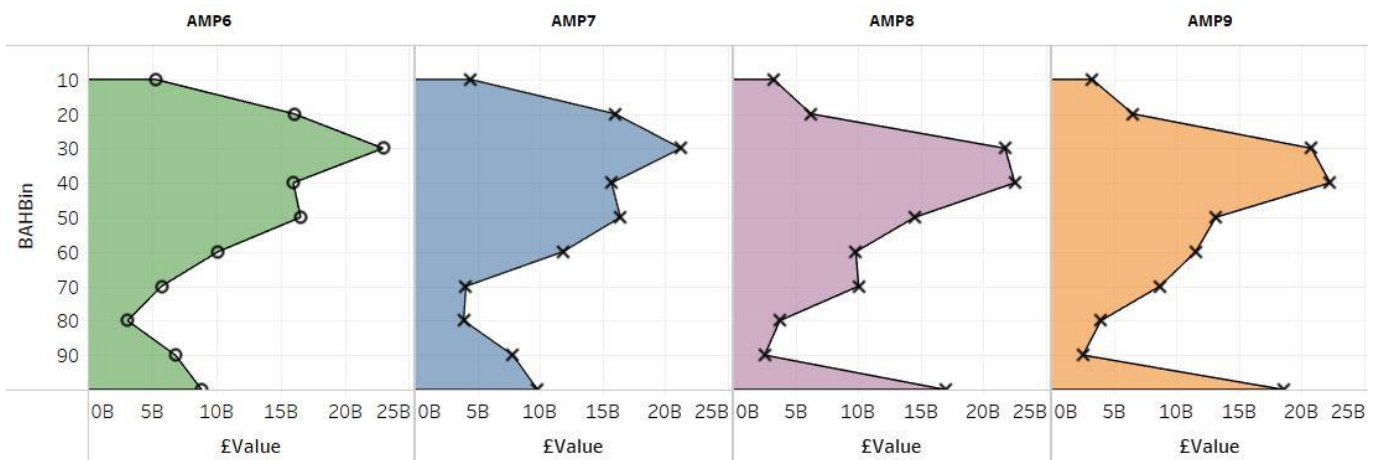
Cyclical investment

Asset replacement is cyclical. Assets built at the same time with similar design lives will tend to require major refurbishment or replacement at the same time, resulting in investment peaks and troughs per asset type. The multiple waves of asset refurbishment and replacement generally enables us to smooth out our total asset health spend in each AMP and over the long term, protecting customers from frequent 'peaky' investment and allowing us to target capital expenditure to deliver the most cost beneficial interventions within anticipated asset lifecycles. For example, our significant investment after privatisation in mains replacement and the associated long life of that investment has subsequently enabled capital funds to be more cost beneficially spent on securing enhanced levels of resilience via other means, such as pressure management and alternative supply vehicles.

Cyclical investment has been present for the delivery of resilience through “resistance”, such as that driven by changes in protective standards and “redundancy” such as the delivery of the West East Link Main in 2010 enabling us to strategically move additional water resources across our region between Liverpool and Manchester. This asset both supports the need to secure a positive water supply demand balance and facilitates the long-term plan for detailed inspection of the Haweswater Aqueduct.

Figure 7-12 is an example of the overall life expectancy profile of our asset base under a potential investment scenario developed in our planning for AMP8. It shows the impact of the investment since privatisation as a bulge of young and middle-aged assets progressing down the charts from top to bottom. The vertical axis indicates the proportion of the nominal asset life consumed, the horizontal axis indicates the current replacement value of the asset base modelled in each decile.

Figure 7-12: Base Asset Health profiles showing the progression of the asset base through life expectancy under a potential investment scenario



As these assets age or deteriorate they are replaced, through future investment, with new assets that enter the top of the charts. The elderly or poorly performing assets appear at the base of the charts, where depending upon their criticality they represent much of the asset health risk to our business. Managing an appropriate volume of

elderly or otherwise “end of life” assets is central to overall cost-effective asset management. In the scenario modelled above, the proportion of “end of life” assets has increased in AMP8 and AMP9 indicating that asset health could be a larger source of operational risk than for the current asset base. We will continue to closely monitor and manage the risks associated with these assets through AMP8. We intend to target investment programmes, such as our infrastructure replacement investment, at assets that are in the poorest health with the greatest service value.

Assessment using our Base Asset Health approach enables us to monitor the impact of our current investment programme as well as testing different future scenarios to better understand the appropriate future levels of investment in these assets in AMP9 and beyond. This helps us to anticipate the overall impact of our short, medium and long-term plans and to monitor and respond to expected changes in both our asset base and the inherent risk it presents to current and future service delivery.

