UUW12

Long-Term Delivery Strategy

October 2023

This document outlines our long-term delivery strategy to meet our ambitions to 2050 and beyond. It describes the core and alternative adaptive pathways which may be required under different scenarios and demonstrates how scenario testing has informed our low-regrets, best value plan for the next five years.

United Utilities

Water for the North West

Contents

Appendices

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This index signposts the reader to key aspects of our LTDS, including how it meets the requirements of the LTDS guidance document 'PR24 and beyond: long-term delivery strategies and adaptive plans', published by Ofwat.

Please note the investment figures referenced throughout this document are on a post efficiency and RPE basis (i.e. consistent with the value we propose to be recovered from price controls). All numbers referenced within the corresponding LTS data tables are on a pre-efficiency basis (i.e. pre frontier shift and real price effects basis).

Requirement	Summary	Location reference
Ambition	We outline **stretching but achievable long-term ambitions** which underpin our long-term vision and purpose.	Section 2.22.2
	We describe the key performance outcomes associated with our long-term strategy.	Section 2.5
	We have considered the improvements that can be delivered through **efficient base expenditure** and have considered where future **efficiencies from base** may be realised.	Section 4.3, 5.3, 6.4. Supplementary document *UUW89*
	Our ambitions have been shaped by **in depth and continuous engagement** with customers and stakeholders.	Section 3.2.
	Our ambitions are shaped by our understanding of the region and its **particular challenges and opportunities**.	Section 2.3
	Our ambitions have **taken consideration of a range of external drivers**.	Section 2.3, and section 2.4.
Strategy	Each of the strategy sections follow the same structure: – The **overview** provides a summary of spend and the adaptive plan diagrams for each strategy; – **Our ambition** describes what we aim to achieve over the long-term for each strategy in more detail; – **The core adaptive pathway of investment** explains how we expect to achieve the ambition and vision, including our approach to base and enhancement; – **Alternative adaptive pathways** describe the changes in investment under plausible scenarios; – **Opportunities to collaborate** outlines the partnership work required to meet ambitions; and, – We conclude by explaining **how we will monitor and adapt our plans** over time.	Sections 4, 5, and 6 (4.1, 5.1, 6.1) (4.2, 5.2, 6.2) (4.3, 5.3, 6.3) (4.4, 5.4, 6.4) (4.5, 5.5, 6.5) (4.6, 5.6, 6.6)
	Customer and stakeholder feedback has informed the development of our strategy.	Section 3.2
Rationale	We explain why our strategy is the right one. We explain **how we developed our core an alternative pathways** to deliver long-term outcomes.	Section 9 Section 9.3

Requirement	Summary	Location reference
	We describe **how options were identified** and selected. These include opportunities to deliver solutions which are adaptive, solutions which drive behaviour change, operational solutions, working with others through partnerships, and learning both through collaboration with others and local pilots and innovations. In all cases we have considered solutions at a range of scales including system level solutions and investment in local infrastructure.	Section 9.3.8 to 9.3.10
	An explanation of why the options and the mix of approaches are **best value**.	Section 9.2
	Details of why the investments are **sequenced for optimal delivery.**	Section 9.3.11 to 9.3.14
	An explanation of why **trigger and decision points** have been chosen.	Section 9.3.15 and 9.3.17
	Evidence of how our strategy reflects the **key principles of adaptive planning**.	Section 9.1.1 and 9.1.3
	Details of **how our core pathway is sensitive to different scenarios** and how our strategy adapts to these scenarios, including any impacts on outcomes and expenditure.	Section 9.4
	Explanation of how our **wider scenarios** were developed to reflect the particular challenges of the North West.	Section 9.5
	An overview of how our strategy **compares to previous long-term strategies**.	Supplementary document *UUW89*
	We consider how our strategy secures **affordability and fairness**.	Section 7, section 9.2
	We highlight where enhancement investment might be needed to **keep future options open**.	Section 4.3 for water, 5.3 for wastewater, and 6.3 for bioresources
Foundation	We describe the assumptions that underpin our plans throughout the strategy sections and summarise these in Appendix A.	Sections 4, 5, 6 Appendix A
	We describe wider factors (outside those addressed by the alternative pathways) which we have made **assumptions** about.	Appendix A.1
	We provide details of our expected **performance improvement from base expenditure**.	Section 4.3, 5.3, 6.3
	We outline the **greatest sources of uncertainty** in our strategy.	Section 9.1.4 and 9.1.5 Section 9.6.12 and 9.6.13
Board assurance	Details of the board assurance of the LTDS.	Section 10
	Our **board assurance statement** includes detail of how the board has ensured board assurance requirements are met.	Supplementary document *UUW11*
	Evidence of where the **board has challenged** company management.	Section 10.1.1 to 10.1.4
	Explanation of the **process the board has used** to confirm our strategy is the best it can be.	Section 10.1.7 to 10.1.13

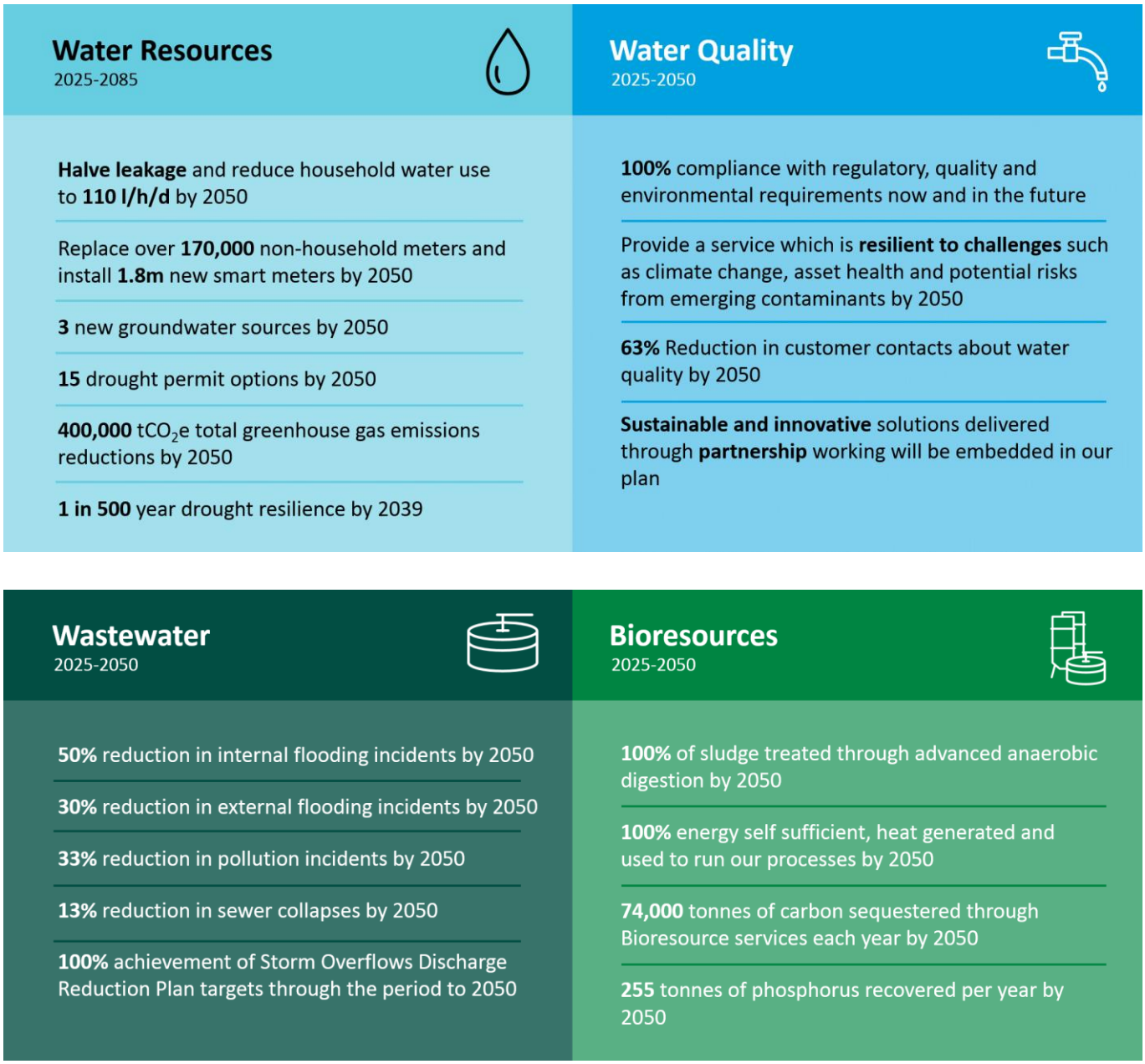
1. Executive summary

1.1 An ambitious strategy for customers

1.1.1 Long-term and adaptive planning is essential to affordable and resilient water and wastewater services. Building on our detailed understanding of the unique strengths, challenges and opportunities in the North West, our new long-term delivery strategy (LTDS) incorporates our most advanced long-term planning to date. Our LTDS is central to how we will deliver our purpose and vision: **"to provide great water for a stronger, greener and healthier North West"** in AMP8 and over the long-term.

1.1.2 Customers and stakeholders are at the heart of our LTDS. We have used a variety of innovative techniques to immerse customers in long-term issues and gather robust feedback. Customers and stakeholders have shaped our vision, helped define stretching long-term ambitions (Figure 1) and challenged the selection and sequencing of investment in our long-term strategies. Customers and stakeholders have shown strong support for the components of our long-term strategies, described further in section 3.

Figure 1: Our long-term ambitions for water resources, water quality, wastewater and bioresources

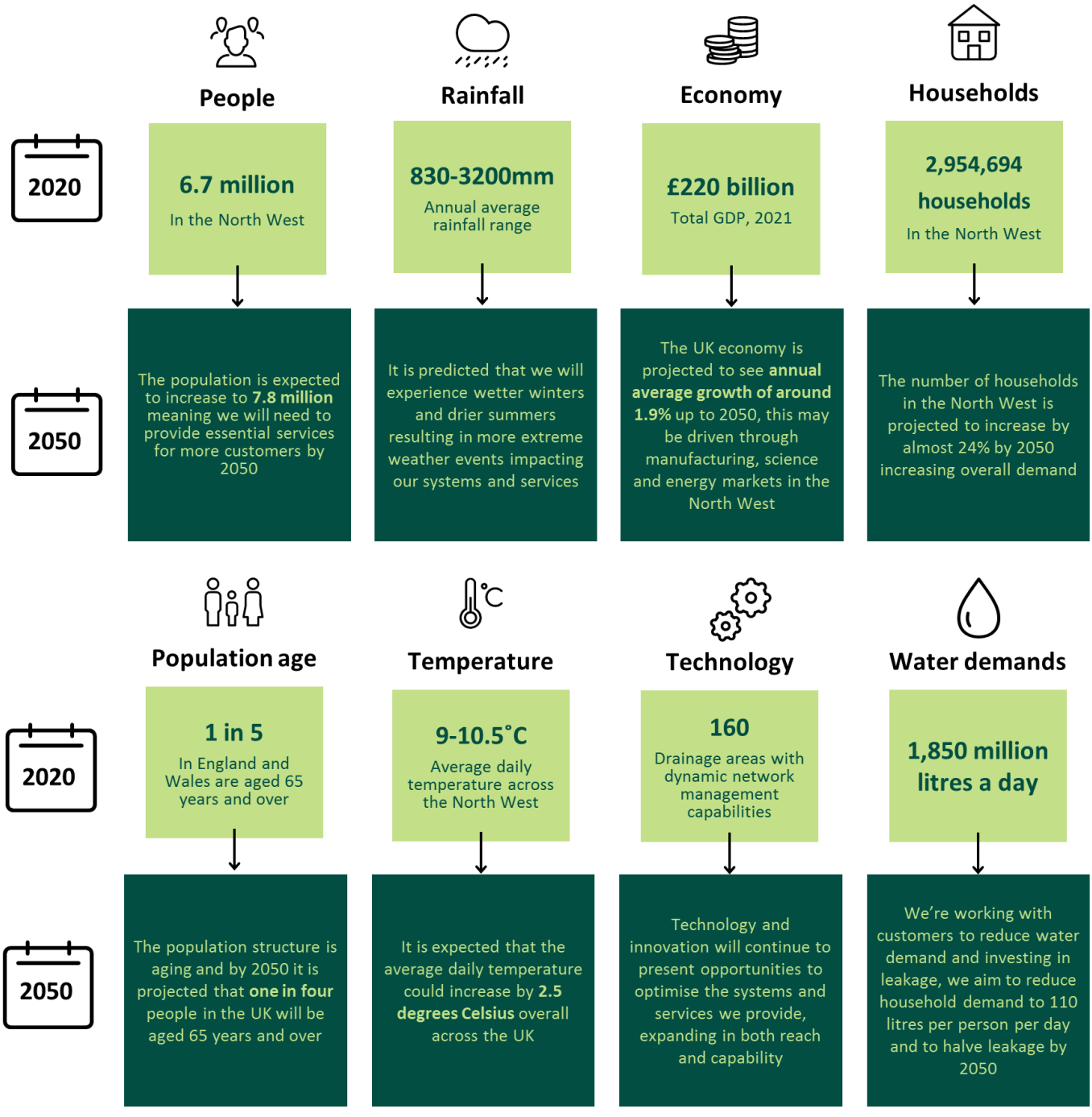


1.2 The challenges our strategy seeks to address

1.2.1 Well considered planning has never been more important with the scale of change and uncertainty we are managing. The changing climate, growing population, technological developments, changes in the economy, and evolving national and regional needs create both opportunities and challenges for the provision of water and wastewater services. Against this backdrop, public expectations of water companies continue to evolve and, rightly, customers expect us to deliver substantial social and environmental value at the lowest cost possible. Some of the changes expected to impact wastewater services over the next 25 years are described in Figure 2.

1.2.2 Our LTDS has been shaped by and adapted to the diverse needs and opportunities of the North West. We have worked closely with stakeholders, communities and customers to develop a thorough and up to date understanding of the region we serve. We aim to leverage our strengths and capabilities to address the specific challenges and opportunities that exist in the North West.

Figure 2: The changes expected to impact on water and wastewater services over the next 25 years



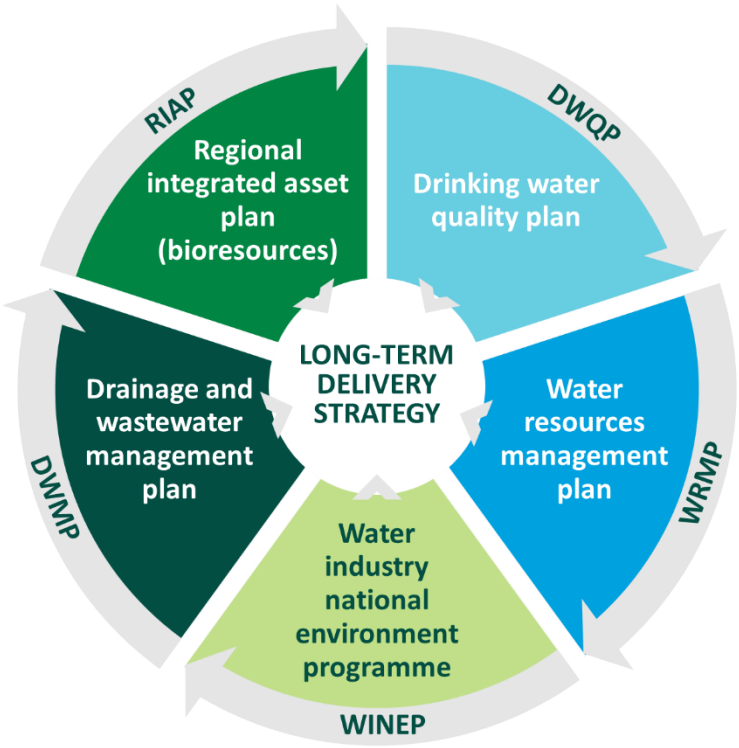
1.2.3 Climate change is of strategic and operational importance with a fundamental impact on our services and how we deliver them. We are already seeing the effects of climate change on the region's weather, with increasing summer temperatures, wetter winters, and more extreme rainfall events putting pressure on the services we provide. Urban rainfall in the North West is 40 per cent higher than the industry average meaning more rainwater enters the sewer system compared to other companies' areas. As our water resources are largely comprised of surface water sources, they react rapidly in wet weather (compared to ground water sources) and also react quickly to dry weather.

1.3 A summary of our strategy

1.3.1 To develop our LTDS we have built on our track record of effective long-term planning and scenario analysis for each of our service areas, summarised in Figure 3. This has enabled us to develop and cost new long-term plans for water, wastewater and bioresources, as well as completing detailed analysis of cross cutting priorities like climate change.

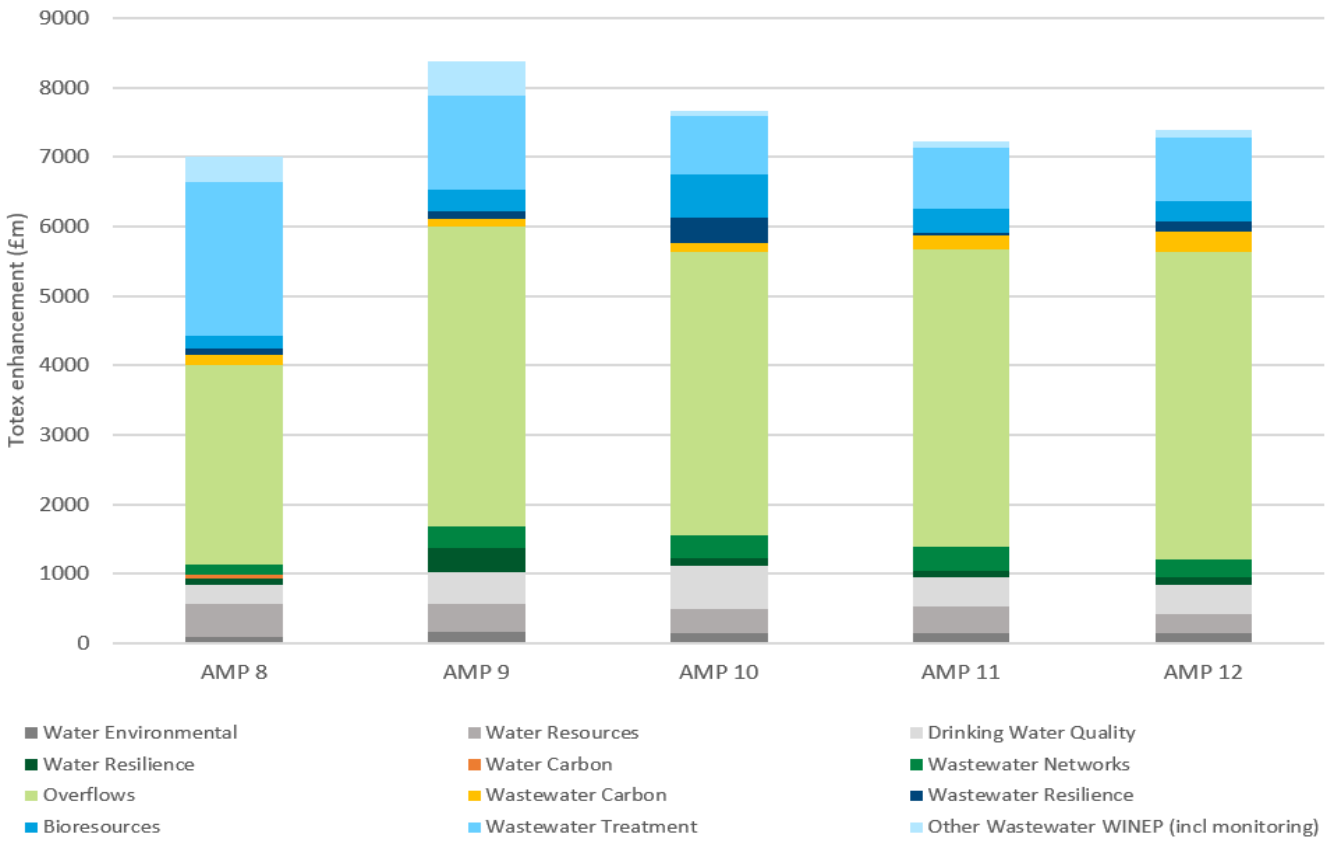
1.3.2 We have embraced adaptive and long-term planning techniques, and built on our internationally-recognised assert management system (certified to the Asset Management Standard ISO55001:2014) to help us manage the challenges and opportunities we face in the most effective and efficient ways for customers and other stakeholders. Scenario testing has enabled us to consider the impact of plausible future extremes and select investments that help us deliver our ambitions under most of these scenarios. We have tested against Ofwat's common reference scenarios for climate change, demand, abstraction reductions, and technology, and two wider scenarios that we believe are important for the North West - water transfers and changing expectations.

Figure 3: Components of our LTDS



1.3.3 We currently forecast that we will need to invest around £38.3 billion between 2025 and 2050 to deliver our LTDS and enhance the services we provide to work towards our ambition. A high level break down of our forecast total enhancement expenditure is outlined in Figure 4. To check that our core pathway is likely to deliver the ambition under a range of possible futures we tested our LTDS using scenario analysis, described further in section 9.4.

Figure 4: Totex enhancement expenditure in our core pathway between 2025 and 2050



1.3.4 Through a comprehensive process of scenario testing and adaptive planning described in this LTDS, we have deferred up to £952 million of investment into alternative pathways in future AMPs. Moving spend into alternative pathways allows us to prioritise low and no regrets investment and build further understanding where the need for expenditure is uncertain.