Improving asset data

Our investment decisions are driven by the available data, coupled with our procedures and processes. Following privatisation, the quality and quantity of available asset information was poor. The limitations of the available data resulted in historic investment appraisal tools being developed that focused on the retrospective resolution of service failures and often delivering outputs rather than outcomes. The best decisions using the data available were made, often coupled with regulatory or legislative drivers such as the prioritisation of large-scale wastewater treatment process enhancement or water mains replacement programmes. However, these tools and approaches did not always identify the highest current or future risk as much of the data was lagging.

In parallel to working within the limitation of the asset information available, we recognised the need to enhance our understanding of the asset base, through the development of systems for capturing and analysing good-quality data. Since privatisation we have improved our understanding of the asset base, starting with simple verification and asset attribute collection through to the embedment of common framework principles and artificial intelligence tools to gather intelligence on asset condition and performance. This includes:

- Centralisation and standardisation of the asset inventory
- Development of common framework tools for marshalling data, modelling risk, standardising investment values through tools such as PIONEER;
- Dynamic, mobile field-based scheduling and data capture;
- Strategic and tactical Bayesian modelling capabilities supporting operational and capital investment programmes including the assessment of base asset health; and
- Data mining widespread operational data for asset management insights using artificial intelligence and cloud-based data storage

New asset information captured by field data tools and improvements to back-end analysis capability has provided the capability to assess and predict the current and future health of individual assets and small cohorts. Development of analysis capabilities allows us to understand and model the risk to our assets of external factors such as extreme weather.

Our long-term strategy of improving our asset information and analysis capability means that we have a substantially improved ability to identify the most cost beneficial investments, including those where an improved response capability may be more cost beneficial than asset replacement. Our capability in asset information and systems was recognised in the 2021 AMMA¹⁷ assessment commissioned by Ofwat, where in relation to UUW’s use of deterioration modelling and decision support tools it was noted:

¹⁷ [Asset management maturity assessment – insights and recommendations](#)

“United Utilities uses strategic deterioration models to give a longer-term view of the expected residual service life of an asset to the next major intervention, using Base Asset Health indicators in addition to performance commitment/outcome delivery incentive performance ... “ and “United Utilities ‘myRisk’ tool captures, assesses and escalated operational risks. It provides a common approach for capture and assessment of risks across a range of financial and non-financial drivers. The tool integrated with the company’s Risk and Asset Planning (RAP) process, allowing risks to be identified and managed locally or escalated to the appropriate level.

United Utilities ... showed that they understood asset health trends over time using overall asset health measures of Base Asset Health and OEE. Both have developed additional asset health measures within overall indices.”

The development of our asset information and tools has enabled us to manage the rate of renewals in large sewers and water mains with the minimum call for additional resources. Even so, we have replaced significant lengths of our water distribution network and have one of the youngest water distribution networks in England and Wales, with an average age of 49 years as of 2022.

Having invested heavily in renewal of our water network post privatisation we have renewed or extended over 40 per cent of our water network. This investment has enabled us to focus on improving our asset understanding and data capture so that we can better model and quantify the risk to service from individual sections of network. This allows us to identify and mitigate key causal factors that lead to service failures, at a pipe and cohort specific resolution. For example developing intervention strategies to mitigate and control operational impacts such as high pressure and pressure transients on vulnerable and/or high consequence water mains cohorts, extending their effective service life and reducing risks to customer service efficiently.

Similarly, on our sewerage system we plan to continue our approach of deploying remote sensing capabilities and developing AI tools to provide real time network operability assessments to target investment before there is service disruption. This process of tactical rehabilitation, through the routine removal of serviceability defects identified either proactively through our DNM approach or reactively via incident response, enables us to extract more life from our existing assets.

Having invested in gathering more asset information, and developing the systems, tools and processes to analyse these new data streams we now have the confidence that when assessing investment strategies we are making best value decisions to either:

- Defer investment without significant risk to service;
- Develop schemes to address causal risk factors, such as operating regime or material cohorts (reducing likelihood);
- Prepare alternative interventions for when a risk does materialise (reducing the effects of a consequence); or,
- Choose to renew an asset.

The output of our strategy to focus on improving asset information has enabled a focus on securing further cost beneficial resilience interventions, for example:

- Centralised systems to improve situational awareness;
- Distributed network monitoring systems comprising vast arrays of digital monitors;
- Water on wheels tankers (ASVs) supporting planned and reactive work across our water network; and
- Pressure optimisation across most served areas providing a stable, reliable supply at a reduced risk of failure.

We have adopted the approach of improving our asset understanding and data capture across our asset base, with our investment decisions driven by current and future risks. From impounding reservoirs where our Portfolio Risk Assessment approach has led to a continued improvement to the health of these safety critical assets, to our wastewater treatment works where continued investment through quality drivers has led to our best ever environmental performance from these assets. In Section 2 of supplementary document *UUW40 - Operational resilience and asset health – our approach* we describe more details of our historic, current and future investment strategies, explaining how better data, systems and processes has led to an evolving and improving strategy since privatisation.

Our approach to securing appropriate asset health is determined by the risk profile of the asset and the service that it provides. Taking a risk-based approach, we account for the criticality and the consequences of an asset failure to determine the level of risk and therefore a risk appropriate approach to securing resilience that the company takes. For example, we take a risk averse approach to our fleet of impounding reservoirs, proactively inspecting to understand asset health and investing in monitoring and to prevent unacceptable deterioration, compared to less critical mechanical assets where a fix on fail strategy is more cost beneficial due to the resilience afforded by the wider systems in which the assets operate.

Our ability to innovate and deliver agile interventions in response to threats is supported by a move away from outputs and towards outcomes. In adopting an outcomes approach to securing asset health, we were able to innovate and develop bigger picture system level investment strategies. This approach allowed us to ensure our future asset health activities would be well targeted as well as delivering the maximum cost benefit for customers, to ensure that we maintained and improved the service to them.

Through adaptive planning we are able to test how our plans respond to a full range of scenarios. Example scenarios include how we expect an adverse climate scenario could require a response within the next decade. For more information and details on our approach to adaptive planning and the outcomes please see Section 9 of *UUW12 Long Term delivery strategy*.

7.6.11 Demographics

The changing customer base that we serve is a key causal driver of our activities. It is, therefore, critical for us to understand demographic change within our supply area to deliver resilient services

Based on Local Development Plans (LDPs) and Office for National Statistics (ONS) population forecasts, we forecast our supply area population to grow by approximately 860,000 by 2045, this is covered in detail in our WRMP Technical Report – Demand for water¹⁸. The increase in population means a direct increase in the demand for water and wastewater services across our region.

We forecast the additional demand for water resulting from the increase in population to be more than offset by the delivery of our WRMP plan, with the annual average demand forecast set to reduce from 1748Mld in 2025/26 to 1442Mld by 2049/50 inclusive of the forecast demand growth, largely as a result of our ambitious leakage reduction programme and per capita consumption reductions.

As well as a greater population, the make-up of that population will alter the demands placed on United Utilities:

- Different segments of the population have varying expectations and needs for water services. For example monitoring of unmeasured household consumption shows that, on average, cultural background can increase household demand by as much as one third;
- Reducing household occupancy rates, observed in the ONS data, increases demand for water as lower occupancy households tend to use more water per person. This is linked to an ageing UK population and lower birth rates. In the North West we forecast that occupancy will reduce from 2.3 per property in 2021 to 2.15 by 2050¹⁸; and
- Increasing demand for water services in the region due to increased domestic and international tourism. This can often be localised in more rural areas of lower historic resilience and tend to only have single supply routes, for example the Lake District.

7.6.12 Climate change

Weather has a fundamental impact on our services and how we deliver them. Climate change will always be of strategic and operational importance. We are already seeing the effects of climate change on the region's weather, with increasing summer temperatures, wetter winters, and more extreme rainfall events. Climate change presents a systemic and often compounding risk throughout our operations and services.

¹⁸ Final Water Resources Management Plan, [Technical Report – Demand for water](#)

In the North West we are already observing:

- Temperatures that are +1°C warmer than the pre-industrial period; and,
- Twice the likelihood of a hot summer, with further seasonal changes in the North West projected to be greater than the average for England and Wales, with much wetter winters and, under some scenarios, much hotter and drier summers.

We recognise that the climate has already changed and we are planning for unavoidable future changes. Adapting to a changing climate represents one of the most significant challenges to future services and operations.

We have tested our plans to a range of climate change projections, using the latest best available information from the Met Offices UKCP18 climate change projections¹⁹.

We have further developed our understanding of how climate change is likely to test the resilience of our services through our company-wide assessment of climate-related risks, updated cyclically with the latest evidence. This explores the risks from both the acute impacts of more frequent and severe weather events, and more chronic stresses over time from trends for drier and warmer conditions and sea level rise.

Relatively high rainfall and a hilly topography in the North of England means that water resource systems are dominated by surface water sources including large numbers of impounding reservoirs. In our region, in a typical year, 94 per cent of the water we supply comes from river or reservoir sources. This means a direct dependency on seasonal rainfall patterns and susceptibility to 'in-year' dry weather periods, which we expect to become more frequent and more extreme under all future climate change projections, see Figure 7-13 for the projected changes in future precipitation.

Rainfall, and the projected increases in both intensity and volume, will pose a significant threat to our wastewater operations. A 1 in 100-year rainfall event in the period 1981–2000 is projected to become a 1 in 50-year event in the period 2061–2080.