1.3.5 Further improvements to ensure better rivers is a clear priority over the short and long-term. A significant amount of the investment in our LTDS is associated with the delivery of the requirements in the government's Storm Overflows Discharge Reduction Plan (SODRP). Changes to surface water management will be key to ensuring long-term resilience and we are working closely with our regulators through our Advanced WINEP proposal to overcome barriers to nature based solutions and accelerate rainwater management.

1.3.6 We have prioritised water efficiency in our plans so that we can extend services to meet the needs of the growing population while minimising pressure on water sources. Our long-term plans aim to meet government targets to reduce household water use to 110 litres per person per day, and by 15 per cent for businesses, as well as achieving interim targets. We're also investing to halve levels of leakage.

1.3.7 Additionally, through our adaptive plan we have identified preparatory work in AMP8 which allows us to keep future options open. Specific examples of how the LTDS has informed our AMP8 plans are described in section 1.4.

1.3.8 The board and executive management have led the development of our LTDS and we evidence this in *UUW11 - Board assurance statement*. Our robust plans have been externally assured, giving confidence that they are high quality. Further detail on board engagement on the LTDS is provided in section 10.

1.4 How our strategy has informed our AMP8 plan

1.4.1 Our AMP8 plan is aligned to the first five years of our LTDS. Adaptive planning has helped us to produce an efficient and low regrets plan for AMP8 which represents best value, balancing the defined needs of the present with the uncertainties of the future. Through this process we've been able to understand the high priorities that require investment now, identified areas where preparatory work is essential to mitigate future risks, and found opportunities to phase investment where needs are uncertain.

1.4.2 An adaptive approach means we are:

- Addressing problems with evidence of short-term impact, ensuring investment is low regrets;
- Developing solutions to meet a combination of requirements driving best value;
- Planning upfront through no and low regrets activities to keep future options open; and
- Monitoring remaining uncertainties, which will enable us to identify appropriate timing and approach for investment as it develops

1.4.3 Examples of how this has shaped our plan for AMP8 include:

- **Water resources:** Low regrets investment in three groundwater sources to ensure we can respond to and support national water resource needs. Potential further investment has been phased into an alternative pathway in AMP9 and beyond to be determined once we have certainty on the outcome of regional reconciliation for water resources.
- **Catchment management for water quality:** continued investment in catchment management, such as through our catchment systems thinking programme (CaST), driving water quality benefits in our rivers and reservoir through working with partners and managing pollutants at source. These programmes also deliver many complementary benefits for recreation, nature and greenhouse gas emissions.
- **Rainwater management and phasing of the storm overflows programme**: prioritising a combination of investment in grey and blue-green solutions at high priority sites and investment in rainwater management through the advanced WINEP in the short-term. Our advanced WINEP is being developed in partnership with regulators to inform the regulatory model for delivering nature based solutions. This prioritised investment will deliver resilience and understanding about the benefits of rainwater management to inform the amount of storage required over the longer-term.
- **Bioresources:** we have phased the significant spend to build alternative outlets for biosolids which will result from any loss of land available for biosolids recycling into future AMPs. Low regrets preparatory investment has been identified for the short-term to build resilience into our system with a mixture of outlets, along with a proposed in AMP uncertainty mechanism (a Notified Item) to manage the immediate risk, detailed further in section 6.
- **Proposed phasing of schemes in the WINEP**: where the outcomes of upstream investment may alter the solution needed downstream and / or investigations are required to reduce uncertainty around decisions we have phased investment into the future. Through phasing we are avoiding potential abortive spend, maximising the delivery of blue-green solutions in the short-term and reviewing the remaining needs to minimise and right-size the grey solution in future AMPs.
- **No regrets land purchase:** to prepare for future needs identified in the WINEP we have identified a number of areas where additional land purchase should be made in the short-term, this will reduce future delivery risk associated with long lead times for land purchase.
- **Investigations and monitoring:** we have prioritised a number of programmes in AMP8 which will enable us to understand issues more comprehensively and reduce uncertainty around investment decisions, aiming to ensure we can confidently deliver best value solutions. Investigations are important components of our plans for both water and wastewater. For example, our Cleaner

Mersey Investigations to identify the investment needed to improve water quality and the best approach to tackle the complex network of combined sewers across Liverpool and the Wirral.

1.5 How our strategy will inform our future plans

1.5.1 We recognise the need to frequently review and monitor our plans. As part of the LTDS we've embedded processes, including cyclical updates, to ensure our decisions are based on the latest, best available information. Through the LTDS framework we are strengthening our decision making. Our strategies will develop iteratively with the latest data and information, and be reviewed and updated as we move into planning for AMP9 and subsequent future AMPs.

1.5.2 We believe the LTDS provides an important platform to align long-term planning activity across our systems into one transparent and visible strategy. The LTDS framework provides a mechanism to address longer-term obligations such as the storm overflow discharge reduction plan, to identify appropriate phasing and use forecasting to understand the range of plausible uncertainties that are likely to impact on our operation over the long-term.

2. Our long-term ambition

Summary

- Our long-term vision is to provide great water for a stronger, greener and healthier North West.
- We have developed our ambitious long-term plan by building on our strategic plans for water, wastewater and bioresources, this has been underpinned by our robust asset management processes and principles.
- We have outlined a stretching but achievable long-term vision and ambitions, shaped by engagement with customers and stakeholders.
- Our ambition is shaped by the unique factors which impact on operating in the North West.

2.1 Overview

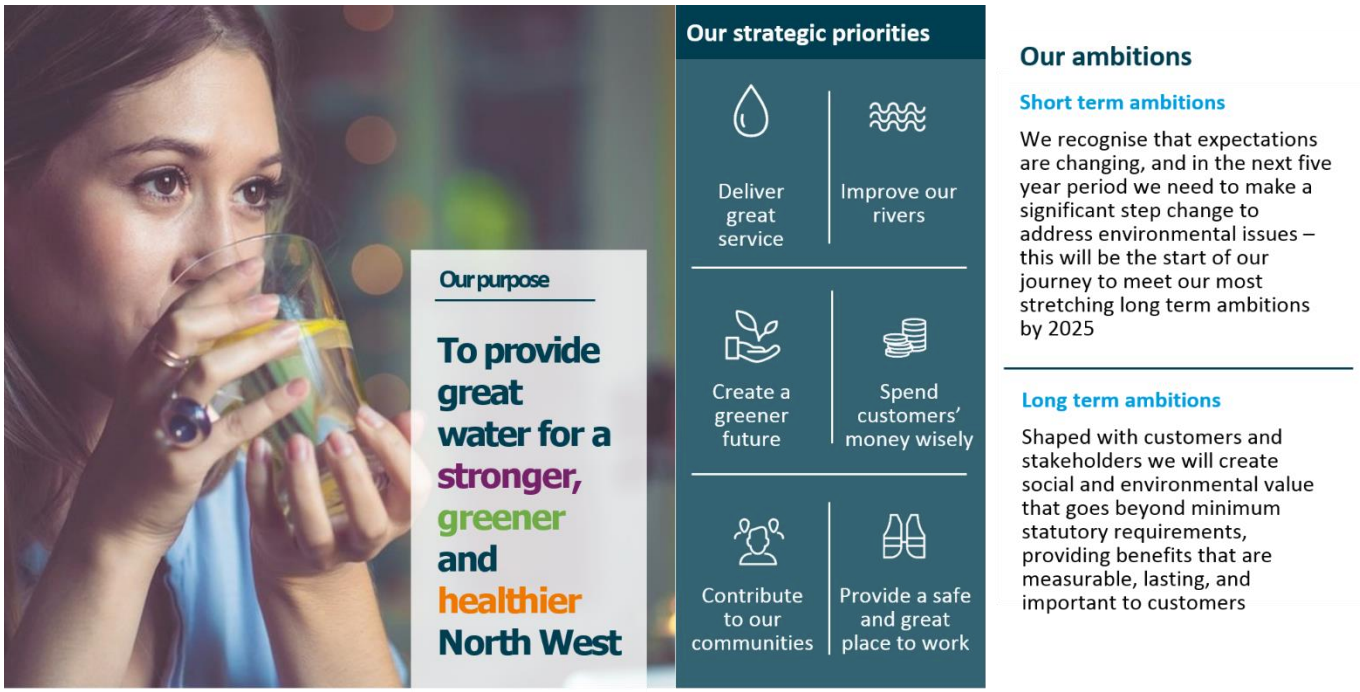
2.1.1 This section describes our purpose and vision, the strategic themes which support the vision and the specific ambitions which underpin each strategic theme in both the long and short-term. The line of sight from our purpose and vision through to our ambitions is described in Figure 5. Our longer-term ambitions present our targets for 2050 and in some cases beyond, we have also outlined the shorter term action and targets through ambitions relating to the next five years, these form our AMP8 plan.

2.2 Our purpose and vision, developed with customers and stakeholders

2.2.1 Our purpose and vision is to provide great water for a stronger, greener and healthier North West. This drives us to deliver our services in an environmentally sustainable, economically beneficial, and socially responsible manner, and create sustainable long-term value.

2.2.2 Regular, in depth conversations with customers and stakeholders have shaped our vision and ambitions for our AMP8 plan and the long-term. We undertake continuous research as well as bespoke research projects to understand customer preferences. We've used an independent consultancy to triangulate insight from a wide range of internal, industry and regulator projects as well as operational data to track priorities over time. In addition we have carried out a number of bespoke research projects to understand ambitions and investment priorities for the longer-term through the WRMP, DWMP and LTDS research. This has directly shaped the ambitions and investment proposed in AMP8 and the long-term. Further detail on our customer and stakeholder engagement can be found in section 3.

Figure 5: Our purpose and vision is delivered through six strategic priorities, underpinned by short and long-term ambitions



2.2.3 Customer research and stakeholder engagement reinforced that:

- Customers expect great water quality, every time they turn on their taps;
- Customers want to see a step change in the outcomes we deliver for the environment. Tackling storm overflows is an important part of this;
- Customers want us to reduce the amount of water that is leaking from our pipes;
- Customers are concerned about their ability to afford future water charges;
- Customers and stakeholders agree it's important to see step changes in outcomes and want to see these now, however this needs to be balanced by money being invested wisely and efficiently;
- Customers and stakeholders think vulnerable customers should be supported, where even a small change in cost can create a heavy burden; and,
- Stakeholders want the North West to be a thriving community and a great place to invest.

Working towards our purpose and vision

2.2.4 Achieving our purpose and vision means working with others to realise a future water environment that supports broad outcomes for the North West. Over the next 25 years we recognise there are significant challenges facing the water industry, from climate change, to protecting the environment, to meeting and managing demand for services. There is considerable action we can take to manage these complex challenges, however action is equally needed from others to drive change and support the delivery of wider environmental and social outcomes for the North West.

2.2.5 By 2050 we are planning to transform our asset base in a number of ways:

- We will continue to ensure our assets have minimal impact on the environment and to provide service efficiently throughout their lifecycle, from construction, through operation and to their eventual disposal;
- Existing assets will be supplemented by an increasing blend of co-owned and natural assets for storing, transporting and treating water, before returning it to the environment;

- Our networks will be smart, enabling us to predict failures and intervene before services are impacted. We will utilise the latest technologies to minimise disruption in our service delivery and waste in our processes;
- Our wastewater treatment centres will be increasingly built to consider the circular economy with an increasing use of regenerative and renewable resources as inputs and repurposing of traditional waste streams as new products;
- We will manage our assets to maximise the value they deliver, whilst being mindful of intergenerational equity; and,
- Investment in our assets will be carried out in the context of place based planning, leveraging wider system opportunities through broad and integrated planning frameworks.

2.2.6 We envisage a future in which water catchments are managed in a holistic, collaborative and integrated manner delivering environmental and social benefits. We will continue to restore catchment land through peatland restoration and tree planting. We are creating strong relationships with communities, establishing networks of river champions and drawing on citizen scientists to build a holistic picture of catchment needs. Catchment improvements will lead to high quality raw water, slow the flow of water in the headwaters of catchments, reduce the impact of storm events; and provide more access to green space for local communities.

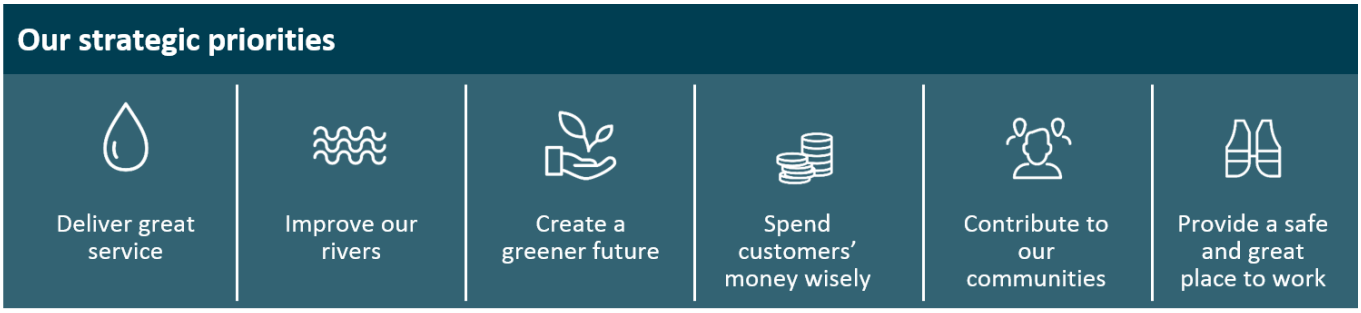
2.2.7 We will promote and adopt rainwater management solutions to address impacts on sewer networks, implementing a network of nature based solutions where this is best value. Additionally we will continue to promote sustainable highways drainage by local authorities, moving to natural solutions and discharge to watercourses rather than the sewer system. We will encourage developers to draw upon best practice drainage in new developments to fully implement sustainable drainage practices. We will work with customers to build water awareness, offering opportunities to manage rainwater in the home through water butts and smart water butts. We would welcome action resulting from the government review of Section 3 of the Flood and Water Management Act, revising the right to connect surface water to the combined sewer system.

2.2.8 By 2050, customers, businesses and communities will place a high value on water and actively reduce personal and business consumption. Businesses will publish their water footprints online driven by consumer demand for businesses to be open and transparent about their full environmental footprint. Government action around water labelling is critical in raising awareness and driving a step change in action in water use.

Delivering our purpose and vision through six strategic priorities for the North West

2.2.9 To achieve our purpose and vision, we are working towards six strategic priorities, each of these is comprised of a number of shorter and longer-term ambitions. Our strategic priorities are outlined in Figure 6 and described, along with the underpinning ambitions in the tables below. Our ambitions inform our approach for both the next five years and enable to us think ahead to ensure we can continue delivering great service over the next 25 years.

Figure 6: Our six strategic priorities



Strategic priority 1: Deliver great service for all customers

Water and wastewater services are essential for daily life. Delivering great service means ensuring all customers have great water quality, ensuring interruptions to supply are minimised and leakage is driven as low as possible, preventing sewer flooding and supporting vulnerable customers through affordability and priority services schemes.

Our ambitions

Shorter-term

- Support customers who need it most, doubling support through the 2025–2030 period by delivering sector leading affordability and priority services schemes.
- Keep bill increases as low as possible, delivering efficient and best value plans for the long-term and making use of markets to drive efficiency.
- Provide customers with great water quality which is 100% compliant with drinking water quality standards.

Longer-term

- Improve the taste, smell and appearance of water, aiming to reduce contacts by 63% by 2050.
- Aim to eliminate lead pipework by 2070.
- Enhance the network and use cutting edge innovation to manage the challenges posed by climate change, aiming to halve sewer flooding incidents by 2050.

What value will this deliver?

Health and wellbeing? ✓	Economic equality ✓	Trust and transparency ✓	Reduce inequality ✓	Economic growth
Quality of place	Biodiversity and ecosystem health	Air quality	Climate mitigation	Protecting the water environment

Strategic priority 2: Improve our rivers

We are dedicated to protecting and enhancing the North West's environment and rivers. Managing issues such as storm overflows and flooding is complex and requires removing significant volumes of rainfall from and increasing the capacity of our sewer network. We are determined to improve river water quality in a way that achieves maximum impact as a rate that is affordable, and catalyses action from many parties.

Our ambitions

Shorter-term

- We are targeting a 26.8% reduction in overflow spills during AMP8, as part of a 60% reduction over the decade to 2030 through rainwater management and increased capacity.
- Protect and improve bathing waters, reduce spills to an average of three per bathing season, and invest in our wastewater treatment works to deliver high standards.
- Deliver the best environmental performance, targeting 4* Environmental Performance Assessment (EPA) rating from the Environment Agency.

Longer-term

- Reducing spills from overflows to an average of ten spills per overflow each year by 2050.
- Continue to drive down pollution incidents and eradicate harm from our assets by 2050, employing leading edge technologies to remotely monitor and control our systems.
- Continue to improve the quality of our wastewater treatment works –achieving new standards and reduce phosphorus in discharges by 80% regionally by 2038.

What value will this deliver?

Health and wellbeing?	Economic equality	Trust and transparency ✓	Reduce inequality	Economic growth
Quality of place ✓	Biodiversity and ecosystem health ✓	Air quality	Climate mitigation	Protecting the water environment ✓

Strategic priority 3: Create a greener future

We are committed to mitigating our contribution to further climate change and to adapting iteratively to the changes we experience. We want to eliminate waste and will continue to develop and maximise the value created through recovery and re-use of our vital sludge resource. We will keep our finger on the pulse of new and emerging issues for the environment.

Our ambitions

Shorter-term

- Use our biosolids, land and other assets for clean energy, to generate energy from waste.
- Transition our cars and vans to low emissions options by 2028.
- Reduce household water use by 10% by 2030 (from 2019/20 baseline)
- Protect nature and biodiversity through our operations, and work with partners to maximise benefits.

Longer-term

- Support customers to reduce water use to an average 110 litres per person per day by 2050.
- Meet our 'science based approach' targets towards net zero greenhouse gas emissions by 2050.
- Embrace circular economies, recover and recycle nutrients in biosolids to provide a sustainable source of nitrogen and phosphorus for famers.
- Deliver integrated wastewater and biorefinery hubs to recover energy, nutrients and CO_2.

What value will this deliver?				
Health and wellbeing?	Economic equality	Trust and transparency ✓	Reduce inequality	Economic growth ✓
Quality of place	Biodiversity and ecosystem health	Air quality ✓	Climate mitigation ✓	Protecting the water environment

Strategic priority 4: Spend customers' money wisely

We recognise the importance of keeping bill increases as low as possible at a time when household wallets are facing upward pressures from many services. This financial pressure comes at a critical time when urgent action is needed to improve the health of our environments and ensure services are resilient to long-term challenges. We're maximising efficiencies to ensure we can deliver more at an affordable rate.

Our ambitions

Shorter-term

- Through robust challenge and use of markets we have identified £375 million of base efficiencies and £376 million of enhancement efficiencies.
- Improve asset management and embrace technology to proactively monitor, respond and invest in assets.
- Deliver 'value engineering' to ensure we get value for money from our supply chain.
- Leverage digital and automation technologies, to streamline our operation, such as through the delivery of dynamic network management to more proactively manage our assets.

Longer-term

- Through adaptive planning, we consider the most appropriate phasing of investment across our system over time, to ensure the burden is shared equitably between current and future customers.
- A robust and resilient financial position, and ability to raise efficient financing, is essential to ensure our ability to fund the long-term infrastructure projects needed to ensure great water now and in the future.

What value will this deliver?				
Health and wellbeing?	Economic equality ✓	Trust and transparency ✓	Reduce inequality	Economic growth
Quality of place	Biodiversity and ecosystem health	Air quality	Climate mitigation	Protecting the water environment

Strategic priority 5: Contribute to our communities

Our work places us at the heart of communities and we strive to engage fully with them and work in partnership. We generate value for communities across the North West through local investment, partnerships and educational programmes, as well as employee involvement.

Our ambitions

Shorter and longer-term

- Be visible in communities, demonstrating what we deliver for the North West, we're engaging with local communities across the five counties of the North West.
- Be open, regularly engaging with customers and stakeholders and committing to sharing data, such as real-time spill data which will be made available by the end of 2023.
- Manage our land responsibly, provide access to green and recreational spaces through our catchment land.
- Deliver social value and environmental value through our operation.
- Create partnerships to drive efficiency and deliver additional social and environmental value through these.
- Build on our track record of successful partnerships and being valued as a trusted partner.

What value will this deliver?

Health and wellbeing? ✓	Economic equality	Trust and transparency ✓	Reduce inequality	Economic growth
Quality of place ✓	Biodiversity and ecosystem health	Air quality	Climate mitigation	Protecting the water environment

Strategic priority 6: Provide a safe and great place to work

Our colleagues are the driving force behind what we deliver, and form the backbone of our organisation. Providing a safe and great place to work means putting health, safety and wellbeing above all else, attracting and developing a diverse group of talented people, and creating an inclusive workplace where people are empowered to contribute.

Our ambitions

Shorter and longer-term

- Build a zero harm culture and positively challenge each other to constantly improve our health, safety and wellbeing.
- Attract and nurture great talent, provide training and development opportunities to engage talent through our award winning apprenticeship and graduate programmes.
- Support and show leadership in driving new inclusivity initiatives such as 'Ambitious about Autism' and '10,000 Black Interns'.
- Build on the success of our apprentice programme and maintain 'good' status from Ofsted for our training academy.
- Create a diverse, inclusive and supportive working environment where all our colleagues feel valued and free to contribute to their full potential.
- Empower our people to contribute, encouraging diverse thought and ideas to deliver better outcomes.

What value will this deliver?

Health and wellbeing? ✓	Economic equality	Trust and transparency	Reduce inequality	Economic growth ✓
Quality of place	Biodiversity and ecosystem health	Air quality	Climate mitigation	Protecting the water environment

2.3 How we have shaped our strategy to the region we serve and the context in which we operate

2.3.1 We have worked closely with our stakeholders, communities and customers to develop a thorough understanding of the region we serve and the specific needs and priorities for the five counties of the North West. Our LTDS has been shaped by and adapted to the region's diverse needs. We aim to leverage our strengths and capabilities to address the specific challenges and opportunities that exist in the North West.