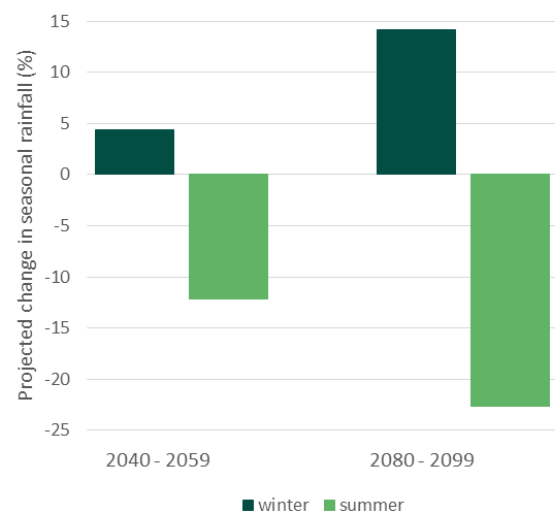
Under all climate change projections we can expect to drain and treat more surface water, increasing the risk of sewer flooding and storm overflow spills if the effects are not mitigated. This risk is exacerbated by the fact that we have the greatest percentage of combined sewers in England and Wales (54% compared to industry average of 33%).

Where the rain falls is as important as the volume, urban rainfall calculations (October 2022)²⁰ demonstrate that, when normalised per 10,000 sewer connections, the urban rainfall in the North West is 40 per cent higher than industry average. Rain falling in an urban area is more likely to enter the sewer system posing a disproportionate threat to performance.

Unique local topographies interact with surface water runoff to increase system surcharging and flood risk. This is especially true of Manchester. Manchester is surrounded by hills to the North and East, but itself relatively low lying forming a 'bowl' shape. The effect is that the area becomes inundated with rainwater from the uplands that is then slow to drain. This will become more impactful under all future climate projections.

More information on our approach to climate change can be found in Section 6.2 of supplementary document *UUW40 - Operational resilience and asset health – our approach* and details on how it has influenced our long term plans in section 4, 5 & 6 of *UUW12 Long term delivery strategy*.

Figure 7-13: Changes in seasonal rainfall from a 1981-2000 baseline



Source: UUW analysis of UK Climate Change Projections

¹⁹ ukclimateprojections-ui.metoffice.gov.uk/ui/home

²⁰ ofwat.gov.uk/publication/urban-rainfall-calculations/

7.6.13 Our resilience action plan

During AMP7, Ofwat required each company to submit an action plan detailing our proposed resilience enhancement activities during AMP7 and beyond. We recognised that while our existing approach to resilience had been assessed as sector-leading, there was more we could and needed to do to develop an integrated systems-based approach. During AMP7, we have been building on our existing strengths and demonstrating how we need to do things differently in future, including activities around training our people, developing our corporate culture, improving data and analysis and more collaboration.

We have striven for continuous improvement during AMP7, learning lessons, developing our thinking and benchmarking against other utilities and sectors. Our plan centres on continually improving and embedding our approach to resilience. Our areas of focus include awareness and management of our interdependencies, further governance and risk improvements, adaptive planning and six capitals approach to better understand and value dependencies and impacts. Below is a summary of the activities and outcomes that have been delivered to close out the PR19 resilience action plan. Further detail can be found in Section 3 of supplementary document *UUW40 - Operational resilience and asset health – our approach*.

We extended our resilience action plan during AMP7 to include further enhancements to our systems-based approach to resilience.

In the delivery of this action plan, we have improved our resilience in the round through:

- **People resilience** – a full organisational capability review has been completed to ensure a comprehensive people plan is in place to support delivery and planning into AMP8 and beyond. This included reviewing our internal capabilities, future requirements and capabilities, and conducting external horizon scanning. We have developed appropriate action plans for delivery, including resourcing and training plans, focusing on engagement, resilience planning and interventions. Following this, we now undertake regular organisational capability reviews to ensure plans remain fit for purpose and support planning into the next AMP, particularly focusing on the capabilities, skills and resources required to support our evolving systems approach to service and resilience;
- **Processes** – we have formal horizon scanning and interdependency analysis processes to better account for long-term risks and opportunities within policy and strategy;
- **Tools and technology** – we have reviewed decision support tools to account for interdependencies, delivering wider benefits and long-term resilience to risks; and
- **Systems resilience training** – this has been developed and delivered to all appropriate staff working throughout asset lifecycle management processes to help to enhance our systems resilience, through improved asset management capability. Our asset lifecycle management training went live in July 2022, over 250 people have now been upskilled with more planned in the coming years.

Systems resilience was identified as a company and sector-wide area that could benefit from improvement. In the following section we explain how we have taken this feedback and developed our systems resilience capability during AMP7.

7.6.14 Improving systems resilience

In understanding how systems interact and depend on each other, we need to account for and anticipate likely cascade failure risks and develop appropriate strategies to absorb, react and recover. We have developed our resilience strategy to more explicitly account for the risk of cascade failures and wider systems hazards during AMP7.

Systems resilience is a key strategy for us, it allows us to look at the bigger picture, to understand the interactions and impacts that individual parts have on one another and to identify optimal interventions quickly and efficiently. We use our ‘resilience in the round’ strategy with its multiple layers of mitigation and control to limit single points of failure across our owned systems and the wider environment.

Our systems-based resilience approach to our operation has enabled us to demonstrate additional value from operating our assets as a system, rather than as isolated assets. The assessment may show that the current level

of redundancy in a system provides sufficient resilience to single asset failure, or that the most efficient approach is to carry strategic stock to mitigate a risk. At a system level, this means preventing failure, mitigating the impact or rapid recovery.

In AMP7, we have developed our approach to systems resilience by mapping our systems and the wider environment on which they rely. We have included physical infrastructure, third-party providers, resources, staff, material and information flows. This development has been in partnership with stakeholders to gain their insights and to ensure we understand their needs.

Instead of focusing on one particular value chain, we have looked at how different parts of systems offer different value to different stakeholders. In addition to a broad view on resilience, we conducted a specific mapping exercise for power resilience, as this is a business priority for us.

We have developed formal methods to document causal linkages from the systems maps. This helps us to embed the insights in business-as-usual risk assessment processes and tools. This helps us to identify risks from cascade failures that may not be apparent on initial inspection. For example, we may have power resilience at our sites, however these same sites are dependent on the power resilience of the telecoms sector to maintain telemetry to our sites. We will continue to develop and embed this tool during AMP8.

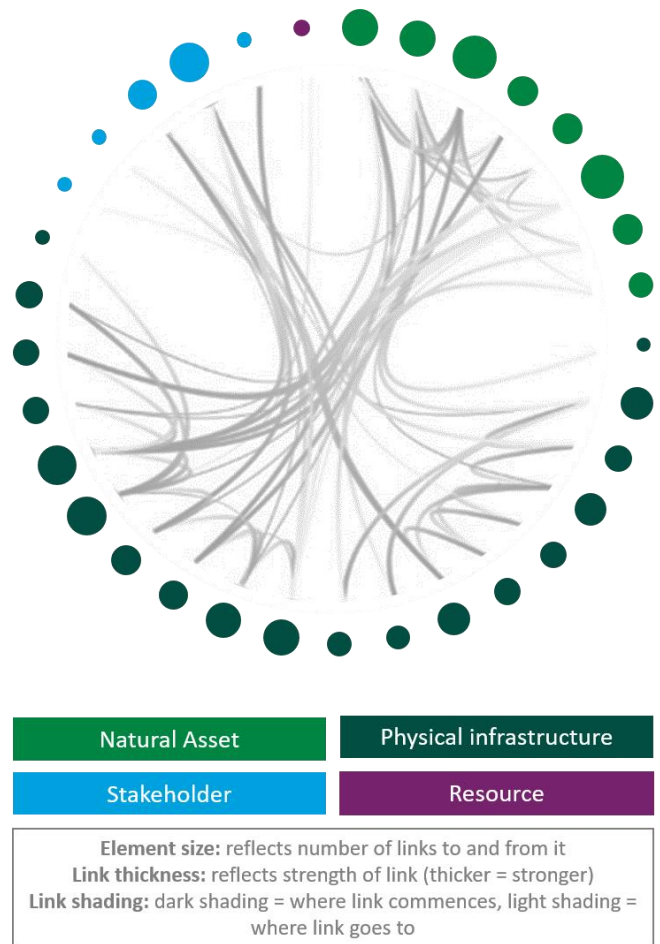
Figure 7-14 illustrates the complexity of our wider system maps. Each of the filaments on the map shows a link that must be maintained for the system to operate efficiently. Some of the links are more critical, carrying more, or more important, goods, services or information. The weight of the line indicates the criticality of the link. The tools we have developed help us to navigate these maps to quickly identify key nodes and links that may be vulnerable to a given hazard. This provides a repeatable way to assess wider system risks to our operations.

We are embedding this systems resilience approach into our decision support tools. This will enable colleagues to take account of both upstream and downstream interdependencies. As an example, this capability can be used to assess if an upstream nature-based solution could better mitigate the risk being considered than a traditional solution. Many AMP8 solutions are considering wider system solutions such as flow separation, rather than directly building additional capacity into combined foul and surface water networks and treatment sites. This helps us to ensure that every investment decision is made with a clear purpose, from a position of knowledge on expected outcomes and a quantification of the expected benefit according to our corporate approach to value assessment.

7.7 Corporate resilience

In this section we explain our approach to corporate resilience and how it supports our business’ resilience and asset health. Further details of our approach to corporate resilience can be found in supplementary document *UUW42 - Approach to corporate resilience* and in our latest annual report²¹.

Figure 7-14: Systems mapping output



²¹ <https://unitedutilities.annualreport2023.com/media/2monspzj/31404-united-utilities-ar-2023-fully-linked-singles.pdf>

Governance

We understand our supply, service and legal obligations and meet them through a mature governance structure, established purpose, strategic priorities and core values and developed risk appetite.