2.3.2 We have identified six key drivers for change in the North West (Figure 7). Each of the drivers for change and their impact in the North West are described in further detail below.

Figure 7: Key challenges for operating water and wastewater services in the North West

Climate impact on flood risk and storm overflows	Climate impact on water resources and water quality	Changes to land use and soil health	Demand from an increasing population	Demand from a growing regional economy

Climate impact on flood risk and storm overflows:

2.3.3 The North West experiences some of the wettest weather in England; with 40 per cent more urban rainfall than the industry average. The region has also experienced numerous extreme storms in recent years, causing major disruption to communities and infrastructure, including our own. These extreme events are likely to become more frequent in future.

2.3.4 Sewer flooding describes instances in which the sewer system becomes overwhelmed either due to a physical constraint in the system such as a blockage or due to excessive rainfall. In worst case scenarios this can cause the sewer system to back up and sewage to escape either externally into gardens and driveways, or internally, into homes. Storm overflows are relief points in sewer systems, built historically in areas where sewers drain both ‘foul sewage’ (waste from toilets, sinks etc.) and rainwater, such sewer systems are known as ‘combined sewers’, these should only operate during heavy rainfall when sewage is very dilute with the aim of preventing sewer flooding.

2.3.5 Higher than average rainfall and a higher prevalence of combined sewers (54% of our sewers are combined sewers compared to 33% across England) creates proportionately greater challenges for draining and treating wastewater. This contributes to the North West having higher levels of sewer flooding from weather-related events and more frequent activation of overflows. To ensure long-term resilience to the growing impacts of climate change on the sewer network, we need to plan beyond historic trends for an increase in the frequency and duration of storm events and consequently higher peak wastewater flows during a storm. This will lead to additional pressure on the capacity of wastewater systems.

2.3.6 We are making plans to manage additional rainfall at the same time as we progressively remove the ‘release valve’ afforded by storm overflows. This will be the largest environmental improvement programme we have ever undertaken. Further detail on how we are responding to tackle overflows and protect against climate change is set out in section 5 underpinned by our long-term strategy for wastewater.

Climate impact on water resources and water quality:

2.3.7 The relatively wet climate of the North West, its geology and its prevalence of upland areas, have shaped how we provide customers with water. Around 93% of our water sources are from surface water – lakes, reservoirs and rivers, with a much smaller proportion of water sourced from groundwater or aquifers. The North West has the highest ratio of surface water to groundwater in England, which means that our water sources react quickly to dry weather but recover rapidly in wet weather. We manage the largest number of reservoirs in the UK, as well as the largest amount of catchment land.

2.3.8 As the majority of North West water resources are sourced from upland surface waters, much of the water we provide is soft or moderately soft. Soft water contains lower mineral content and has lower alkalinity. In turn this makes it more corrosive, contributing to a higher risk of discolouration in drinking water. Surface water supplies are also prone to the naturally occurring compounds geosmin and 2-methylisoboreneol (2-MIB) that are produced by some algae and bacteria, and can lead to earthy or musty taste and odour in drinking water. Consequently, many North West water sources require more treatment and monitoring than other parts of the UK to ensure good taste, odour and appearance at the tap, and to avoid unplanned outages.

2.3.9 Many of our surface water resources are in upland, northern catchments whereas most of the large population centres are in the south of the region. We therefore use large aqueducts to transport raw water from the North to the South of the region. In AMP8 and beyond it will be critical that we maintain and manage these significant assets to ensure resilience for supplies over the long-term, including action to secure resilience to climate change.

2.3.10 In considering long-term climate change impacts on water resources, we are planning for warmer and drier weather that will lead to a potential reduction in reservoir inflows and volumes we can sustainably abstract in a drought. We also anticipate other impacts, including an increased risk of soil erosion and associated water quality issues linked to an increase in frequency of short, intense summer storms. Water quality and quantity are linked - poorer raw water quality can lead to reduced deployable output of water as the throughput of treatment processes may be reduced as they need to work harder.

2.3.11 We have been working with the Moors for the Future Partnership since its inception in 2003 to protect damaged blanket bog habitats across the Peak District and South Pennines. Moorland environments are vulnerable to wildfires, such as that on Darwen Moor in 2020, which impact on biodiversity, release tonnes of carbon into the atmosphere and impact raw water quality.

2.3.12 Erosion risk is also likely to increase as a result of climate change. Increased coastal and riparian erosion is expected to put more critical infrastructure at risk, such as pipes situated on eroding coastlines or riverbanks, as is flooding from rivers where this impacts on water and wastewater treatment works or other network assets.

2.3.13 We also operate along, and interact with, the North West coast from the Wirral peninsular in the South, to Gretna in the North. We have invested to support our coastal waters, which are made up of 29 designated bathing waters - as well as four inland bathing waters - and 26 designated shellfish waters. Protecting the quality of coastal waters is important for customers and the regional economy, providing social and economic value through tourism and recreational use. Delivering good quality coastal waters is important to support biodiversity and protect unique coastal ecosystems which are increasingly threatened by climate change.

Changes to land use and soil health:

2.3.14 We support farming through provision of sustainable organic nutrients in recycled treated biosolids, to almost 20,000 hectares of agricultural land each year. The majority of these biosolids are produced following treatment of wastewater in the urban areas of Greater Manchester and Merseyside where there is limited local agricultural landbank, increasing the distance we have to transport biosolids for recycling.

2.3.15 Demand for our biosolids product is shaped by the geography of the region. In the North West the agricultural landbank is characterised by small upland hill sheep farms in the North of the region, and larger dairy farms in Cheshire and the South. The North West landbank available for biosolids recycling is constrained by significant areas of protected landscapes, upland topography, wet weather and large volumes of competing livestock manure inputs. Only 50% of agricultural land is available for recycling, and only 16% is arable, which is the most flexible for biosolids recycling. As a result, we have to travel further to recycle to agricultural land than other water companies.

2.3.16 The relatively lower proportion of local landbank means our biosolids recycling routes are vulnerable to changes. New environmental regulations resulting from changes to the Farming Rules for Water are

expected to be clarified in 2025, the impact of these regulations could lead to unprecedented landbank restrictions in the future with insufficient lead times to implement changes.

Demand from an increasing population:

2.3.17 The North West is the UK's third most populous region. Over seven million people rely on United Utilities Water every day to provide great water and wastewater services. The population has grown by 8.6% since 2002 and around an additional one million people are forecast to live here by 2050, increasing demand for water services. Additional demands on water and wastewater infrastructure are expected to be concentrated in certain high growth areas, such as Manchester and Carlisle. Population growth and associated development of new or extended urban areas means water efficiency and rainwater management are key priorities during AMP8 and the longer term.

We recognise that affordability of all utility bills is a hugely important issue for customers, particularly against a background of rising household costs, economic uncertainty and a decrease in the percentage of people of working age. The degree of socio-economic challenges in the North West means the need for affordability support and priority services to help customers is greater than many other areas in England and Wales. 47% of the most deprived (top 1%) neighbourhoods in the country are in the North West. We support over 200,000 customers with payment of their water bill. Affordability will continue to be an important consideration in the long-term and is something we will regularly assess and discuss with customers as future plans develop.

Demand from a growing regional economy:

2.3.18 The North West has a rich history of industry and manufacturing, and is still one of the UK's biggest manufacturing hubs. There are 15,000 manufacturing businesses based in the region directly employing around 350,000 people. A significant proportion of manufacturing is for aerospace, pharmaceuticals and automotive industries. The water we provide and treat represent critical services that enable manufacturing industries to thrive and our plan ensures we can continue to support the economy and sustainable growth

2.3.19 Tourism plays a key role in the region's economy and culture. Between April and December 2021, the North West region saw the fourth highest number of day visits in England, over 13 million visits, accounting for some 13% of England's day visit market. Populations can increase by up to 68% during peak periods in some popular towns. This creates challenges in planning for water and wastewater services, with fluctuating demand for water and increases in discharges to our sewer network. Over the next 25 years we anticipate visits will continue to account for a significant amount of demand, particularly during peak periods.

2.3.20 Another challenge to the sewer network in the North West is the higher than national average density of food service establishments, with 118.2 per 100,000 population compared to an average of 90.8 per 100,000 population. This creates additional challenges with 'fats, oils and grease' entering the sewers which, over time, build up causing blockages and ultimately can cause sewer flooding or pollution incidents.

2.3.21 The North West is one of the two nationally fast tracked industrial clusters developing hydrogen generation, storage and distribution networks, and scoping is underway for tidal energy generation in the River Mersey and Liverpool Bay. Our long-term plans for water account for the additional water resource needs which are required to support hydrogen production in the North West. We have made provision for approximately 30Ml/d for hydrogen production in the Strategic Resource Zone supply demand balance in our WRMP and will continue to work with the hydrogen sector to support its development in the North West.

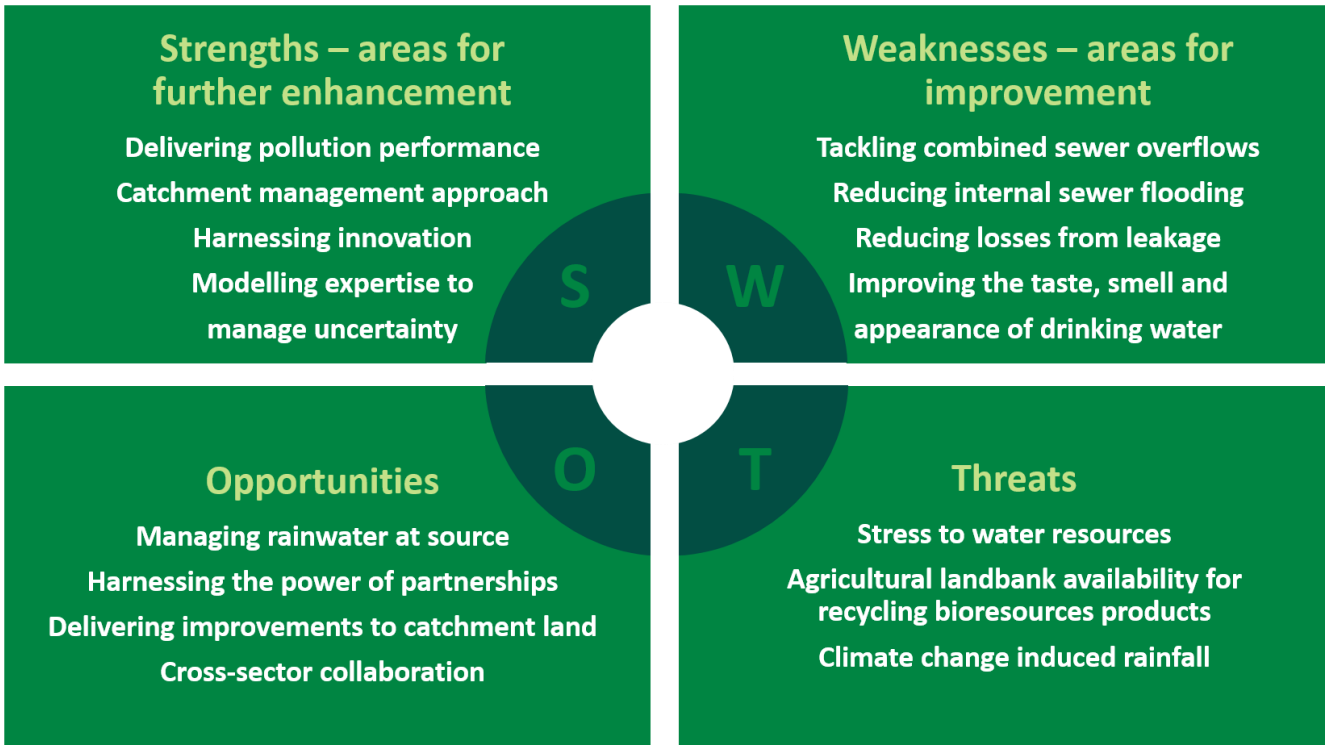
2.3.22 The agriculture, forestry and fishing sector makes up just over one per cent of regional jobs but has shaped the landscape of the region and is nationally significant in terms of production. The North West is home to 25 per cent of England's dairy farming with more than 480,000 cows with an additional three million sheep and over 420,000 beef cattle, making up 17 per cent of England's livestock production.

The sector is dependent on reliable water supplies as well as having a significant impact on water quality through land management practices.

2.4 SWOT analysis

2.4.1 Figure 8 summarises some of the threats and opportunities we face and some of the strengths we can harness and weaknesses we need to improve. We expand on these in the text that follows.

Figure 8: Summary of the key strengths and weaknesses and the threats and opportunities we face



2.4.2 Strengths: internal areas for ongoing performance enhancement include:

(i) **Delivering pollution performance:** we are one of only two water and sewerage companies to achieve better than the Environment Agency's pollution incident targets for 2022. We will continue to refine and implement our comprehensive pollution incident reduction plan to sustain our track record of zero serious pollution incidents, achieved in five of the last seven years. Our pollution incident reduction plan involves a range of actions such as improving wastewater treatment processes, adopting innovative technologies for monitoring and controlling wastewater systems, and, more broadly, partnering with stakeholders to promote sustainable catchment management practices.

(ii) **Catchment management approach:** we will continue to strengthen our catchment management practices to protect the long-term quality of water resources and manage rainwater at source. Building on our historic innovative catchment programmes: catchment systems thinking and place-based planning. We will prioritise the protection of sensitive ecosystems, work with land owners to promote sustainable land use practices, and invest in nature-based solution to manage flows upstream and improve water quality.

(iii) **Harnessing innovation:** our open innovation model has enabled us to positively disrupt the UK water sector; from our strategic innovation programmes and radical Innovation Labs to local incremental efforts, we routinely test and adopt new ideas, using a managed innovation investment portfolio to ensure that both short and long term interests are served. Key areas for development to meet long-term objectives include the use of artificial intelligence and machine learning. For example, through our dynamic network management approach we are implementing systems that use real-time data to identify and address issues in the sewer and

water network, optimising the efficiency of assets, and improving performance across key areas such as pollution, flooding and leakage.

(iv) **Modelling expertise to manage uncertainty**: over the past two decades we have developed significant coverage in both our hydraulic sewer and environmental water quality models as well as water resource modelling expertise. This means we are well placed to develop robust plans to manage future uncertainties such as climate change. This has already helped us to optimise the significant changes required under the storm overflow discharge reduction plan and helped us deliver a high quality Drainage and Wastewater Management Plan (DWMP) and Water Resources Management Plan (WRMP).

2.4.3 Weaknesses: areas for performance improvement include:

(i) **Tackling storm overflows**: the performance of storm overflows is a particular challenge in the North West due to high urban rainfall and high proportions of combined sewers. We're delivering a step change in AMP8 through our 'Better Rivers' strategy. Rainwater management, including the implementation of nature-based solutions such as sustainable drainage systems (SuDS), is a critical step on our long-term plan to reduce operation of combined sewer overflows and build resilience to climate change. In addition to investments to increase sewer capacity we will continue and expand investigations to understand the longer-term feasibility of disconnecting surface water from sewers and develop the partnerships needed for this work.

(ii) **Internal sewer flooding:** continuing to implement preventative operational measures such as regular cleaning and inspection of pipes will be critical over the long-term, as will investment to replace or reline assets to improve their asset health. Investigations to assess the condition of high risk and high consequence sewers are important component of the plan. Additionally, increasing public awareness of 'what not to flush/pour' and the risks associated with flushing items down the toilet to reduce blockages.

(iii) **Reducing losses from leakage:** a focus on reducing water loss across the water network by implementing our comprehensive leakage reduction and metering strategy. Our strategy for leakage reduction includes upgrading aging infrastructure, increasing leak detection through innovation and consequently targeting repair activities.

(iv) **Taste, smell and appearance:** we have made great strides with a 20 per cent improvement in contacts about the taste, smell and appearance over the last year. However this is an area of continued focus. Our water quality first programme will continue to drive improvements to taste, smell and appearance, along with catchment management activities to improve raw water quality.

2.4.4 Opportunities: external factors we can harness or capitalise upon to further our performance include:

(i) **Managing rainwater at source:** in order to build long-term resilience to climate change we are harnessing opportunities to manage rainwater at source, reducing the amount of rainwater entering the sewer system, for example through SUDs and surface water disconnection, to benefit both flooding and combined sewer overflows particularly in areas prone to hydraulic flooding.

(ii) **Delivering improvements to catchment land:** the resilience and health of catchments in the North West is critical to the delivery of water services. However, catchments also offer much more in services to society; they hold water and slow the flow to reduce flooding, provide land for access and recreation as well as benefits to human health, they intercept pollutants in the air, land and water environments. Large areas of catchment in the North West are woodland and peatland carbon sinks, where we need to work collaboratively with other land owners and stakeholders to protect and improve.

(iii) **Harnessing the power of partnerships:** one of our most significant opportunities is to collaborate with our stakeholders to deliver more than we could do in isolation. Our partnership working delivers a variety of benefits:

a. Attracting third party investment in the North West;

b. Delivering green jobs;

c. Offering social value through volunteer and community led activities; and

d. Delivering natural capital and biodiversity benefit through peatland restoration.

(iv) **Cross-sector collaboration:** we collaborate with other water companies and other sectors to test and harness the latest technologies. We participate in research and actively engage with regulators and the rest of the industry, so that we stay up to date with the latest knowledge and are ready to act to continue supplying safe and wholesome drinking water and resilient wastewater services both now and in the future.

2.4.5 Threats: external factors we need to manage:

(i) **Stress to water resources:** there are increasing pressures on North West water resources, hotter drier summers as a result of climate change, additional risks to taste, smell and appearance driven by storm events and algal blooms and increasing demand from population growth and national water resource needs.

(ii) **Climate change impacts, particularly more extreme rainfall:** more frequent extreme rainfall associated with climate change, particularly in urban areas will put additional pressure on the sewer system creating further challenges for sewer flooding and storm overflows.

(iii) **Agricultural land availability:** a combination of factors including increasing regulation, emerging contaminants, societal expectations, policies to further protect sensitive sites, and climate change threaten land availability for biosolids recycling. The cumulative impact of these constraints creates a risk to landbank nationally and the need to provide alternative treatment and disposal outlets.

2.5 Performance outcomes over the next 25 years

Performance forecasts

2.5.1 Our performance forecasts for common performance commitments, aligned to LS1 and LS2, are presented in Table 1. They are stretching but achievable, and align to both our long-term vision and customers' expectations. They meet statutory targets and existing commitments UUW has made, and they are aligned with the outcomes of other planning frameworks.

2.5.2 Our performance forecasts will be delivered through a combination of base expenditure to operate and maintain existing capacities, and enhancement expenditure where we are improving the capacity of assets or services.

Table 1: Our long term ambitions for common performance commitments, aligned to LS1 and LS2

Strategic theme	Performance commitment	Unit	AMP7 (2024-25)	AMP8 (2029-30)	Long –term base forecast (2049-50)	Long-term total forecast (2049-50)
Deliver great service	Water supply interruptions	HH:MM:SS per property per year	00:05:00	00:04:22	00:02:58	00:01:30
Deliver great service	Customer contacts about water quality	Contacts per 1,000 population equivalent	1.08	0.8	0.57	0.4
Deliver great service	Unplanned outage	Percentage of the peak week production capacity	2.34	0.41	0.21	0.21
Deliver great service	Mains repairs	Number per 1,000km mains	106.5	106.4	89.3	89.3
Create a greener future	Business demand	% reduction	2.5	8.3	8.6	14.1
Create a greener future	Leakage	% reduction	10.8	23.8	2.0	49.4
Create a greener future	Per capita consumption	% reduction	5.1	9.7	11.2	24.7
Deliver great service	Internal sewer flooding	Number per 10,000 sewer connections	2.88	1.96	1.88	1.43
Deliver great service	External sewer flooding	Number per 10,000 sewer connections	15.66	13.65	11.14	10.90
Improve our rivers	River water quality	% reduction of phosphorus per person from annual average of 2020-22	3.65	21.25	n/a	88.74
Improve our rivers Contribute to communities	Bathing water quality	% score	61.8	63.0	n/a	66.4
Improve our rivers Create a greener future	Biodiversity	Biodiversity units per 100km2 for which company provides monopoly services	0.00	0.64	0	35.82
Deliver great service	Sewer collapses	Number per 1,000 km sewer	13.07	12.41	11.32	11.32
Improve our rivers	Total pollution incidents	Number per 10,000km wastewater network	16.03	12.02	10.70	10.70
Improve our rivers	Serious pollution incidents	Number of incidents	0.00	0.00	0.00	0.00
Improve our rivers	Storm overflows	Average spills per overflow	29.21	19.6	29.26	8.5
Create a greener future	Operational GHG emissions (water)	Tonnes CO_2e	-	127,652.27	142,260.40	107,590.03
Create a greener future	Operational GHG emissions (wastewater)	Tonnes CO_2e	-	291,257.86	291,495.21	370,482.75

Statutory requirements and industry commitments:

2.5.3 In developing our long-term plans customers agree it is vital that we meet our statutory requirements. Some of our key statutory requirements are outlined below:

Water Industry Act 1991 (as amended)

- To provide a sufficient supply of wholesome water;
- To effectually remove and treat wastewater;
- To maintain a charges scheme;
- To ensure that an area is and continues to be effectually drained;
- To undertake work on its assets in accordance with its powers; and,
- To provide and maintain information.