Our mature approach to corporate resilience helps us to avoid, cope with and recover from disruption to service delivery. Our governance structure and accountability and assurance processes support our overall approach to resilience and asset health.

Our obligations

The primary statutory obligations relevant to our functions as a water and sewerage undertaker are set out in the Water Industry Act 1991.

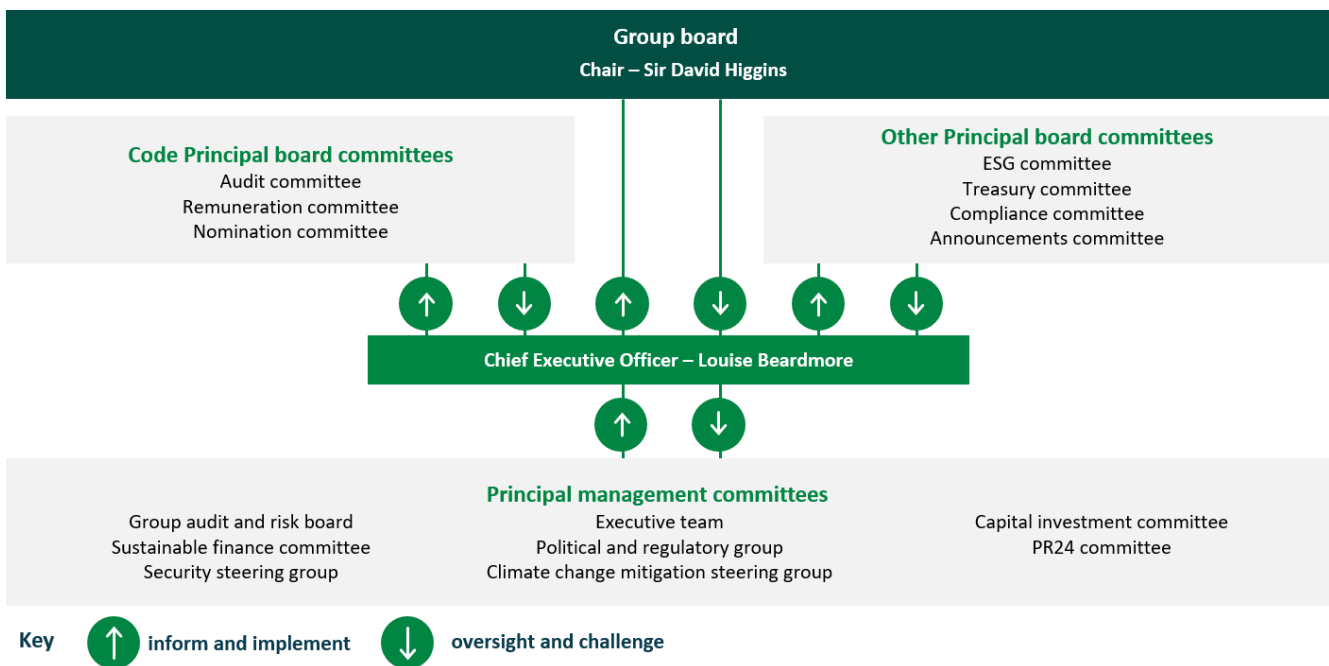
As a listed company on the London Stock Exchange, United Utilities Group is required to comply or explain non-compliance against the UK Corporate Governance Code, the principles and provisions of which meets the board leadership, transparency and governance principles issued by Ofwat.

Meeting our obligations through our Governance Structure

The United Utilities Group board retains overall responsibility for managing the effective and efficient delivery of its obligations and operation of everyday activities within the business. Figure 7 15 below, highlights the Principal Board and Management Committees.

- The Board Committees provide strong governance with authority and independence
- The Management committees discuss the needs of the business, raise issues, identify and delegate appropriate actions, monitor progress of key performance measures, and ensure any lessons learnt are implemented.

Figure 7 15 Governance structure of the board, its principal committees, and the principal management committees



There are then further layers of focus at management and business unit level, all of which feed up through the layers of committees and, ultimately, relevant information and decisions go up to the board through this structure.

One notable governance forum is the compliance working group, formed in 2015 in order to formally determine how the company’s diverse obligations are identified and discharged. The group carries out horizon scanning to identify new legislation and identifies any areas of potential non-compliance against obligations. In 2023, we have further boosted the visibility of compliance matters by establishing a Board subcommittee on compliance.

To support the translation of board risk appetite to everyday operations we have developed strategic appetite statements for ten inherent risk areas of the business, which reflect the primary and supportive activities as an integrated system and from which value can be gained, preserved or lost. Our approach is summarised in Figure 7-16 below.