2.5.4 In addition to the water industry act there are many pieces of legislation which influence our plans for the future, these include but are not limited to:

The Environment Act 2021

- Prepare, publish and maintain a drainage and wastewater management plan;
- Ensure water resource and drought plans are in place and develop joint plans where appropriate;
- Maintain a Storm Overflow Discharge Reduction Plan – setting out our plan to achieve:
  - No more than an average of 10 spills per year by 2050;
  - No adverse ecological impact from storm overflows at high priority sites by 2045 and all sites by 2050; and,
  - To deliver no harm from storm overflows in bathing waters by 2035.

The Water Resources Act 1991

- To carry out water resources management planning; and
- Outlining statutory requirements for abstraction and impounding.

The Climate Change Act 2008

- To reach net zero greenhouse gas emissions by 2050 in line with the UK target.

The Flood and Water Management Act 2010

- To contribute to flood risk management including management of river and coastal erosion;
- To contribute to multi-agency regional flood and coastal committees;
- To ensure the resilience of water supply and wastewater services during extreme events; and,
- Adopt sustainable water management practices.

3. How customers and stakeholders have shaped our LTDS

Summary

- We have undertaken robust research with both current and future customers as well as stakeholders to challenge the material issues included in our LTDS. Our research is high quality and meets the standards prescribed by Ofwat's customer engagement positioning paper.
- Customers and stakeholders have shaped our LTDS, specifically our long-term ambitions and the sequencing of options in our long-term strategy.
- Our research is representative of the North West customer base. Specific engagement has been tailored to ensure challenge from future customers as well as vulnerable and hard to reach customers is captured.

3.1 Overview

3.1.1 We regularly engage with customers and stakeholders and have shaped our LTDS with a wealth of insight on long-term issues, particularly from engagement on our statutory planning frameworks (the WRMP and the DWMP). Additionally, key material issues have been discussed in depth with customers, to gain robust insight and challenge our planned investment. This includes in relation to storm overflows, greenhouse gas emissions and management of bioresources where regulatory change could lead to significant investment needs. Figure 9 outlines the range of customer engagement projects which have fed into the LTDS.

Figure 9: Summary of the customer insight which has informed our LTDS

3.2 How customers shaped our LTDS

3.2.1 Our engagement has focused on areas in which customer views can have a meaningful impact on our plans and strategies. Consequently, the majority of our customer research is centred around areas of discretionary spend or the decisions we can make within statutory programmes. Non-discretionary spend associated with statutory drivers makes up a significant proportion of our future planned investment.

3.2.2 We recognise that identifying customers' views on the long-term future is more difficult to achieve than eliciting views on the here and now. While current customers are able to articulate their current needs, wants and concerns it is often difficult for individuals to forecast how their own lives may change in the future. In addition, the mix of the UUW customer base will change over time, with today's young people becoming future bill payers. In response we developed a three-pronged approach to forecasting how customers' views may change overtime to feed into the LTDS.

Phase 1: Research synthesis

3.2.3 Continuous research and engagement programmes mean we have significant amounts of customer feedback on a range of priority areas. This allows us to track customer priorities over time and compare this with revealed preference data. We recognised this data is invaluable in feeding into our long-term planning and we set out to synthesise and triangulate data from various sources to:

- Identify how customer priorities have changed over time and what lessons can be learnt from this.

- Understand how macro events and interruptions impact customers' priorities and what this tells us about similar events happening in the future.
- Map the insight to different scenarios to understand how priorities might change in the future.

3.2.4 Using an independent consultancy to synthesise the insight and following the best practise principles laid out in the CCW/SIA report, we used varied and continuous sources of insight such as UUW and external research studies, operational data and social media volume data were used to inform our synthesis.

3.2.5 The analysis allowed us to understand that individual events do not tend to permanently shift overall customer priorities, but cumulative events (e.g. storm overflows) and macro trends (e.g. cost-of-living challenges and environmental focus) do move them over time. Affordability is the current number one driver given cost-of-living challenges, but the independent synthesis allows us to indicatively predict which priorities are likely to remain priorities in the future, based on their performance in the past. For example, environmental issues are likely to rise to the fore by 2050, either as a reaction to negative climate events or after global efforts to tackle adverse effects in the intervening decades. Specifically, biodiversity, storm overflows, carbon and bathing/river water quality will likely grow in priority due to cumulative events and macro trends.

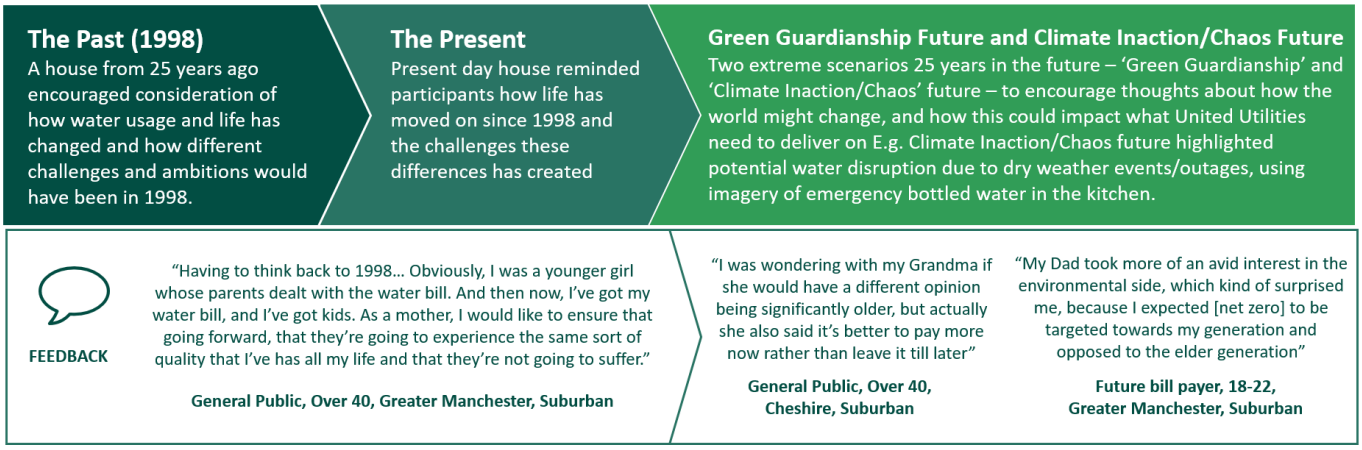
3.2.6 These findings support the improvements in resilience and asset health, pollution, leakage and environmental protection in our AMP8 plan and enable us to prioritise these areas in both the short and long-term. Our AMP8 plan is the first step to achieving long-term improvements. This research supports our prioritisation of environmental investment including nature-based solutions, rainwater management, and hybrid and partnership working. This synthesis allowed us to understand how priorities over time could evolve in the future and we were able to use this insight to create ambitions for our long-term delivery strategy, which were tested in Phase 2 of our research.

Phase 2: Immersive ambitions testing

3.2.7 We commissioned an innovative immersive research project, which used Artificial Intelligence (AI) to immerse customers in possible future scenarios (Figure 10). Projective techniques were used to encourage customers to think of changes to the world over the last 25 years and then using AI, project them into possible benign and adverse futures. Using AI technology helped customers consider the scale of change in day-to-day life over the last 25 years and apply this thinking forwards to separate from the concerns of today and consider ambitions over the long-term.

3.2.8 Throughout the research the independent research agency probed to explore key issues in the context of intergenerational fairness. This allowed us to gain greater depth of insight to understand views and to explore how, if at all, opinions change after the long-term AI futures were introduced. A post-task was conducted so participants could talk to a family or friend of a different generation who had not been part of the research, and discuss their views. This led to rich follow-up interviews and nuanced conversation around intergenerational fairness, giving us confidence in this approach and the results.

Figure 10: AI technology was used to generate images to immerse customers in the past, present and two potential future scenarios



Phase 3: Synthesis and triangulation

3.2.9 In phase 3, we collated customer insight on our proposed long-term strategies from a number of engagement projects, this informed how we should sequence key investments in our long-term plan. We used the customer insight gained to define a series of principles we have used to prioritise and sequence interventions in our LTDS.

3.2.10 These learnings triangulated alongside other relevant research insights, also taking into account factors such as deliverability, cost and risk. Table 2 illustrates how each research piece informed our long-term delivery strategy and its component parts, such as water resources, wastewater and bioresources.

Table 2: Long-term delivery strategy research drives impact

Customer priorities tesearch and long-term synthesis Ofwat/ CCW customer preferences research	
Key findings	**Impact**
Highlighted customer priorities over time. Allowed us to develop indicative projections of future priorities, considering how priorities might change in different future scenarios. Environmental issues are likely to be at the forefront for customers over the long-term. Minimum service levels will consistently stay high priority. Leakage and asset health are also likely to increase in priority over time as economic and affordability concerns lessen.	Supports the investment in resilience and asset health, pollution, leakage and environmental protection in our AMP8 plan and enables us to prioritise these in the short and long-term. Supports our environmental prioritisation including nature-based solutions, rainwater management and hybrid and partnership working. The synthesis enabled us to shape our long-term ambitions to test further with customers, highlighting further areas of insight for Phase 2.
WRMP and DWMP research packages	
Key findings	**Impact**
Strong endorsement of measures that encourage more responsible behaviour at a household level for wastewater. Highest ranked initiatives were water efficiency, customer engagement and using technology to control sewers and monitor for problems. For solutions that provide water services to customers, prioritised initiatives included leakage, promoting water efficiency and reusing waters. Preference scores for our proposed plan was strong across all household, non-household and future bill payer segments (at least 63%).	We used this insight to select the key investments in our long-term plans. These are reflected in the adaptive pathways in our LTDS where we have used options preferred by customers wherever possible. Where less preferred options are required to deliver our ambition, we have sequenced our solutions to focus on options customers prioritised in the shorter term. This gives us time to explore alternative solutions and new technologies before committing to future schemes.

Bioresources research	
Key findings	**Impact**
Customers were concerned about river water quality, environment and air quality and microplastics. They preferred advanced anaerobic digestion and believe we should be investing in established technologies and exploring new technologies simultaneously to keep one eye on the future. Advance Anaerobic Digestion (AAD) with heat source was their most preferred treatment option for us to invest in.	Customers' preference for AAD, and the movements to this being identified as low regrets in our scenario analysis, means we plan to increase AAD sludge treatment to reduce operational carbon emissions. Customers were highly concerned about river water quality, the environment and air quality. AAD treatment will create a high-quality, enhanced biosolids product with low microbial contamination and reduce water quality risks. Customer concern around micro plastics influenced decision making to include enhanced sludge screening to reduce rag, grit, plastics and other foreign material within biosolids being spread to land in the short-term and explore further options in the long-term.

3.3 How stakeholders have shaped our LTDS

3.3.1 We work closely with a range of stakeholder groups throughout the development and delivery of investment programmes and on day to day operational issues. Stakeholder insight has shaped our long-term strategy.

Understanding stakeholder ambitions across the North West

3.3.2 Many North West groups we work with produce plans and strategies for the short, medium or long-term. Stakeholder priorities and aspirations for the North West have shaped our long-term ambitions and priorities. Analysis of local stakeholder plans for the future identified three themes: the economy, people, and the environment.

The economy

3.3.3 There is a significant focus on economic recovery after the impact of Covid-19, building an economy where people can thrive without inequality and reducing the number of people facing economic hardship. Much of this is supported by an increase in connectivity to allow residents more access to employment opportunities. Infrastructure to support a growing economy is key, both an increase in transport links, and an increase in digital connectivity to support access to remote and hybrid jobs. Combined, economic ambitions aim to place the North West as a nationally recognised economy.

People

3.3.4 Delivering improvements in quality of life is a recurring theme across plans. Delivered through improvements to health, wellbeing and access to employment. Combined with economic ambitions, a shift towards creating more employment opportunities across the North West will play a key role in improving socio-economic conditions, and support in reducing inequalities. Underpinning health, wellbeing and employment is also the ambition to improve education at all levels. This can be both in an early years setting when focusing on the education of future generations, and also education of the current workforce, by creating access to upskilling and employment opportunities.

The environment

3.3.5 The environment is a key priority amongst Local Authorities across the North West, with the shared ambition of working towards a cleaner and more sustainable region. There will be an increased drive towards sustainable practices and carbon net zero. Different Local Authority plans set out different approaches to tackle environmental priorities: Greater Manchester Combined Authority (GMCA) identify priorities in investment in green transport and sustainable housing; Cumbria have identified priorities in investment in natural resources supporting sustainable energy generation. All North West local authorities share the ambition of increasing access to green spaces recognising the intrinsic link between the natural environment, health and wellbeing.

Further stakeholder engagement shaped our ambitions

3.3.6 We engaged stakeholders on our long-term ambitions for the future, testing their thoughts on our proposed future ambitions, and how these ambitions should be prioritised in PR24 and the long-term. We explored stakeholder priorities through a variety of stakeholder engagement events, during which future priorities for their organisations and sectors were considered as well as for the water sector. We asked attendees to consider the biggest challenges facing the sector today and how these may change over the next 25 years. Through this engagement with engaged with a range of stakeholders including local authorities, NGO's, businesses, academia and regulatory organisations. Through 65 respondents we identified 18 themes, the five most important challenges highlighted for the North West were:

(1) Supporting household bills;

(2) Resilience to and mitigation of climate change;

(3) Access to funding for investment in the environment;

(4) Engaging with the public to drive actions; and,

(5) Resource efficiency.

3.3.7 In addition to this ongoing engagement, we worked with a research and engagement consultant to create a bespoke digital platform to engage directly with stakeholders to shape and challenge the LTDS. The digital and online nature of the platform made our engagement accessible to stakeholders across the whole region, removing barriers to engagement of travel and time. The platform included a virtual consultation space to immerse stakeholders, and capabilities such as mapping to allow identification of place based stakeholder priorities.

Engaging with stakeholders on our long-term strategies

3.3.8 We have engaged extensively with our stakeholders to understand their perspectives on how we should deliver our water and wastewater services over the long-term and we have used this insight to help us define the long-term vision. Our stakeholder engagement has also enabled us to develop a series of partnership delivery opportunities and associated pipeline which we will continue to grow and seek to implement wherever the associated schemes deliver best value.

Engagement shaped our long-term plan for wastewater

3.3.9 Throughout the development of DWMP, we engaged with a wide range of stakeholders to inform our objectives and shape the selection and sequencing of options in our strategy (Figure 11 and Figure 12). The first stage was to understand long-term ambitions of organisations across the North West and share initial wastewater ambitions. We then worked with stakeholders to develop a set of long-term objectives and targets in strategic planning group workshops. The workshops were facilitated by independent consultants, allowing stakeholders to provide honest feedback. Following the sessions, we further developed our long-term objectives, taking on board stakeholder feedback. Key changes included making the pollution planning objective more ambitious, ensuring that catchment offsetting was explored as part of options development, and making the flooding planning objectives more ambitious.

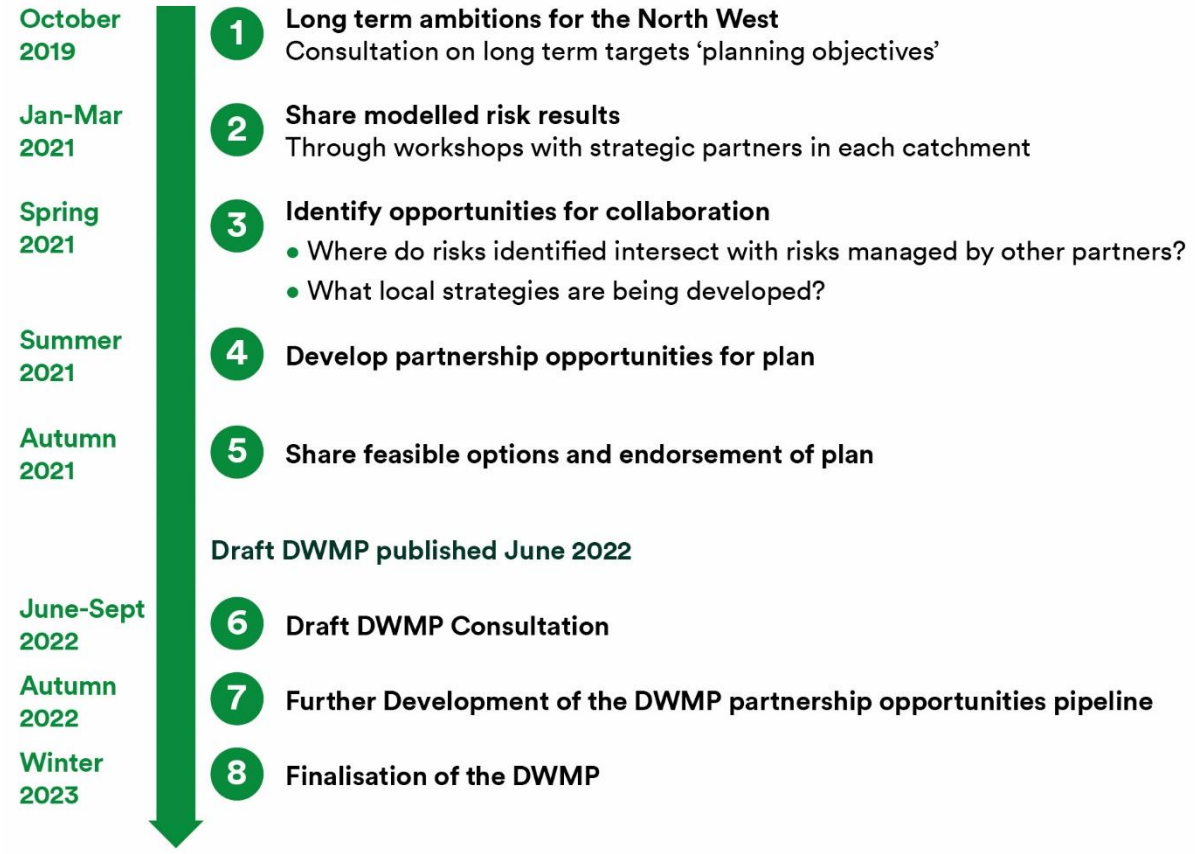
3.3.10 Following stage 2 and 3 engagement (see Figure 12), potential partnership opportunities were mapped and associated with mitigating specific risks. These were also screened depending on the opportunities timescales, proximity to UUW assets and the level of detail. This refined list informed our early partnership opportunity pipeline which has been further developed for AMP8.

3.3.11 The final stage of engagement prior to draft DWMP was on the approach to selecting preferred options. An online survey was used to invite Strategic Planning Group members to feedback on their preferred approach for selecting preferred options. The survey showed that survey respondents preferred the options hierarchy approach. This was also supported by the Your Voice Environmental and Social Capital Sub-group (ESCG) and was ultimately used to select preferred options. Feedback received from

stakeholders in organisations such as the Environment Agency, Rivers Trust and County Councils helped to identify the most appropriate approach to selecting preferred options.

Figure 11: Scale of engagement activities in developing the DWMP

Figure 12 timeline of stakeholder engagement in developing the DWMP



Engagement shaped our long-term plan for water

3.3.12 Our approach to developing our WRMP was also heavily influenced by engagement with our stakeholders. We set out to conduct a large and varied set of stakeholder engagement, and started these activities much earlier in the planning process than in previous planning rounds to maximise the benefit of this dialogue and to ensure we were able to take stakeholder feedback fully on-board. For example, we commenced stakeholder pre-consultation process in autumn 2016. By commencing our research activities earlier, it helped ensure that we were engaging early, engaging widely and using different or innovative approaches to prioritise the major issues affecting stakeholders within the North West when developing the plan.

3.3.13 During our pre-consultation, letters and accompanying briefing notes were sent to statutory and non-statutory consultees and all known stakeholders. Around the same time, we also initiated market engagement activities on potential third party options, including a market engagement event. The briefing notes were Crystal Mark accredited and focused on the Defra guiding principles and the main themes of our plan. Ofwat, the Environment Agency and Natural Resources Wales all received a more detailed methodology statement as required by the planning guidelines; this included cumulated

feedback from previous discussions on our approach. We then held four events across the region in combination with our Drought Plan consultation.

3.3.14 Pre-consultation is a formal part of the WRMP planning process, however, we have also undertaken a range of other stakeholder engagement activities including Technical Stakeholder Group events. The first Technical Stakeholder Group event was held at our offices in March 2017. This included describing our approach to plan development and the key themes and influences on the plan. The second half of the day included two interactive sessions. The first session was on option preferences and the second on metrics/measures for 'extended methods'. Stakeholders gave different options rankings, enabling us to derive the ranking presented in Figure 13. This ranking was used in the option selection process for the WRMP and, in turn, LTDS. A second Technical Stakeholder Group event was held to further explore stakeholder option preferences and elicit their views on the acceptability of different service levels.

Figure 13 stakeholder ranking of water resources options

3.4 How we adjusted our plans to meet customer and stakeholder expectations

3.4.1 Our approaches to testing are robust and give us confidence that we have obtained meaningful views on long-term issues from customers:

- We have adjusted our long-term plans to meet customer and stakeholder expectations informing our long-term ambitions and strategy;
- We recognise current affordability pressures and therefore have placed even more emphasis on efficiency, innovation and partnerships to keep short-term bill increases as low as possible, we have identified significant opportunities for demand reduction and surface water removal;
- We recognise rising environmental expectations from customers, stakeholders and regulators which will become even stronger in the future, this has resulted in significant investment in the environment in AMP8 and the long-term and has informed our escalating approach to net zero;
- We have considered intergenerational fairness and the impact of phasing of options on current and future bill payers, to create stretching but achievable long-term ambitions; and,
- Regional and local plans and priorities have informed our long-term ambitions – supporting green growth ambitions, infrastructure transformation and improving health, wellbeing and access to employment.

4. Our long-term strategy for water

Key points

- **Invest in assets fit for the future:** Our long-term plan for water outlines around £5.6 billion of enhancement expenditure over the next 25 years to meet our ambitions for water.
- **Safeguarding water resources:** Our plan aims to achieve ambitious targets to halve the level of leakage, reduce non-household demand and reduce water use per person per day to 110 litres by 2050. The reduction in demand for water will contribute to managing supply resilience to climate change and supports our commitment to reduce greenhouse gas (GHG) emissions.
- **Improving water quality:** Our plan delivers on our commitment of excellent water quality. Our proposed long-term investment ensures that drinking water quality will be resilient to challenges, such as climate change, asset health and potential risks from emerging contaminants and associated new water quality standards. We aim to reduce water quality contacts by 63% by 2050.
- **Supporting national needs:** Our plan supports national water supply resilience by developing options which allow us to transfer large volumes of water outside the region during times of need elsewhere in the country.
- **Adapting to the future:** We have tested a range of scenarios to ensure that our plan can adapt to future uncertainty in the face of climate change, population growth and abstraction changes, as well as understanding the opportunities offered by innovation and technology.
- **A low regrets plan:** Our proposed best value plan for water is formed of low regrets solutions which are flexible in addressing uncertain futures. They enable us to deliver our ambition of providing broad benefits to customers in the North West as well as supporting national water resource needs and delivering environmental improvements.

4.1 An overview of our long-term plan for water

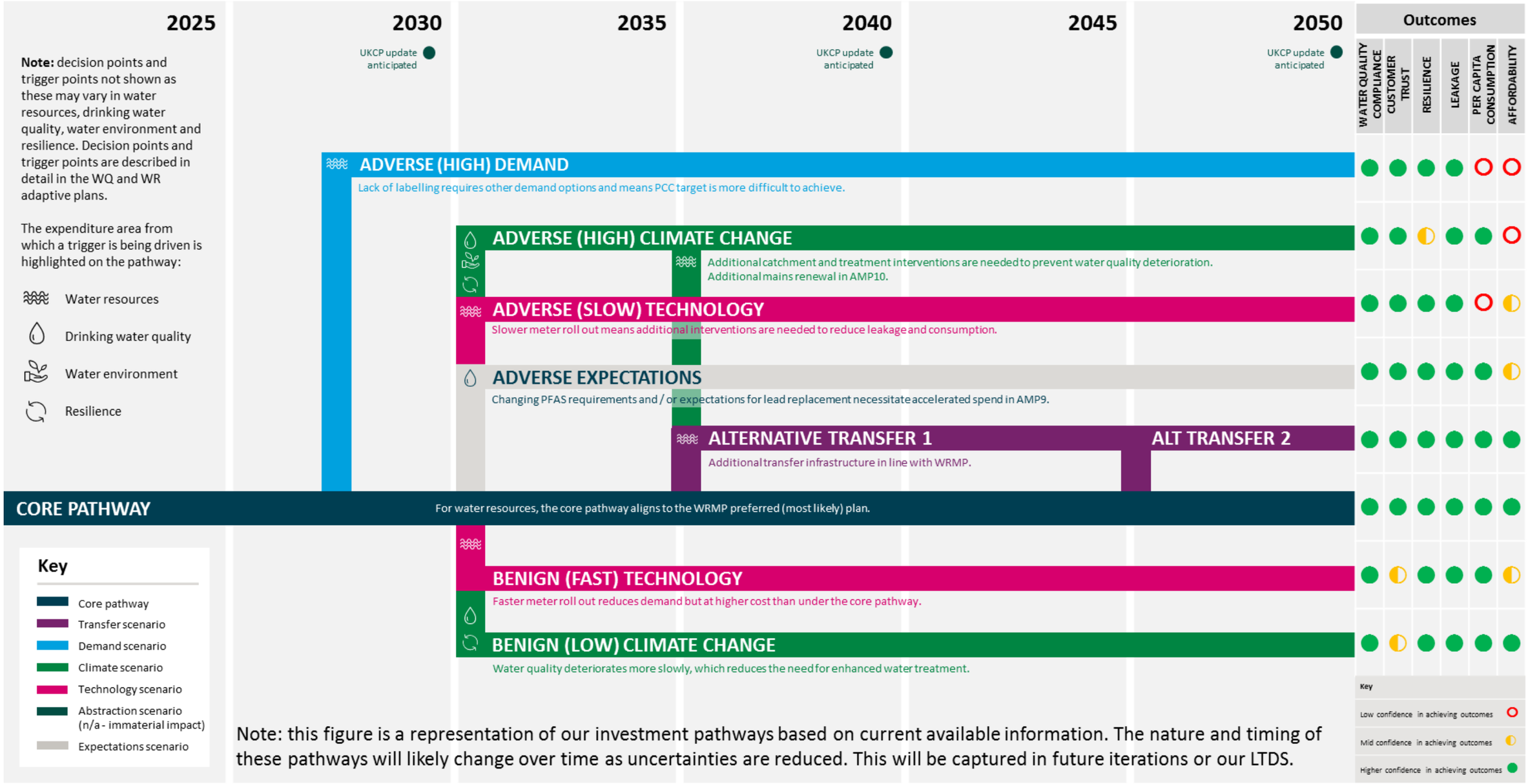
4.1.1 Our adaptive plan for water enables us to deliver our ambition for the North West under plausible extremes of climate change, water demand, abstraction reductions, technological development, water transfers and changing customer and stakeholder expectations.

4.1.2 Our adaptive plan is comprised of a core pathway of low regrets investment and expenditure that keeps future options open, and alternative pathways containing investments required under more extreme future scenarios. Figure 15 highlights some of the investment and outcomes our core pathway delivers. ***Figure 14*** shows under what circumstances we may need alternative pathways to help deliver our ambition.

4.1.3 Our alternative pathways are described by clear decision and trigger points which we will proactively monitor. Alternative pathways may be required at different points in time. For example, we expect an adverse climate scenario could require an alternative pathway within the next decade.

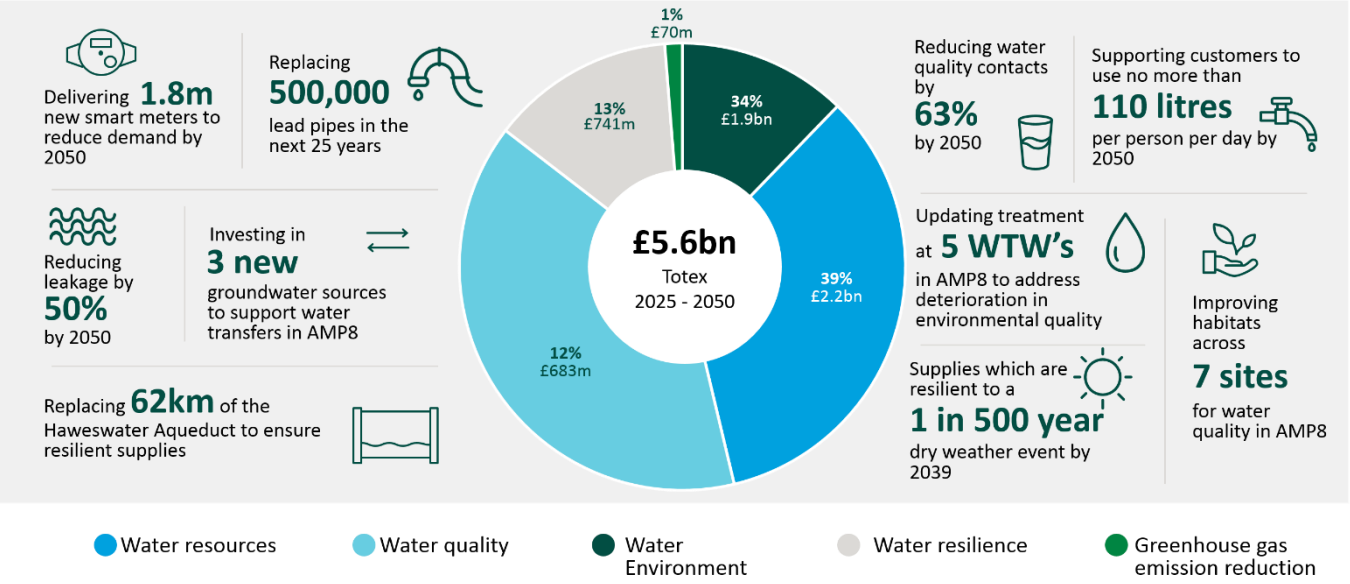
4.1.4 In many cases, alignment of trigger and decision points with regulatory cycles is important to ensure efficiency and best value for customers. For example, a change in supply pipe ownership to aid lead removal at the beginning of an AMP will allow appropriate funding and processes to be put in place.

Figure 14: Our singular adaptive plan for water, combining our Revised Draft Water Resources Management Plan (WRMP) and Drinking Water Quality Plan (DWQP)



Note: this figure is a representation of our investment pathways based on current available information. The nature and timing of these pathways will likely change over time as uncertainties are reduced. This will be captured in future iterations or our LTDS.

Figure 15 A summary of our total enhancement expenditure and the outcomes delivered through our long-term plan for water



4.2 Our ambition for water services in the North West

4.2.1 Our ambitions for our water services align to our company long-term vision, outlined in section 2. They have been developed by working with customers and stakeholders, addressing statutory requirements and reflecting guidance from regulators.

4.2.2 Providing great water includes the provision of a reliable and secure water supply, which is high quality and supports a healthy natural environment. Our ambitions for water are detailed in Table 3, these are divided into:

- Water supply, reflecting the Water Resources Management Plan (WRMP);
- Water quality, reflecting the Drinking Water Quality Plan (DWQP); and,
- Water environment, reflecting activities included in the Water Industry National Environment Programme (WINEP).

Table 3: Our ambitions across the water strategy

Ambition	Detail
Water supply	
Ensure that we have a resilient water service now, and in the future (to 2050 and beyond)	This means continuing to provide an excellent service under a range of potential future scenarios, reflecting customer support for a reduced annual chance of temporary use bans and drought orders / permits. **AMP8:** Through intervention for demand reduction, we aim to reduce the frequency of temporary use bans from 1 in 20 years (5 per cent annual chance) to 1 in 40 years (2.5 per cent annual chance) by 2031.
Embrace government demand management and leakage policies	We are planning to achieve a 50 per cent reduction in leakage (from a baseline of 2017/18 reported values) and reduce per capita consumption (PCC) to 110 litres per person per day by 2050, in line with the Government's Environmental Improvement Plan 2023. These activities play a key role in reducing overall demand thus ensuring a sustainable supply of water across the North West. **AMP8:** in AMP8 we are investing to replace 641km of mains contributing to a 24 per cent reduction in leakage from 2019-20. Additionally, investment in customer engagement and metering will support us to achieve 129 l/p/d per capita consumption.

Ambition	Detail
Support the national effort through water transfers, regional planning and the RAPID gated process	Our plans will be agile to future water transfer requirements, while providing a net positive impact to the North West. We aim to provide up to 180Ml/d depending on Severn Trent and Water Resources South East's requirements. **AMP8:** We plan to deliver three supply side options by 2031 to enable a 25Ml/d transfer to Severn Trent Water for the core pathway transfer requirements. The construction will take place over AMP8.
Water quality	
Provide services that are resilient to challenges, such as, climate change, asset health and potential risks from emerging contaminants	Our fundamental responsibility is to provide a wholesome supply of water to customers. Therefore we will continually focus on minimising risk and delivering 100% compliance (as captured in the Compliance Risk Index (CRI)). We will use catchment management to protect, stabilise and improve raw water quality. Our long-term ambition is that all our drinking water catchments (surface and groundwater) have a safeguard zone action plan in the Environment Agency River Basin Management Plan by 2040. We will take a long-term view to investing in treatment and distribution assets. Decisions will be guided by our company-wide assessment of climate-related risks, appraisal of system risks (e.g. single points of failure, power loss) and consideration of emerging concerns such as per- and polyfluoroalkyl substances (PFAS). **AMP8:** We are investing in a second phase of schemes to make drinking water catchments more resilient to extreme weather - mitigating the impact of climate change. Planning upgrades at five water treatment works – managing deterioration in raw water. Replacing tunnel sections of the Haweswater Aqueduct – single points of failure that supply 2.5 million people.
Ensure customers are confident and trusting of their drinking water quality	By 2050 we aim to reduce water quality contacts by 63 per cent. This will be delivered through: • Our water quality first approach putting quality at the centre of decision making and our target that 80 per cent of maintenance is proactive, recognising that this reduces risk. • A risk based mains flushing and renewal strategy that targets areas with high contact rates and considers water quality, leakage and bursts in the round. • Continuing to support and deploy world leading research into the mechanisms and management of processes affecting the taste, smell and appearance of water, including organic compounds in reservoirs and discolouration within distribution systems. Our long-term ambition is to have a lead free network by 2070 to remove the associated health risks. **AMP8:** We aim to reduce water quality contacts by 25.9 per cent from 2025 to 2030, and, subject to enhancement funding, plan to replace up to 30,000 lead pipes during AMP8.
Water environment	
Protect the environment, including delivery of our 'environmental destination'	To support the natural environment, we're planning for 77,000 Ml/year of licence reduction by 2050 from our borehole sources to meet the Environmental Destination targets (equivalent of an overall licence reduction of 40 per cent at these sources) set by the Environment Agency. Environment Destination is a new area of work for WRMP24. It plans for the potential long-term environmental deterioration risk from our abstraction licences due to climate change and also looks to identify where environmental improvements can be made. **AMP8:** Over the next five year period we will carry out 18 investigations to understand the impacts of our abstraction on the environment and plan for appropriate mitigating action to take place in AMP9 and beyond.

Ambition	Detail
We will take a Catchment Systems Thinking approach to protect and enhance the environment	We will continue to influence the management of catchment land to protect and improve raw water quality and quantity. We will take a Catchment Systems Thinking (CaST) approach which considers what is best for the environment, customers and communities by integrating risks and driving multiple natural capital benefits, developing better ways of working through co-governance, collaboration and partnerships. **AMP8:** 4,764 hectares of peatland restored through the WINEP.

Challenges and opportunities

4.2.3 The delivery of the water service we provide is intrinsically linked to the natural and human environments around us. The pressures of population growth, climate change and environmental considerations mean that it is now more important than ever to plan how we will manage water into the future. With careful planning and an understanding of the unique characteristics of the North West, we can continue to deliver a reliable supply of wholesome water for customers in the future, while protecting and enhancing the environment. The challenges and uncertainties in the region are outlined below.

Water quality

4.2.4 We own over 45,000 hectares of catchment land, of which 84 per cent falls within a designated landscape and 41 per cent of our land holding is a Site of Special Scientific Interest (SSSI). Industry leading catchment management enables us to deliver best value for customers. Prior to catchment work starting in 2005 at one of our water treatment works, raw water colour was forecast to exceed the design envelope in 2011. Peatland restoration slowed this trend and we were able to defer treatment upgrades to our AMP8 plan. Likewise, due to successful catchment management, the option to enhance processes at our largest treatment works is now scheduled for AMP9, not AMP6 as originally forecast.

4.2.5 Catchment interventions create opportunities to leverage external funding to benefit water quality and the environment at the same time. Our SCaMP project (2005-2015) secured £4 million in grants for farmers to manage land better, in AMP6 a share of £15 million through the Moors for the Future Partnership and, in AMP7, £2.5 million Nature for Climate grant funding to restore peatland.

4.2.6 Our water supply relies predominantly on surface water sources, with 93 per cent originating from rivers and reservoirs, with the remainder from groundwater. This presents a challenge with water quality due to higher concentrations of manganese, which is linked to discoloured water, and lower alkalinity. Low alkalinity water accelerates the corrosion of metallic water mains, further increasing the risk of discolouration, and lead service pipes, thereby necessitating a higher dose of phosphate to manage lead risk.

4.2.7 The 2022 DWI Chief Inspector's report[1] commends us for completing work to inspect and clean every one of our service reservoirs. This substantial programme, funded from our base maintenance allowance, confirms current asset condition, enables us to manage compliance risk more effectively, and puts us in a strong position to meet future challenges.

4.2.8 Climate change will increase the risk of taste and odour issues arising from surface waters. More frequent periods of warm, sunny and calm conditions promote cyanobacteria activity which, in turn, produces compounds with a musty taste and smell. Changing temperatures will also affect chlorine demand within the network, and consequently, dosing regimes may need to be reassessed in future.

4.2.9 We face the increased risk of raw water quality issues, especially colour and turbidity, from increased winter rainfall events resulting in land slips, increased surface erosion and run-off, and the increased frequency and severity of moorland fires. This can result in less stable catchment land due to loss of vegetation, resulting in higher erosion and sediment loads into reservoirs.

[1] Drinking Water Inspectorate. 2022. *Drinking Water2022 – Summary of the Chief Inspector's report for drinking water in England* https://www.dwi.gov.uk/what-we-do/annual-report/drinking-water-2022/

4.2.10 Upland catchment systems can have high susceptibility to high consequence storm events. For instance, Storm Desmond caused significant damage to the Thirlmere valley catchment in 2015. This resulted in a significant deterioration in raw water quality, which exceeded the treatment envelope of the water treatment works (WTW) and resulted in a net reduction in the resilience of supply to customers. The net consequence caused by these types of events is increasing. By contrast, restored catchments such as Ennerdale suffered only minor damage in the same events.

Water supply

4.2.11 We forecast that the baseline available water supply will reduce by around 265 Ml/d from 2026 to 2050. This is driven by:

- The hydrological impacts of climate change (forecasted using ensemble models based on the UKCP18 projections); and
- Reduced abstractions to secure sustainable abstraction and our environmental destination.

4.2.12 Our baseline forecast for demand suggests only a small increase across the planning horizon as a consequence of the benefit of baseline free meter option (FMO) - people requesting a meter which leads to a gradual reduction in unmetered households. This increase in baseline water efficiency offsets the expected increase in demand due to population change. Notwithstanding, our baseline supply-demand balance indicates a potential deficit in our Strategic Resource Zone as a result of climate change and abstraction reduction. This, alongside national policies and targets, is a key driver for demand reduction outlined in our core pathway.

4.2.13 Outside of supply-demand impacts, climate change is increasing the frequency and severity of extreme weather. This increases the risk of poor service or supply interruptions due to water infrastructure being affected by impacts like loss of power, landslips, ground movement and flooding that increases risks to pipe bridges and pipes near riverbanks.

4.2.14 It is critical that water infrastructure is reliable and can resist and recover from shocks and stresses to avoid substantial customer, public health and economic impacts. One way to manage risk at a system level is to build resilience through redundancy (issues at one asset can be offset by others elsewhere) and improve management of interdependencies (diverse assets are not exposed to the same geographical risks such as flooding and do not depend on the same components of third party infrastructure such as electricity substations for example). However, single points of failure and critical connectors between systems are a particular challenge. We have identified increasing risk against key aqueducts; these are high value and long-life assets which play a critical role in enabling resilience around the region. In AMP6 and AMP7 we addressed a specific risk associated with the Hallbank Tunnel on the Haweswater Aqueduct. The broader Haweswater Aqueduct Resilience Programme Direct Procurement for Customers (HARP DPC) project will progress through AMP8. These increase resilience for customers and provide critical learning to guide us as we safeguard future supplies.

Our long-term performance forecast

4.2.15 Table 4 summarises the performance outcomes we aim to achieve over the period to 2050 from total expenditure. Table 5 outlines the performance improvement we aim to deliver through our maintenance programmes (base expenditure), and the performance that will be associated with specific investment to achieve new levels of service (enhancement expenditure). We need to collaborate with others to deliver all aspects of the long-term vision for the North West.

Table 4 Our performance forecasts for water outcomes from total expenditure

Outcome	Units	Performance forecast					
		2024–25	2029–30	2034–35	2039–40	2044–45	2049–50
Water supply interruptions	hh:mm:ss per property per year	00:05:00	00:04:22	00:03:39	00:03:00	00:02:10	00:01:30
Customer contacts about water quality	Contacts per 10,000 population	1.08	0.80	0.70	0.60	0.5	0.4
Biodiversity	Biodiversity units	0.00	0.64	6.09	15.48	25.65	35.82
Leakage	% reduction for a 3-year average from 2019-20	10.8	23.8	32.3	40.1	45.8	49.4
Per capita consumption	% reduction for a 3-year average from 2019-20	5.1	9.7	13.7	18.1	22.8	24.7
Business demand	% reduction for a 3-year average from 2019-20	2.5	8.3	10.8	11.7	12.9	14.1
Mains repairs	Number per 1,000km	106.5	106.4	100.8	96.4	92.9	89.3
Unplanned outage	%	2.34	0.41	0.36	0.31	0.26	0.21
Operational greenhouse gases (water)	Tonnes		127652.27	110970.31	108125.06	105022.98	107590.03

Table 5: Our performance forecasts for water outcomes from base expenditure

Outcome	Units	Performance forecasts				
		2029-30	2034-35	2039-40	2044-45	2049-50
Water supply interruptions	hh:mm:ss per property per year	00:04:55	00:04:50	00:03:56	00:03:27	00:02:58
Customer contacts about water quality	Contacts per 10,000 population	0.93	0.84	0.75	0.66	0.57
Biodiversity	Biodiversity units	0	0	0	0	0
Leakage	% reduction for a 3-year average from 2019-20	1.8	2.0	2.0	2.0	2.0
Per capita consumption	% reduction for a 3-year average from 2019-20	7.4	8.3	8.8	10.0	11.2
Business demand	% reduction for a 3-year average from 2019-20	4.6	5.3	6.2	7.4	8.6
Mains repairs	Number per 1,000km	106.4	102.1	96.4	92.9	89.3
Unplanned outage	%	0.41	0.36	0.31	0.26	0.21
Operational greenhouse gases (water)	Tonnes	134,334.64	135,597.52	137,493.78	139,813.65	1,442,260.40

4.3 Our core adaptive pathway to deliver our water ambition

4.3.1 Our core pathway for water is made up of low regrets investment aligned to our strategic programmes (WRMP, DWQP, WINEP) and AMP8 enhancement needs, and tested against the CRSs and our wider scenarios.