Figure 7-16: Risk appetite and tolerance



7.7.1 Accountability

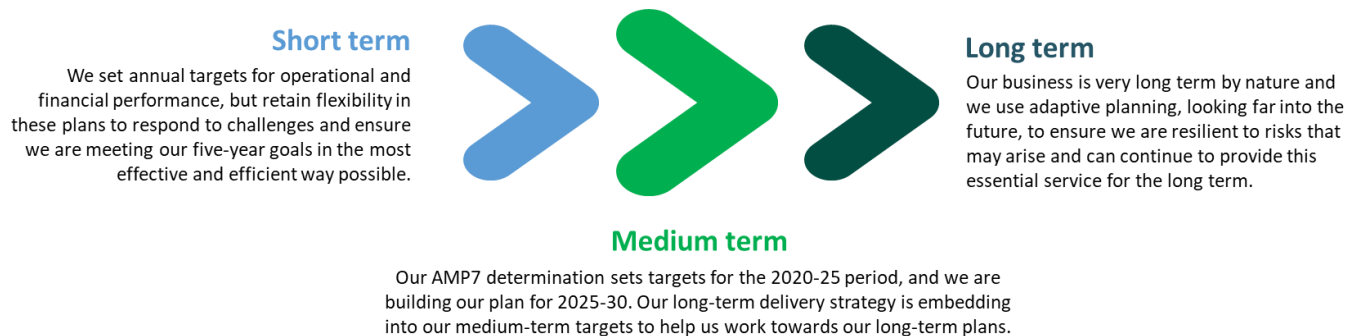
In this section, we summarise how our business model, company business plans, organisational structure and corporate risk and resilience framework align to our obligations, notably to deliver resilient services in the short and the longer term.

Our business model, company business planning

The business model focuses on delivering long-term value that reflects customers' priorities and has the environment at its core by considering our key resources, external drivers and the full range of stakeholders.

We take an integrated approach to everything we do, planning for long, medium and short-term horizons to deliver our purpose sustainably, see Figure 7-17 below.

Figure 7-17: Our planning horizons



The group board and executive committee undertake annual strategic planning days using analysis, including sensitivity and stress testing, from strategic and financial teams. In addition, regular “deep dive” sessions are held by both the board and the executive committee, focussing on issues of key strategic importance.

Organisational structure

The organisational structure is designed to deliver the business model and the company business plan in line with the purpose, strategic priorities and core values. The core services of customer services, water, wastewater and bioresources are supported by functional areas providing specialist support, knowledge and understanding of the wider business environment. These include health, safety and wellbeing, human resources, finance, technology services, supply chain and corporate affairs. Performance is measured and reported on key performance indicators throughout the organisational structure.

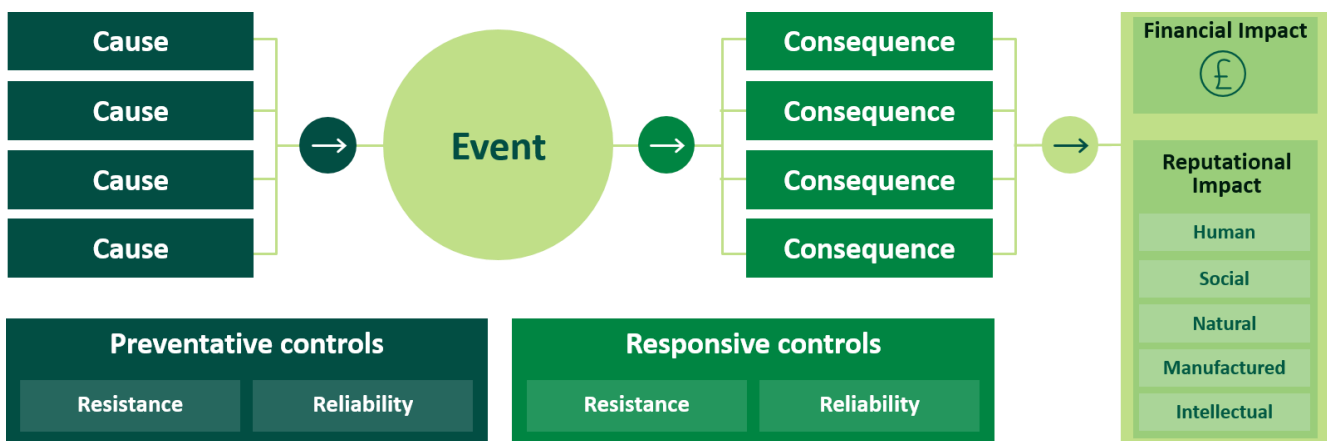
Our risk and resilience framework

United Utilities corporate risk and resilience framework is the overarching framework for the company, which, in line with BSI: ISO 31000:2018, follows an enterprise-wide approach defined as holistic, integrated and forward looking.

As an enterprise-wide risk system the corporate risk profile consists of inherent event-based risks, which reflect the end-to-end water and wastewater (including bioresources) production cycles and supporting systems such as customer services, technology services and people management.