4.3.2 To deliver our ambition, we forecast the need to invest £5.6 billion over the period from 2025 to 2050. This investment comprises of the following key enhancements :

- £1.9 billion in water resources including £940 million on leakage improvements and £123 million on smart metering. Our core pathway is the same as our WRMP preferred (most likely) pathway.

- £2.19 billion in drinking water quality including £1.29 billion to remove lead pipes and £745 million to address raw water deterioration.
- £683 million in environmental improvements, including £60 million on drinking water protected areas.
- £742 million on enhancing resilience, including £241 million on aqueduct resilience

4.3.3 Our core pathway for water will allow us to deliver our ambition under most future scenarios. Under a small number of scenarios, we may need to use alternative pathways to deliver our ambition (see section 4.4).

4.3.4 We've optimised our plans to prioritise options which deliver cross cutting benefits for example: mains replacement for quality, leakage benefit and resilience/asset health benefit; leakage for demand reduction and thus environmental benefit; and, customer demand management delivering efficiency for water and wastewater.

Water resources

4.3.5 Our core pathway embraces national efforts to reduce leakage by 50 per cent, non-household demand by 15% and household consumption to 110 litres per person per day by 2050 through plans to invest £782 million on metering, an enabler for water efficiency. The core pathway includes interventions on leakage and demand reduction such as in-pipe repairs and lining technologies, and water efficiency measures. These interventions will improve the resilience of water supply in a changing climate, protect the environment by reducing abstraction to sustainable levels, and deliver better day-to-day service for customers. The core pathway also supports the need for national water transfers by delivering three groundwater sub-options. These sub-options introduce additional production capacity to the North West and build the resilience of the system to prepare for times where water transfers are required.

4.3.6 We undertake extensive risk assessment, option development and appraisal and adaptive planning through our statutory WRMP. We also contribute to the development and delivery of the regional water resources plan and wider national water transfer planning as part of Water Resources West. Both of these documents, like the LTDS, have a long-term planning horizon to 2050 and beyond. Our WRMP is designed to meet the Environment Agency's Water Resources Planning Guideline (WRPG)[2] alongside supplementary guidance and Ofwat's PR24 Guidance on Long-Term Delivery Strategies[3].

4.3.7 Our options deliver a net negative whole life carbon impact as a result of their demand reduction. The total greenhouse gas (GHG) emission of our preferred plan over 80 years is a reduction of 417,688 tCO_2e (Table 27) which will support achievement of our science-based targets to reduce our scope 1 and 2 emissions by 42 per cent and our scope 3 emissions by 25 per cent by 2030 and help achieve our long-term net zero ambition by 2050.

Water quality

4.3.8 The DWQP is our long-term strategy to secure water quality for future generations. The plan is based upon the requirements of the Drinking Water Inspectorate's long-term planning guidance[4] and includes high level ambitions applicable to the whole water supply system from catchment to customers' taps, for the planning period 2025 to 2050 and beyond.

4.3.9 Our core pathway aims to deliver 100 per cent water quality compliance, as measured via the CRI, while targeting a 63 per cent reduction in customer contacts by 2050 and removal of lead pipework from the network by 2070. Our core pathway proposes £745 million investment in catchments and at treatment works to manage deteriorating raw water quality. It also plans £1.78 billion investment to deliver a resilient and wholesome supply, while exploring opportunities to phase future spend through condition and performance assessment. Research shows that complete lead removal, including privately owned

[2] Environment Agency. 2023. *Water resources planning guideline* (Version 12)

[3] Ofwat. 2022. *PR24 and beyond: Final guidance on long-term delivery strategies*

[4] Drinking Water Inspectorate. 2022. *Guidance Note: Long-term planning for the quality of drinking water supplies*

supply pipes, delivers a significant public health benefit so our core pathway includes funding to support customers alongside removing UUW owned communication pipes.

Water environment (WINEP)

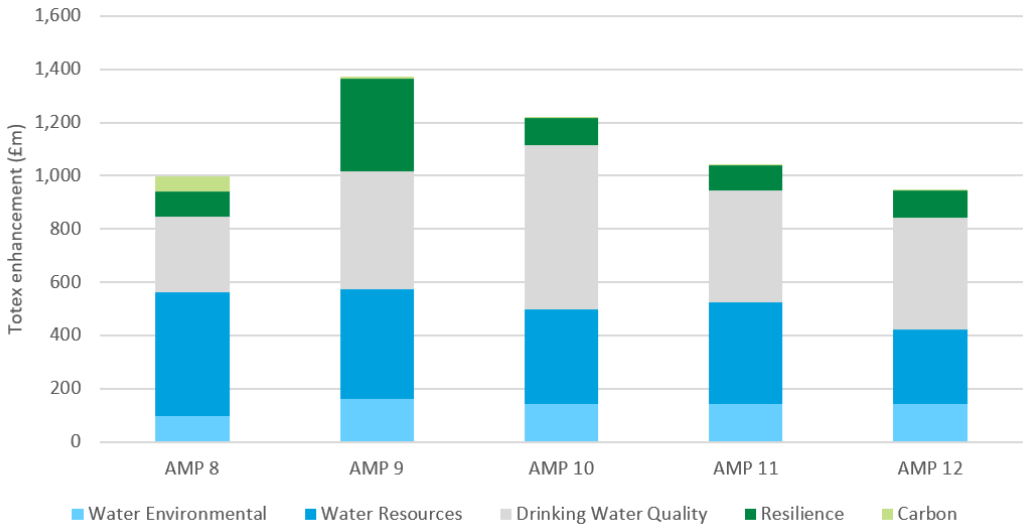
4.3.10 We have completed extensive options development and testing to identify investments to improve the water environment. These investments fall under the statutory WINEP and include but are not limited to schemes to improve biodiversity, network and river monitoring, and investment to further enhance the quality of treated wastewater.

4.3.11 Future planned WINEP schemes are concentrated over the period to 2035 (as required by the Environment Agency), however they also provide a starting point for longer-term thinking. Our WINEP programme aligns to the Environment Agency's WINEP methodology, which in turn addresses relevant aspects of the Government's 25-Year Environment Plan.

The detail of our core pathway for water

4.3.12 We will deliver against our ambitions by investing in our existing assets (to maintain them, for example) and investing in new or upgraded assets (to increase capacity/capability). The investment is grouped in into base and enhancement expenditure. The enhancement investment associated with our core pathway for water is presented by enhancement type in Figure 16.

Figure 16 Our core pathway of investment to 2050, by expenditure type



Benefits we will deliver from base

4.3.13 We will make significant progress towards our long-term ambitions through base expenditure, especially when the benefits of innovations and improved efficiency are included. Examples of our planned base expenditure include:

- Targeted, risk-based and efficient investment in the health of our assets to deliver value across the planning horizon to 2050. This includes our plans to be industry leaders in maintenance, leading to fewer asset failures and, in turn, better performance across water quality compliance and customer contacts;
- Mains rehabilitation and renewal to protect service to customers. This covers multiple benefits - including supply interruptions, leakage reduction countering the natural rate of rise in leakage, and water quality contacts. Interventions will be targeted to deliver overall best value;
- "Find and fix" repairs to prevent the natural rate of rise in leakage;
- Reducing raw water losses to maintain our supplies;
- Reducing unplanned outage through proactive maintenance;

- Our development and use of innovative machine learning and artificial intelligence to facilitate intervention prior to the occurrence of water quality issues; and,
- Our efforts to reduce water quality contacts by 63 per cent, through a continued focus on a water quality first culture and planned investments across our system.

4.3.14 Notwithstanding the benefits base expenditure provides, it will be insufficient to enable us to meet all aspects of our water ambition. Our enhancement expenditure plans are, therefore, vital for delivering our ambition and new requirements.

Improvements from enhancement

4.3.15 Within our water core pathway, our key enhancements are:

- For water resources:
  - Our programme of demand management activity as outlined in the WRMP. Principal interventions include smart metering of households on single supplies, mains rehabilitation / renewal / replacement, and free water efficiency visits to households. The long-term pathway includes advanced sensors to identify leakage and further mains rehabilitation / renewal / replacement.
  - Developing three groundwater sources (Aughton Park, Woodford and Tytherington) with a combined capacity of 22 Ml/d to support water transfers.
- For water quality:
  - Catchment interventions that allow more costly and carbon intensive 'grey' solutions to be avoided or deferred by protecting water quality and availability at source. Where the scope of catchment solutions is exceeded, additional treatment will be needed to offset deteriorating raw water quality. In combination, our core pathway identifies £895 million of expenditure for grey solutions covering both raw water deterioration and improvements to taste, odour and colour.
  - This begins in AMP8 with £41 million investment planned to for install granulated activated carbon or advanced oxidation at five sites to treat compounds (such as geosmin and 2-MIB) that give water a musty taste or smell. We will continue to work with our academic colleagues to understand the origins for the production of taste and odour compounds, since the exact environmental conditions and stimuli resulting in their production is poorly understood. Our current modelling forecasts the prevalence of these compounds increasing with climate change; affecting 17 further upland source by the end of AMP8 and 23 more in AMP9. Our core pathway, built around a central climate projection, keeps pace by extending enhanced treatment to further water treatment works.
  - Potential water quality concerns, such as per- and polyfluoroalkyl substances (PFAS), are also a consideration; the core pathway includes low regret decisions to build resilience by carrying out investigations to increase knowledge on how to manage these risks. We have also included an allowance for enhanced treatment solutions in AMPs 9-12 (we have used granulated activated carbon as a notional solution for planning purposes, but will review this as the science develops). This understanding, and other factors, such as climate change may influence later requirements and trigger a change to an alternative pathway; and,
  - Increasing the pace of lead pipe removal to keep us on track for our 2070 ambition. Our core pathway investment for lead follows an 'S-profile'. Replacements accelerate through the 2030s as demand drives growth and innovation in the supply chain. They then peak in the 2040s as the pool of remaining lead pipes shrinks, and the complexity of those remaining increases. We also recognise the barriers to lead pipe removal (such as the disruption caused by replacement and navigating partial customer ownership) and have included assumptions around collaboration with the supply chain, others in the industry and policy makers to reduce these barriers.

  - Enhancing the resilience provided by large diameter trunk mains; highly critical, long life assets that enable our water system to manage shocks and stresses. We forecast that extreme weather driven by climate change driven will increase these pressures, in parallel with a growing population and increasing customer expectations. Our strategy follows a systems approach; understanding assets current and future role in system performance, while embedding proactive monitoring to assess assets' potential and risks. This will allow investment to be deferred, or brought forward, in line with requirements.

- For water environment:
  - Delivering abstraction reductions to protect the environment and achieve our 2050 'environmental destination'. We have modelled abstraction reductions, which total 65,000 Ml/year licence reduction by 2050. We can deliver these reductions in abstraction as a result of demand reduction. We have profiled the 24 known and other potential licence changes over the planning period and plan site specific investigations to prioritise and refine this programme.
  - Catchment interventions including WINEP enhancement schemes at Thirlmere, Haweswater, Bowland, West Pennines, South Pennines, Poaka Beck and Upper Duddon. As well as improving raw water quality and availability, these interventions will enhance and restore natural environments in step with Defra's Local Nature Recovery Strategies.

AMP8 forms the first five years of our long-term plan

4.3.16 Our AMP8 plan aligns with the low-regret Core Pathway with activity in three areas:

- Intervening where timely action is necessary;
- Enabling work for alternative pathways; and
- Monitoring risks and opportunities to inform future revisions of our long-term plan.

4.3.17 We have used extensive option identification and selection processes, alongside engagement and challenge from regulators, to ensure that our AMP8 interventions deliver best value for customers and the environment.

4.3.18 Our plans have carefully considered what enhancement interventions are needed in AMP8 to keep options open and enable alternative pathways. Our Water Transfers enhancement includes prudent planning activities to be adaptable to alternative pathways. Our enhancement proposals and their link to the long-term plan are summarised in Table 6.

For further details on how performance commitments and enhancement cases deliver for customers see *UUW05 – Delivering great service and UUW08 – Delivering at efficient.*

4.3.19 Our monitoring of risks and opportunities will continue through AMP8. It includes specified WINEP investigations into achieving or maintaining Water Framework Directive status at seven surface water sites, and 11 further studies to support our long-term Environmental Destination. There are also broader uncertainties around drinking water quality and water resources risks (e.g. new contaminants of concern, climate change etc.) which could trigger a change of pathway. Therefore, we will continue to maintain an effective risk register and horizon scan for future hazards.

Table 6 Our AMP8 enhancement cases for water form part of our long-term adaptive plan

Enhancement Case	Background	Link to adaptive plan	Justification
Lead	Exposure to lead proposes a risk to customers. This enhancement case describes the proposed investment to replace 30,000 lead pipes from the water main to the compliance point at the first customer tap in order to reduce this risk.	We aim to have a lead free network by 2070 at the latest, with opportunities to accelerate if innovation and funding materialise. We will also work with customers to encourage and incentivise them to replace their lead plumbing	We aim to provide a targeted lead replacement scheme to support customers who cannot remove their own lead pipe. This work use **partnership working** by collaborating **with** third parties such as Social housing landlords. We have developed a long-term **adaptive plan** to account for technological, regulatory or legislative change uncertainties. We will build resilience to external challenges such as disruption to the orthophosphate supply chain. We plan to positively influence industry by **sharing learnings** and influencing policy.
Raw water quality deterioration	Raw water deterioration poses a challenge to the provision of safe and clean drinking water. We propose investment to install new treatment processes at five water treatment works to mitigate the effects of deteriorating raw water quality in the associated source waters.	Our long-term drinking water quality strategy describes an adaptive plan to meet our 2050 ambition to provide a service that is 100% compliant with regulatory, quality and environmental requirements. Our ambition is to reduce water quality contacts to fewer than 0.4 contacts per 10,000 customers. This enhancement case mitigates risk from deteriorating raw water quality.	Raw water has deteriorated beyond the designed capability of the Water Treatment Work (WTW) and therefore investment outlined by this enhancement case is no regrets. We have invested in previous AMPs in catchment measures to defer the investment need. Our adaptive plan further assesses the potential impacts future scenarios, including climate change and our developing understanding of these metabolites that cause water quality issues to ensure AMP8 is low regrets.
Water WINEP	This enhancement case includes expenditure required to meet WINEP/NEP obligations.	Investigations will help us to understand our future investment needs, reduce uncertainty and prioritise the timing of solutions in the context of the long-term plan. Our long-term strategy considers the likely need for future WINEP drivers with associated costs built in to the core pathway. Additionally we have considered the impact of different scenarios on future WINEP need, including climate change, demand, technology, abstraction reductions and changing expectations.	We have built our Water WINEP enhancement case around the AMP8 WINEP programme, consequently there is a statutory need for these investments during AMP8. In order to ensure this reflects **low regrets** investment we have challenged drivers and worked with regulators to prioritise needs. Additionally we have considered phasing of solutions into AMP 9 as part of our **adaptive plan**. An adverse climate change scenario may require that we move to an alternative pathway, with a trigger point in AMP9.

Enhancement Case	Background	Link to adaptive plan	Justification
Vyrnwy	The Vyrnwy treated water aqueduct is an integral part of the regional supply network. Enhancement investment is required in order to complete the final phase of the Vyrnwy aqueduct relining programme which will improve downstream water quality for customers through improved compliance with the iron standard and reduced risk of discolouration.	Our long-term strategy sets out our adaptive plan to improve our water quality performance significantly over the next 25 years. We are aiming to achieve a 63% reduction in water quality contacts by 2050. This enhancement will play a vital role in achieving this goal. Our water quality targets are ambitious and investment is required now to meet both short and long-term goals.	The Vyrnwy aqueduct is a strategic asset, a fundamental part of our supply system, enhancement expenditure is required to ensure that water travelling through the pipeline does not deteriorate in quality. The completion of this work forms part of our long-term drinking water quality strategy. We anticipate that this work, alongside targeted water network interventions, will significantly reduce the number of customer contacts about discolouration as well as improving resilience.
SEMD & NIS-D	The UK government has introduced security and resilience legislation to protect significant assets. Investment is required to meet these obligations.	Our core pathway proposes investment in security and resilience through SEMD and NIS-D. We have planned adaptively to account for uncertainty in future technology advances and demand which would have an impact on the level of investment required to meet our desired level of resilience.	All Water Companies – under Section 208 of the Water Industry Act 1991 are required to adhere to the general and specific directions of the Secretary of State. Our proposed investment is necessary for compliance with regulation in the interests of national security and mitigating the effects of a civil emergency.
Leakage	This enhancement case describes our proposed investment to deliver targeted mains renewal and network optimisation to reduce leakage.	Our long-term strategy involves an adaptive plan to reduce leakage significantly. We aim to reduce leakage by 23.8% by 2035 (from 2019-20 leakage levels using three-year average leakage). This enhancement case will contribute significantly to this reduction, as well helping us achieve our ambition of halving leakage by 2050. This programme of works also contributes to our ambition to reduce water supply interruptions by building resilience during freeze-thaw events.	Reducing leakage and overall water demand is critical to securing water resources resilience, as assessed for our Water Resources Management Plan 2024. We are aiming to deliver the long-term and interim leakage targets set out in the Environment Improvement Plan 2023. Investing in targeted mains renewal, instead of increasing delivery of active leakage control (ALC) of “find and fix”, is a long-term solution that will lead to reductions in the leakage natural rate of rise (NRR) over time. Mains renewal brings other benefits in terms of resilience (e.g. during freeze-thaw events) and reductions supply interruptions. Our targeted, modular interventions can be scaled up in the future if necessary.

Enhancement Case	Background	Link to adaptive plan	Justification
Smart Meters	We are proposing a significant programme of works to roll out smart (AMI) meters to existing customers as well as replace existing meters with new AMI capable meters.	Delivery of our smart meter programme is a core aspect of achieving long-term targets for demand reduction, customer engagement and network management.	In order to work towards Ofwat guidance for companies to have full smart meter penetration by 2035 we require investment in smart meter installation in AMP 8. Currently we are projecting meter penetration of over 80% by 2037, reaching economically viable maximum meter penetration levels.
Water efficiency	We need to help customers use water more efficiently which will safeguard our long-term water supplies, protect our environment and benefit customers through reduced bills.	Our demand reduction targets for AMP 8 and beyond are stretching and therefore require a significant investment. Our long-term ambition is to reduce water consumption by 3% by 2035 and 10% by 2050. Our adaptive pathways outline an increase in expenditure under adverse climate and demand scenarios.	Our programme of works builds on the insights from our metering programme and comprises household and non-household water efficiency visits, as well as the installation of household efficiency devices and flow regulators. We will achieve this in a targeted way in order to continue to test the benefit of investment at a local level. This investment will trigger behavioural change which will deliver long-term benefits beyond AMP 8.
Water Transfer	We will continue to progress the North West Transfer (NWT) and Severn to Thames Transfer (STT) Strategic Resource Options (SROs) under the RAPID gated process. We also propose to deliver infrastructure to develop new water sources and engineering modifications to the Vyrnwy system. This will facilitate water trading and maintain supply resilience to customers within the UUW operating region.	Water transfers will contribute to nationwide water resilience, within the water resources west draft plan[5] we have outlined adaptive pathways for water transfer options. Alternative transfer needs have also been incorporated as wider scenarios in our water adaptive plan. We have identified low regrets investment in the short term to keep options open, this supports transfer needs with potential trigger points in the future relating to increased transfer needs.	We will work closely with partners such as Water Resources West (WRW) and Water Resources South East (WRSE), Severn Trent Water and Thames Water. This collaboration serves to strengthen nationwide water resilience, benefiting people and the environment.
HARP	To reduce the risk to water supplies in the long-term, we must improve the resilience of the continuous supply of potable water delivered via the Haweswater Aqueduct (HA), which will be delivered through Haweswater Aqueduct Resilience Programme (HARP) under Direct Procurement for Customers (DPC).	Improving the long-term resilience of the HA is a critical activity in meeting our long-term ambitions, ensuring we continue to deliver water sufficiency and great water quality now and in the future. In particular, the delivery of HARP will protect water supplies and minimise the risk of customer contacts about water quality in the future.	We will deliver this work with a Competitively Appointed Provider (CAP) (who is responsible for the financing, design, build and maintenance of the replacement tunnel sections) and an Independent Technical Advisor (ITA). We consider this programme to be no-regrets investment and remains relevant under all future planning scenarios of our adaptive plan.

[5] https://static1.squarespace.com/static/5e67889204d86850e1fdcece/t/6374bcc4bc2d9e543adfc90a/1668594894637/Draft+Regional+Plan+v1.1.pdf

Developing our Core Pathway by testing against scenarios

4.3.20 Our Core Pathway was developed by testing a wide range of options against the Ofwat Common Reference Scenarios and our wider scenarios:

- Our WRMP is accompanied by a Technical Report – Deciding on Future Options[6] which provides detailed coverage of this testing; therefore only a brief summary is given below.
- Our DWQP is not required to be accompanied by equivalent technical reports so a comprehensive explanation is included in this section.

4.4 Our alternative adaptive pathways for water

4.4.1 Notwithstanding its suitability under a wide range of scenarios, the Water Core Pathway will not deliver our stretching ambitions in all scenarios. By testing how our plan responds to a range of future scenarios we have created the alternative pathways of investment shown in Figure 17 and Figure 18.

4.4.2 We have tested the impact of the following benign and adverse scenarios, and considered what expenditure is required under each of these scenarios to deliver our ambition

- Demand;
- Climate change;
- Abstraction;
- Transfer needs;
- Technology; and
- Changing expectations.

Adverse scenarios

Adverse (high) demand alternative pathway

4.4.3 Our Core Pathway assumes government action to introduce water labelling in 2025—26, which targets demand reduction through changes in customer behaviour and purchasing choices. This alternative pathway is triggered from 2028 if water labelling is not introduced, or does not have the anticipated benefit. A series of options are available depending on the scale of the challenge, including rainwater harvesting and metering of households with common supply pipes which are less economical options.

4.4.4 This pathway is less optimal, because our PCC target is not achieved and additional investment is needed to maintain a resilient supply-demand balance and deliver level of service improvements.

4.4.5 In the long-term (end of AMP9 and beyond), even with the expensive interventions described, we would be unable to meet PCC reduction targets. This highlights the importance of government intervention through water labelling.

Adverse (high) climate alternative pathway

4.4.6 The high climate change alternative pathway reflects the expected impacts of a high emissions scenario (a 4 degree world as per representative concentration pathway (RCP) 8.5. Under this adverse scenario:

- Natural catchment systems are affected faster; for example, we forecast an additional 16 reservoirs will be impacted by geosmin by 2035. This means catchment and treatment interventions are needed sooner to prevent adverse impacts on the taste and smell of water. Deteriorating raw water also reduces treatment capacities so upgrades are accelerated to maintain peak production capacities in line with our water resources management plan (WRMP).

[6] United Utilities Water. 2023. Technical Report – Deciding on future options

- In 2031 the level of service for temporary use bans reverts to the current average annual chance of 5 per cent (our Core Pathway is designed to improve it to 2.5 per cent) and a second phase of water mains renewal is started sooner in AMP10.

4.4.7 Under this alternative pathway, our ambitions for water quality compliance and customer trust are met but the scale of infrastructure adaptation increases pressure on affordability and emissions. Resilience can be built in through these adaptations, but it is still at risk due to the severity of the climate change impacts.

Adverse (increased) expectations alternative pathway

4.4.8 This pathway reflects a need to deliver better water quality in response to changing customer expectations, regulatory intervention, new science or a combination of all three (recognising that they are interrelated). Examples of triggers include new understanding about drinking water risks (e.g. PFAS) which require enhanced treatment or a change in legislation that accelerates lead pipe removal.

4.4.9 By definition, this pathway performs well against compliance and customer trust. It also builds resilience. Performance against affordability and GHG emissions is mixed because higher requirements drive more interventions, which carry higher costs and emissions.

Alternative transfer 1 (Water Resources South East (WRSE) 'no South East Strategic Reservoir Option (SESRO)') transfer scenario

4.4.10 There is currently uncertainty around the transfer requirements of other companies. We have regular engagement with other regional groups as part of Water Resources West to understand changing needs. As part of the reconciliation process, regional groups agreed on a Core Pathway for water transfers and two alternative scenarios. In the Core Pathway, a 25 Ml/d transfer is required by Severn Trent only. Alternative agreed scenarios include transfers at a variety of volumes and dates by WRSE. Decision points for these alternative pathways are identified and linked to WRSE requirements and sub-option implementation periods. The 'no SESRO' scenario is linked to the decision on planning permission for the SESRO.

4.4.11 The outcomes of this pathway match those of the Core Pathway, reflecting the principle that water transfers should only have a net zero or net positive impact on the source region.

Adverse (slower) technology alternative pathway

4.4.12 The adverse technology pathway envisages meters being installed much more slowly than our Core Pathway. 75 per cent fewer are installed in AMP8 which delays full coverage until 2045. As a result alternative and more expensive interventions (such as pressure management, rainwater harvesting and flow regulators) are needed to reduce leakage and consumption.

4.4.13 The pathway does not deliver our long-term PCC target and performs poorly against affordability due to additional investment requirements.

Benign scenarios

Benign (low) climate alternative pathway

4.4.14 This pathway considers the impacts of a small change in climate where global temperatures only increase by 1°C (RCP 2.6). It does not materially affect our water resources plan because statutory targets to reduce demand and provide water transfers continue to drive our interventions. However, it does prompt a change in our water quality plan as raw water quality will deteriorate slower which, in turn, defers the requirement for enhanced treatment.

4.4.15 This pathway performs well against all outcomes.

Benign (faster) technology alternative pathway

4.4.16 This pathway sees smart metering delivered faster, and demand for water reducing as a consequence. It does not affect near-term low-regret decisions as progress is monitored through AMP8. However it

removes the need for other interventions later in the planning horizon. In some areas (e.g. lead replacement, leak repair) we are seeking transformative change but uncertainty at this stage remains too high to reflect explicitly in pathways.

4.4.17 The pathway generally performs well. However affordability deteriorates due to the short-term costs of accelerated meter installation (the guidance for this scenario states that full metering is achieved by 2035, and currently the costs for doing this on households with common supply pipes is expensive and difficult to deliver).

Benign (low) demand alternative pathway

4.4.18 This pathway assess the impact of compulsory water labelling, accompanied by minimum standards, being introduced in 2025-26. We continue with our low regret demand interventions in this scenario until the benefits of water labelling with minimum standards are measured and confirmed in the long-term. This allows time to gather evidence and prepares us for other alternative scenarios.

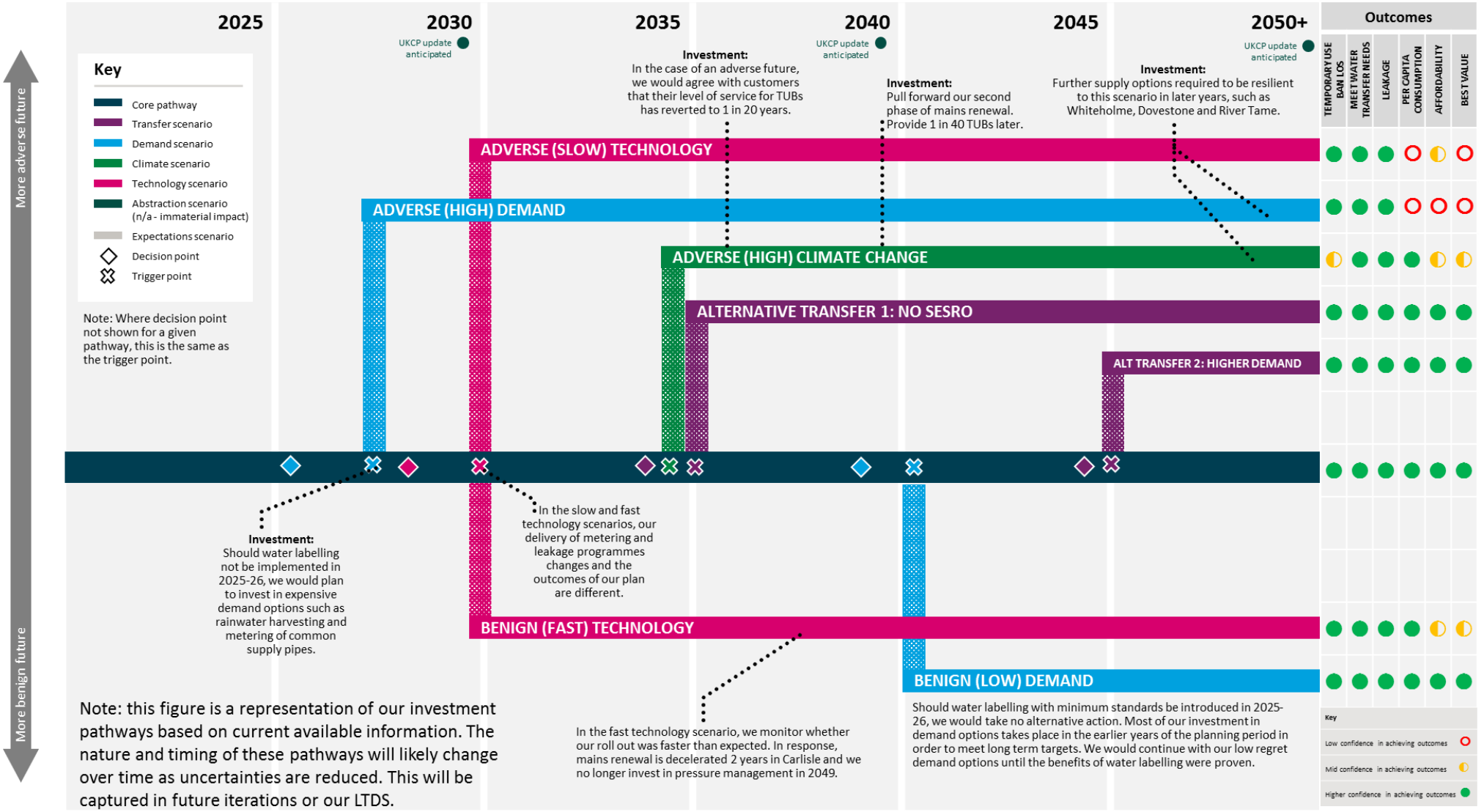
4.4.19 The pathway performs well against all outcomes.

Inconsequential alternative pathways

4.4.20 The following pathways do not drive substantially different decisions nor deliver different outcomes compared to our Core Pathway;

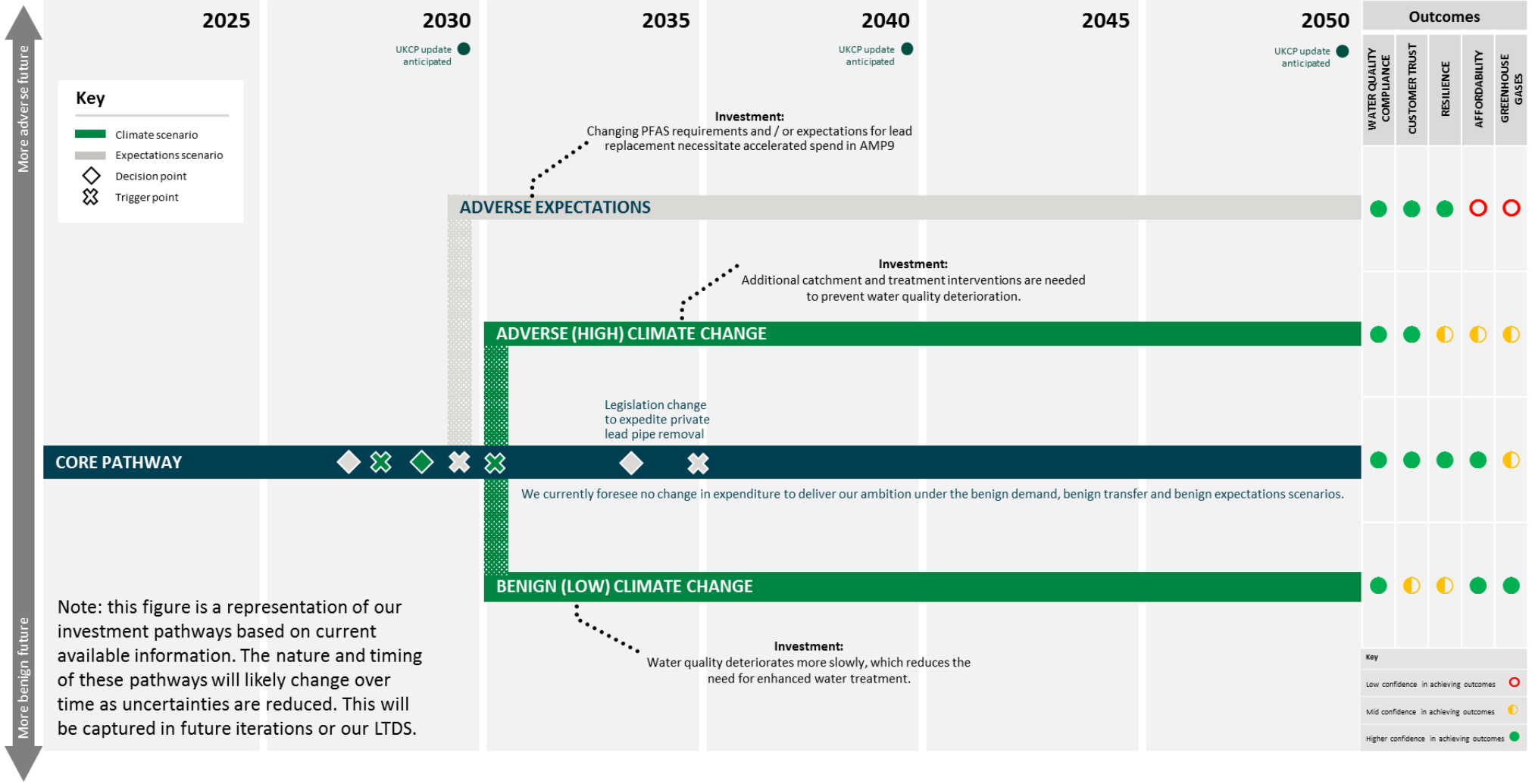
- Adverse abstraction reductions;
- Benign expectations;
- Benign transfer; and,
- Benign abstraction reductions.

Figure 17 A summary of our adaptive plan for water resources



Note: this figure is a representation of our investment pathways based on current available information. The nature and timing of these pathways will likely change over time as uncertainties are reduced. This will be captured in future iterations or our LTDS.

Figure 18 A summary of our adaptive plan for water quality



4.5 Opportunities to collaborate

4.5.1 Challenges such as climate change and environmental resilience cannot be addressed in organisational silos. Collaboration with stakeholders is critical in supporting the delivery of our ambitions. This include with the Drinking Water Inspectorate, Environment Agency, Natural England, Natural Resources Wales, local councils, non-governmental organisations such as the RSPB, Rivers Trust and Wildlife Trust, other abstractors, business users and other land owners.

4.5.2 There are widespread benefits of collaboration including delivering more efficiently for customers, delivering wider benefits such as further social and environmental value, unlocking alternative funding opportunities. The alignment of funding cycles across strategic planning organisations proves a challenge in delivering in partnership, and misalignment of funding cycles makes it difficult for organisations to make commitments to co-funding and co-delivery of schemes. Regulatory support to incentivise partnerships would remove some of the barriers, enabling partnership schemes to be delivered with reduced expenditure.

4.5.3 Achieving stretching per capita consumption targets requires support from the government. Our core pathway, in line with the Environment Agency's Water Resources Planning Guideline (WRPG)[7], includes policy action to introduce mandatory water labelling by 2026. If this does not happen, our adverse demand pathway includes additional expenditure over the planning horizons to offset the additional demand. Water quality outcomes will also be achieved more efficiently if supported by policies to aid the replacement of privately owned lead pipes and to control the use of potential contaminants such as PFAS and microplastics at source.

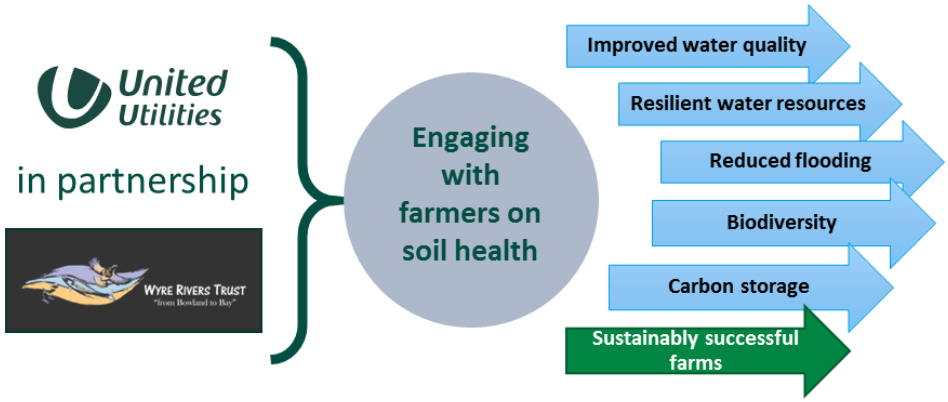
4.5.4 Additionally, the role of other catchment users is important in protecting water quality, particularly in drinking water protected areas where nitrates, pesticides and other pollutants enter groundwater. We work closely with the farming communities in these areas and support them to reduce the risk of pollutants entering groundwater.

4.5.5 We will engage with policy makers and industry partners to promote critical steps like mandatory water efficiency labelling, without which we would not be able to meet long-term targets for PCC reduction. We will also work to resolve some of the barriers to long-term best value (e.g. controlled use of contaminants such as PFAS, supply-pipe ownership).

How are we collaborating in AMP8?

4.5.6 We collaborate with partners across the region, and we have introduced pilots of place-based planning in AMP7 to realise the potential to work more closely with stakeholders. These pilots aim to strengthen partnerships and provide a framework to increase collaboration. They deliver cost-effective benefits for UUW customers, as well as the wider environment and community. An alternative to the Wyre catchment work outlined in Figure 19 would be to spend £55 million on new sources.

Figure 19 Working in partnership in the Wyre catchment



[7] Environment Agency. 2023. *Water resources planning guideline* (Version 12)

4.5.7 By 2030, we will deliver a second phase of catchment resilience schemes to improve raw water quality in the long-term by restoring the underlying ecosystems and natural processes. Activities include riparian woodland planting (which buffers pollutants and connects habitats) and a specific river restoration in the Upper Duddon catchment to reduce erosion and acute raw water quality deterioration during flashy storm events.

4.5.8 Our 2020—2022 WINEP investigations were the latest step in our longstanding work to advance scientific understanding of catchment systems. They highlighted the complex relationships between land management and compounds which affect the taste and smell of water. This led us away from some direct catchment interventions in AMP8, which could have been ineffective or inefficient, towards an ongoing research programme (e.g. working with leading academics at Cardiff University) to inform long-term catchment planning.

4.6 How we will monitor and adapt our plans

4.6.1 For each of our water alternative pathways, we have identified:

- Metrics that will be monitored, how these will be calculated, and the source of the data;
- Triggers to consider a change of pathway, and when we expect this trigger could occur; and,
- Decisions that triggers can prompt, and when these decisions are needed.

4.6.2 Our full LTDS monitoring plan in presented in Appendix B including an explanation of how the LTDS monitoring plan is integrated within the UUW corporate risk management process. Our monitoring plan identifies a suite of metrics to evaluate whether we are following an alternative scenario and the requirement to move onto an alternative pathway. These are summarised below.

Monitoring demand

4.6.3 In line with Environment Agency Water Resources Planning Guidelines[8], the introduction of mandatory water labelling is a key trigger in our monitoring plan. Our adverse demand pathway is linked to labelling not being established by 2025-26, whilst labelling with minimum standards by that date could enable the benign demand pathway.

4.6.4 The introduction of water labelling is an important factor influencing the achievement of our outcome for per capita consumption. Without the benefit of this intervention, we are unable to achieve our long-term target of 110 litres per person per day. We also need to begin investment in uneconomical demand reduction options such as rainwater harvesting at a larger scale than previous pilot trials and metering of households on common supply pipes. Even when taken into consideration these are still not sufficient to meet targets, and only support supply-demand needs.

4.6.5 We will assess the benefits of this, and other interventions, by measuring per capita consumption and business demand. These are key parameters included in our annual performance reporting and data from the roll out of smart meters will enable more frequent and accurate analysis. We will also utilise control groups to measure effectiveness of demand reduction interventions. If benefits are less than forecast then this could be addressed via our high demand pathway, or the low pathway could be adopted if expectations are exceeded.

Monitoring technology

4.6.6 The technology alternative pathways are closely related to delivery of our metering programme in the 2025—2030 period; faster delivery enables the benign pathway whereas delays are linked to the adverse pathway. Our AMP8 enhancement proposal for smart metering includes a price control deliverable which will ensure progress is visible and can be tracked.

[8] Environment Agency. 2023. *Water resources planning guideline* (Version 12)

Monitoring climate change

4.6.7 Our decision point for climate change is driven by updated UK climate projection (UKCP) data, 2018, and a review of international scientific expectations on the most realistic climate change scenarios. If they conclude that an adverse scenario (i.e. a 4°C world by 2100, RCP8.5) is the most likely, then we will trigger a review of the steps we need to take to adopt the adverse climate alternative pathway. Similarly, the benign climate pathway is linked to reporting a benign climate scenario (i.e. a 1°C world by 2100), though the UN have reported this is unlikely[9].

4.6.8 The timing of UKCP reports is irregular, so we will also consider other indicators, especially those relevant to our services in the North West. These include yields from catchments, demand for water and the quality of raw water (colour, compounds affecting taste and smell etc.). Outside of day-to-day business planning, the five yearly cycle of business plans and water resources management plans drive periodic reviews.

Monitoring expectations

4.6.9 This trigger covers a broad spectrum of issues so it is not appropriate to specify a particular metric.

4.6.10 Some issues are well established and managed risks where the acceptability or feasibility of the controls could change. A good example is controlling lead risk through dosing phosphate, which is a finite resource with geopolitical risks to the supply chain. If these risks increase then the balance against cost and affordability shifts, and the alternative pathway will be considered.

4.6.11 The uncertainty for other issues lies in the underlying science. A relevant example here is the risk from PFAS chemicals. The Drinking Water Inspectorate (DWI) have provided precautionary guidance in advance of further international research. As research is completed (and translated into DWI guidance or regulation) it could highlight additional risks, making the increased expectations pathway desirable.

4.6.12 Our assessment of triggering the alternative pathway will draw on a range of sources, reflecting the spectrum of issues at play. We will continue to engage with customers to understand their expectations. We will also cooperate on a national level (e.g. through Water UK) to understand and support developments in policy and regulations.

Monitoring transfer requirements

4.6.13 Water companies and regional groups are following adaptive planning processes and detailing their future needs for water transfer. As the source region for the North West Transfer Strategic Resource Option (NWT SRO), we are in regular contact through regional groups with potential recipients of transfers and are regularly updated on future needs; therefore our monitoring is continuous. The NWT SRO is a flexible and scalable transfer option, which includes a wide range of support options of varying lead times. Our adaptive plan trigger points are therefore based on the size of the transfer need and the lead time of the option required. Decision points align to WRMP and regional plan cycles to ensure national consistency.