The assessment of inherent event-based risk focuses on new and emerging circumstances relating to a broad range of hazards, which drive and influence risk (causal factors), a package of outcomes (consequences) including those which are cascading, and the strengths, weaknesses and gaps in the control environment (control effectiveness). This approach is illustrated in Figure 7-18F below.

Figure 7-18: Risk impact assessment and identification of common themes



Each risk is sponsored by the most relevant senior manager and is systematically assessed twice a year or in the event of a significant business change. The outcome of the assessment is reported to the group board at the full and half-year reporting cycle via a mature governance and reporting structure.

The group board are given visibility of the entire profile of inherent event-based risk relative to the inherent risk areas (principal risk), with emphasis being on the most significant risks facing the company.

Each of the event-based risks has multiple causes and consequences, which in turn lead to financial and/or non-financial impacts. Preventative and responsive controls, which incorporate the four components of resilience (resistance; reliability; redundancy; and response/recovery), are applied to reduce the likelihood of the event occurring and limit the impact if the event were to materialise. Analysis of the profile highlights common themes, notably associated with the causes and consequences. These common themes can then be considered more holistically, which combined with the analysis of the strengths, weaknesses, gaps and interdependency of control across the business, enables a more integrated approach to risk management.

The assessment of risk is forward looking, based on current knowledge and understanding. Likelihood analysis represents the likelihood of the event occurring in any one year based on the causal factors over the medium-term, therefore reflecting estimated increases or reductions.

We consider a broad range of shocks and stresses for each risk by analysing the minimum, maximum and most likely scenarios, allowing us to understand the remote but plausible impacts as well as more probable impacts and the strength and/or weakness of our control across this range.

Control/mitigation is a key element of the overarching corporate risk and resilience framework and emphasises the clear line of sight to resilience. Each control, regardless of type, is allocated an owner and is assessed for its effectiveness by the risk sponsor in the context of the risk, enabling us to improve resilience by focusing our attention on the specific need.

The control framework requires risk sponsors to consider multi-layered controls to prevent or limit shocks and stresses, and to minimise the impact if they occur. This aligns with our wider 5R model.

The outcome of the control assessment contributes to the quantification of likelihood or impact of the risk, but fundamentally for improving resilience, determines further mitigating action required to achieve the desired risk exposure (target state) relative to risk appetite and tolerance.

Continuous improvement is a key feature of the framework; following the widely recognised best practice four step method of plan, do, check, act.

7.8 Financial resilience

We have a duty to stakeholders to ensure financial resilience over the long term. Financial resilience means we have access to sufficient financial resources so we can act to protect customers from the occurrence of severe but plausible events. This includes a wide range of scenarios such as sustained totex overspend, ODI penalties, higher debt costs, persisting low inflation as well as operational incidents such as the failure of a major operational asset. Financial resilience ensures that we can continue to attract the finance required to fund customer-focused long-term investment programme at the lowest possible cost, providing resilient water services.

We have a long-term and responsible approach to financial risk management and have maintained a strong capital structure and liquidity position. This has enabled us, for AMP8, to be confident of efficiently financing our increased projected capital expenditure to fund cost beneficial investment across the full spectrum of the business operation, while remaining in line with our target gearing range and with minimal increase to financial risk. Chapter 9 and supplementary document *UUW68 – Financial resilience provide* a more detailed analysis of financial resilience including the key points outlined below.

- **Strong capital solvency position** – The UUG group’s policy of maintaining debt to regulatory capital value (RCV) of between 55% and 65%, which is consistent with a robust capital structure and strong solvency position, and which in turn supports UUW’s current credit ratings of A3/BBB+/BBB+ with Moody’s, S&P and Fitch respectively;
- **Strong liquidity position** – At July 2023 UUW had £1,533 million of available liquidity covering expected cash outflows through to April 2025, providing a significant buffer to absorb short-term cash flow impacts;
- **UK leading pension schemes** – UUW pension schemes are fully funded on a low dependency basis and fully hedged for market risk;
- **Economic and regulatory environment** – Considerable protections exist from the economic and regulatory environment in which the company operates and the insurance in place to protect against catastrophic risk;
- **Resilience to absorb all modelled scenarios without taking mitigating actions** – ability to absorb all ‘severe but reasonable’ company risk specific scenarios and the extreme common scenarios prescribed by Ofwat, while maintaining investment grade credit ratings; and,
- **Extensive mitigations available in extreme scenarios** – to improve capital structure and/or liquidity including, raising of new debt or equity, restricting dividends, closing out our derivative asset position, deferring capital programme spend, or reducing discretionary spend.

This has enabled the board to provide a 12-year long-term viability statement through to March 2035²² satisfied itself that our plan will support the financial resilience of the company over at least this period, with sufficient headroom to enable it to continue to deliver its commitments under a range of stressed conditions.

²² Details of the long-term viability statement are provided in supplementary report *UUW68 financial resilience*