Other factors

4.6.14 It is important to recognise that this monitoring plan is not exhaustive; other factors will also be considered as we review and revise our strategies. These include assumptions that do not align to particular scenarios or pathways, yet influence and enable our plans.

4.6.15 We will maintain our business as usual monitoring of the end-to-end water system, including raw water quality and quantity, the efficacy of our treatment processes, water quality and leakage in the network, and customers' requirements from the overall system. This will allow intervention if changes affect statutory, customer or regulatory requirements.

4.6.16 Our plans use partnership working and collaboration extensively because it can be more efficient,

[9] https://news.un.org/en/story/2022/10/1129912

delivers best value and unlocks outcomes that could not be achieved in isolation. Prior experience gives us confidence that this will be effective but we recognise the dependency on both regional and national partners. We also rely on regulators supporting well justified and efficient business cases which align with legislative and customer requirements.

4.6.17 Every option has both opportunity and risk. For example, granulated activated carbon is a well-established additional treatment technology. Looking to the future, it may play a role in managing emerging concerns such as PFAS. However, our horizon scanning indicates that national capacity for regenerating granulated activated carbon could be an issue in future. There are additional concerns arising as GAC regeneration is an energy intensive process, leading to high greenhouse gas emissions. We are leading national research with UKWIR to determine the risk associated with insufficient national regeneration capacity. We will keep each option under review to assess whether it still represents best value, and be alert for alternatives which could perform better.

Table 7 Monitoring plan for water

Pathway name	Monitoring metric	Decision Threshold[10]	Current expected decision date	Trigger threshold	Current expected trigger date
Adverse (high) demand	Regulatory decision / Per Capita Consumption	• Water labelling is not introduced • Water labelling does not deliver anticipated 70 Ml/d benefit by 2050 (combined benefit across all water resource zones	2026	Readiness of schemes - Invest in additional demand reduction options (rainwater harvesting, installing meters on common supply pipes) to meet supply-demand needs and reduce consumption as much as possible. We are unable to meet long-term PCC targets in this scenario.	2028
				Readiness of schemes - Revert temporary use bans annual likelihood to 2.5%	2030
Benign (low) demand	Per Capita Consumption	Water labelling with minimum standards is introduced and delivers anticipated 146 Ml/d benefit by 2050 (combined benefit across all water resource zones)	2030	As per decision threshold	As per decision date
Adverse (slower) technology	Number of smart meters installed	Metering programme delayed or ineffective	2028	Approval of enhancement cases: Invest in additional demand reduction options (rainwater harvesting, installing meters on common supply pipes)	2030

Pathway name	Monitoring metric	Decision Threshold[10]	Current expected decision date	Trigger threshold	Current expected trigger date
Benign (faster) technology	Number of smart meters installed	Metering programme exceeds expectations Metering common supplies becomes cost effective	2028	As per decision threshold - no requirement for a second phase of water mains renewal in the Strategic Resource Zone	2030
Adverse (high) climate	IPCC climate change projection Raw water quality	4°C warming forecast by 2100 Raw water quality (e.g. colour, taste & smell) frequently exceeds design envelopes at treatment works	2030 2028	As per decision threshold - Revert temporary use bans annual likelihood to 2.5%	As per decision date
				Approval of enhancement cases: Accelerate investment to offset faster deterioration in raw water quality	2030
Benign (low) climate	IPCC climate change projection Raw water colour	1°C warming forecast by 2100 Raw water quality (e.g. colour, taste & smell) rarely exceeds design envelopes at treatment works	2028	As per decision threshold No change in investment for water resources Decelerate investment in line with a slower deterioration in raw water quality	As per decision date
Adverse (increased) expectations	Customer engagement Regulatory and policy direction Global best practice	DWI introduce more stringent requirements than current guidance for PFAS	2028	Approval of enhancement cases: Accelerate investment in enhanced treatment	2030
		Legislation introduced to expedite lead pipe removal (e.g. change of ownership)	2032	Approval of enhancement cases: Increase lead pipe removals (by, on average, 8000 pipes per year)	2035
Alternative transfer 1	Water Resources South East Regional Plan monitoring	Monitoring shows selection of 'No SESRO' option	2034	Approval of enhancement cases: Develop new sources to be ready for 2042	2035
Alternative transfer 2	Water Resources South East Regional Plan monitoring	Water Resources South East identify that they are on a 'High Demand' pathway	2044	Approval of enhancement cases: Develop new sources to be ready for 2050	2045

5. Our long-term strategy for wastewater

Key points

- **A transformational investment for the future:** Our long-term plan for wastewater outlines £30.3 billion of totex expenditure over the next 25 years targeting bold ambitions for drainage and wastewater treatment. Reducing storm overflow spills is a priority and we aim to deliver against the timelines of the Governments Storm Overflow Discharge Reduction Plan (SODRP).
- **Protecting customers from sewer flooding:** By 2050, our plan aims to further reduce internal flooding by 50 per cent and external flooding by 30 per cent. It also targets improvements to the resilience of our network, for example by reducing sewer collapses.
- **Protecting the water environment:** By 2050, our plan aims to further reduce pollution incidents by 33 per cent. We will continue to protect and restore catchments, rivers and coasts throughout the North West, including action by 2030 to improve 11,728 hectares of Sites of Special Scientific Interest (SSSI) and 386 km of river. Additionally we are investing to improve and maintain the status of shellfish waters at 34 storm overflows and at 35 storm overflows for bathing waters. Our approach sets out our ambitions to unlock wider environmental outcomes, while meeting our statutory obligations.
- **Embracing latest innovation:** We will use technology and data solutions to further enhance our system operation, expanding our dynamic network management approach to proactively identify operational issues and optimise performance, minimising sewer flooding and pollution at lower cost and greenhouse gas (GHG) emissions.
- **An adaptive plan that will remain fit for the future:** We have tested a range of scenarios and pathways to ensure that our plan can adapt to future uncertainty in the face of climate change, population growth and environmental changes, as well as understanding the opportunities offered by innovation and technology. The pathways associated with these scenarios are described in section 5.4.
- **In summary**, our core pathway offers a flexible, low regrets and best value solution, which provides significant environmental improvements and benefits to customers in the North West with more resilient wastewater services.

5.1 An overview of our long-term plan for wastewater

5.1.1 Our adaptive plan for wastewater enables us to deliver our ambition for the North West under plausible extremes of climate change, demand, technological development and changing expectations.

5.1.2 Our adaptive plan is comprised of a core pathway of low regrets investment and expenditure that keeps future options open, and alternative pathways containing investments required under more extreme future scenarios. Figure 20 highlights some of the investment and outcomes our core pathway delivers. Figure 21 shows under what circumstances we may need alternative pathways to help deliver our ambition. Our alternative pathways are described by clear decision and trigger points which we will proactively monitor. Alternative pathways may be required at different points in time. In many cases, alignment of trigger and decision points with regulatory cycles is important to ensure efficiency and best value for customers.

The benefits delivered by our Core Pathway

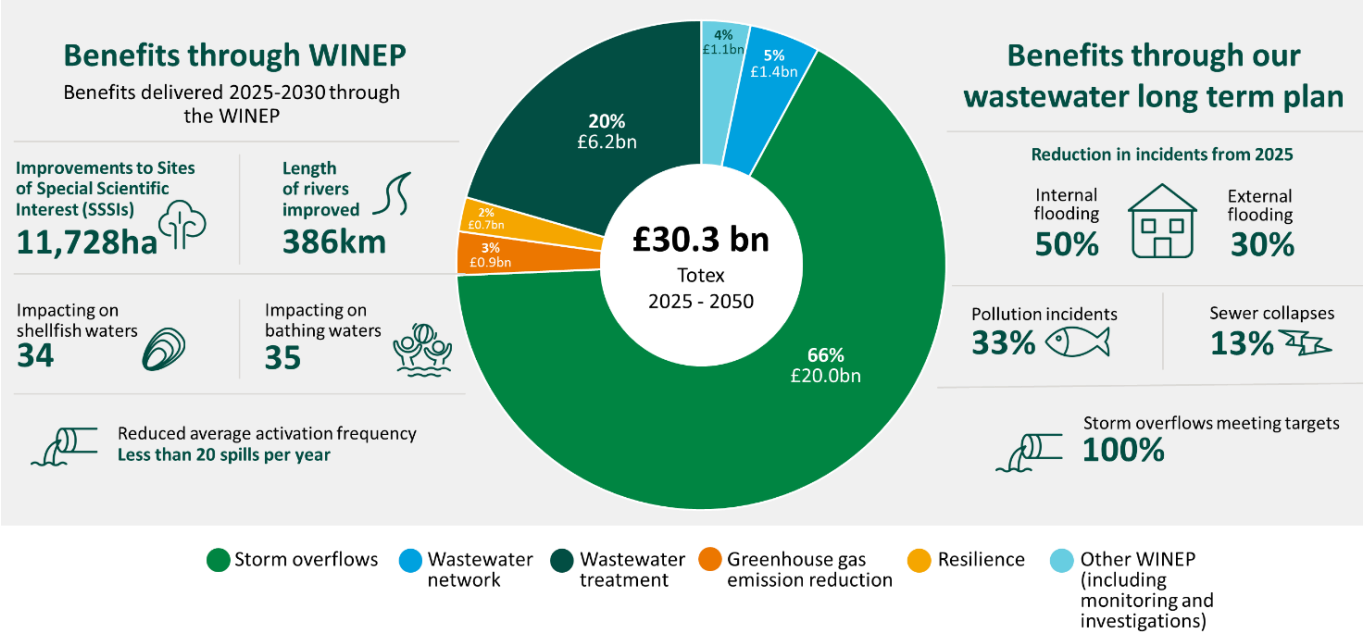
5.1.3 Our long-term plan for wastewater includes £30.3 billion of investment between 2025 and 2050. A significant proportion of this spend, £20.0 billion, is associated with delivering the step change in requirements for storm overflows, driven by the Governments' Storm Overflow Discharge Reduction Plan (SODRP). £1.38 billion is associated with solutions for flooding, pollution and collapses identified through our Drainage and Wastewater Management Plan (DWMP). £6.2 billion of non-overflows WINEP spend based on current expectations about future drivers, and £867 million demonstrates the scale of

offsetting for greenhouse gas emissions, given the size of the enhancement programme and associated emissions.

5.1.4 The planned investment in our core pathway delivers a range of outcomes by 2050, these are summarised in Figure 20 and further detailed in section 5.2. This investment aims to deliver across all of our ambitions, for example removing or storing enough rainwater to reduce overall annual spills by 29,000 by 2030. By 2050, our core pathway delivers a 50 per cent reduction on internal sewer flooding, a 30 per cent reduction on external sewer flooding from 2025 baselines and delivers resilient services, reducing sewer collapses by 13.4 per cent.

5.1.5 Our action on storm overflows aims to provide improvements and benefits across the 25 years of our long-term plan, meeting long-term and interim targets set out in the Government's SODRP. For the environment, our ambition is to deliver improvements to Sites of Special Scientific Interest (SSSIs) across almost 11,728 hectares, improve 386km of rivers and deliver a 33.3 per cent reduction in pollution incidents, including no serious pollutions.

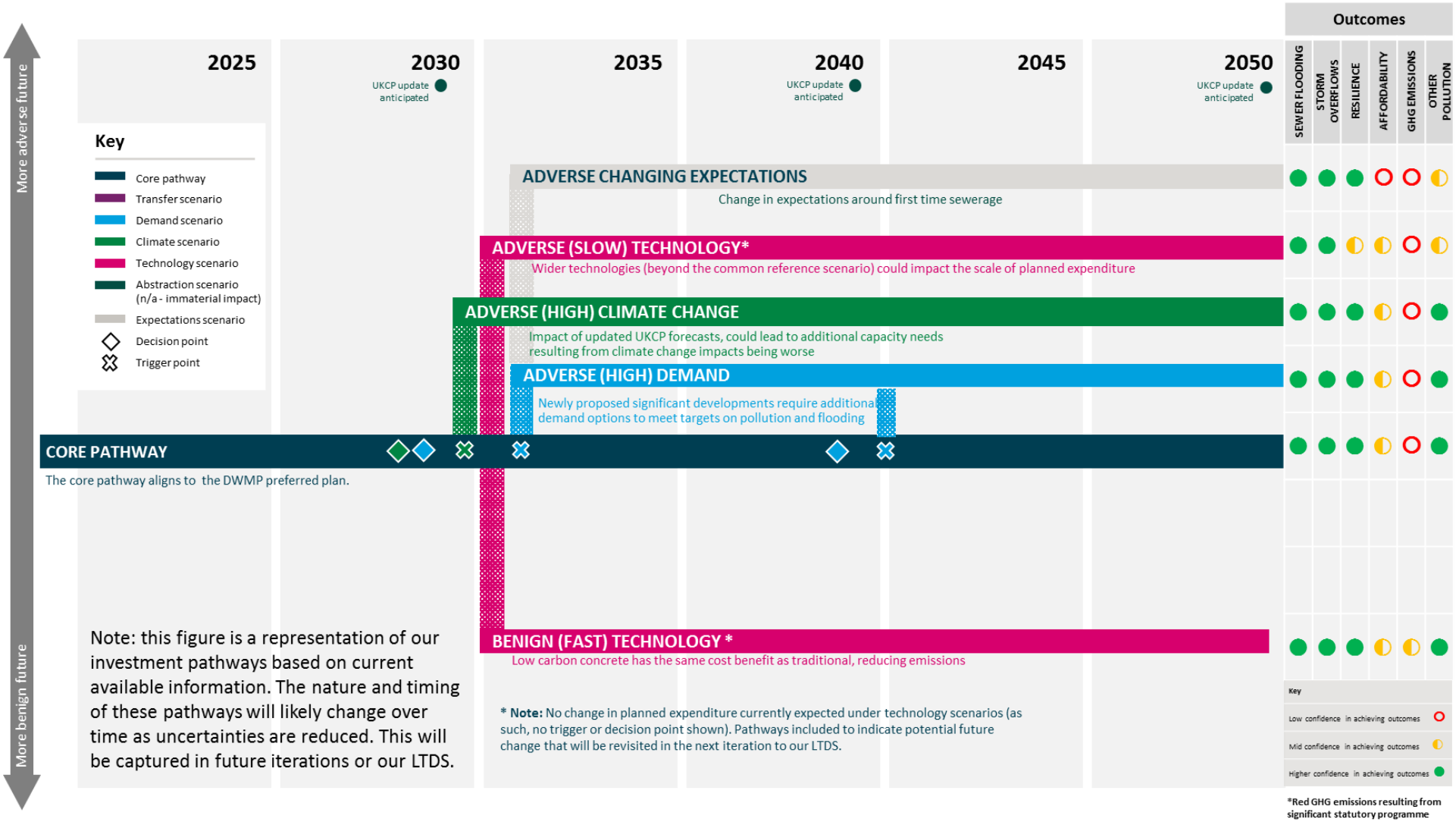
Figure 20: A summary of our totex expenditure and outcomes delivered through our long-term plan for wastewater



5.1.6 Figure 21 outlines our adaptive plan for wastewater. Our core adaptive pathway aims to deliver under the benign and adverse scenarios, and keeps options open for the future, as demonstrated. There are challenges in meeting greenhouse gas (GHG) emission targets and delivering a plan that is affordable, this is driven by the significant scale of our statutory WINEP programme to deliver against the SODRP.

5.1.7 Our adaptive plan for wastewater identifies a core pathway of expenditure to 2050 along with a number of decision and trigger points, which indicate where an alternative pathway of expenditure may be needed to meet our ambitions under changing external factors. The diagram also includes an indication of how challenging it will be to meet each outcome under the different scenarios, demonstrated by the 'red, amber and green' markers. Due to the scale of the statutory overflow requirements for wastewater, affordability and GHG emissions are challenging to achieve under every scenario.

Figure 21 Our adaptive plan for wastewater



5.2 Our ambition for wastewater services in the North West

5.2.1 Our wastewater ambitions () align to our vision (section 2) and have been developed by engaging with customers, stakeholders and regulators. They address statutory requirements and guidelines and go beyond to meet the preferences of customers, where there are choices.

5.2.2 We supply wastewater services to over 7.3 million people across the North West of England. We own and operate over 500 wastewater treatment works and 78,000km of sewers, all of which help us to manage 1,300 million litres of wastewater, which is collected every day.

5.2.3 We have invested heavily over the last three decades across the region to dramatically improve the services we deliver to customers and to protect the environment of the North West. This has included significant improvements to bathing waters, protected habitats and rivers.

5.2.4 We have pioneered catchment work (known as Catchment Systems Thinking (CaST)) to deliver better value outcomes and are at the leading edge of developing partnership and market solutions to catchment level problems.

Table 8: Our ambitions for wastewater

Ambition	Detail
We will provide excellent wastewater services, reducing our impact on the environment.	We aim to deliver significant investment to ensure no overflow spills more than ten times on average, each year by 2050 – fully meeting the Government's Storm Overflow Discharge Reduction Plan targets, timescales and priorities including the elimination of environmental harm by 2035. We will continue to deliver our wastewater services to meet permits and legislation, which are becoming increasingly more stringent in order to protect the environment. **AMP8:** We are targeting 26.8 per cent reduction in spills during AMP8, as part of a 60 per cent reduction over the decade to 2030 through a combination of green, traditional and hybrid solutions. Our successful Advanced WINEP proposes £250 million of investment to progress towards overflow spill reductions through rainwater management (including through partnerships). With significant and welcome regulator support, through accelerated and transitional investment, we have started early on projects across £1.5 billion of our AMP8 programme, bringing forward £200 million of investment into AMP7 for overflows and nutrient neutrality. We have seen good progress in AMP7 from our Better Rivers Better North West programme and we plan to continue this in AMP8. This will combine with our use of short-term mitigation to reduce spills earlier and ahead of the permanent WINEP solutions. In addition to spills the programme will monitor and investigate emerging challenges. Our plan sets out interventions that are in-line with our Core Pathway to achieve long-term Environment Act targets for an 80% reduction in phosphorus by 2038.
We will protect, restore and improve the natural environment of the North West through our actions.	We are dedicated to protecting and enhancing the region we serve. This includes dedicated action to maintain the status of our bathing waters. Our plan targets reduced impacts from 34 storm overflows on shellfish waters and 25 storm overflows impacting bathing waters across the North West maintaining their quality offsetting the challenges of climate change. Our long-term plan aims to achieve a 33.3 per cent reduction in total pollution incidents by 2050. We will use CaST in the longer term as we will increasingly focus on root cause solutions with partners, to focus on wider catchment risks around flooding and water quality and the use of nature-based solutions.

	AMP8: We plan to manage and reduce the risk of pollution incidents and drive to optimise how we manage our dependency on the environment. Building on our sector leading performance, with no serious pollution incidents in three of the last four years, we aim to continue that stretching performance. A key enabler for reducing pollution is our cutting edge Dynamic Network Management capability. Our AMP8 plan builds on our DNM capability to connect our system to the wider catchment. Our pilot in Windermere, supported by a bespoke performance commitment, and continuing with the "Love Windermere" partnership, targets catchment benefits for customer and environmental improvements. Our CaST ambitions for restoring the natural environment in AMP8 include improving 11,728 hectares of SSSI and 386 km of river.
We will drive better rainwater management to reduce demand on the sewerage system. We will sustainably reduce the risk of sewer flooding in the North West.	We aim to achieve the benchmark upper quartile performance on flooding, reducing the risk of internal sewer flooding incidents to 1.43 per 10,000 customers by 2050. We aim to reduce external sewer flooding incidents to 10.90 per 10,000 customers by 2050. We aim to reduce sewer flooding caused by hydraulic overload of the sewer by removing rainwater entering our combined sewers. We plan to reduce sewer flooding caused by factors other than hydraulic flooding (FOC) through controlling the controllable, such as customer engagement on what not to flush and dynamic network management to remotely monitor and identify issues with the system. **AMP8:** Our PR24 rainwater management enhancement case proposes investment in rainwater management to reduce the risk of hydraulic sewer flooding. Our DNM capability will also be rolled out further to help reduce flooding.
We will enhance the resilience of our wastewater service.	We will utilise technology and data solutions to enhance our system operation, including making optimal use of capacity to deliver service. We plan to regularly monitor and assess external risks such as flooding of assets, and erosion and act when required to maintain resilience. Technology will be harnessed to assess the condition of sewer systems and support efficient repair/replacement to reduce the risk of sewer collapses. For example, our plan aims to reduce sewer collapses by 13.4 per cent by 2050 through better proactive targeting of interventions and mains renewal. **AMP8:** We will invest to enhance services will deliver improved resilience through activity such as 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.
We will sustainably reduce our greenhouse gas emissions.	We have produced an ambitious and adaptive strategy to achieve net zero in scopes 1, 2 and 3 greenhouse gas emissions by 2050. We are building on a strong record of emissions reduction and disclosures, including the successful reduction in scope 1 and 2 emissions by more than 70 per cent since 2010, achieved through a focus on renewable electricity. We are now moving beyond the most commercially attractive options and have expanded to all areas of our emissions. We are working towards our six carbon pledges on areas of immediate priority, which include the first independently verified science-based targets (SBTs) in the sector. We are minimising large emissions growth pressures through efficiency, innovation and collaboration. Our AMP8 business plan has around 40 per cent fewer emissions than it would have; greatly reducing the emissions impact of extending assets and services to meet latest treatment standards and serve the growing population. Further collaboration is central to our plan, including working with customers to use less, and with policy makers in striving for frameworks that value carbon and support sustainable outcomes in the round.

AMP8: In AMP8 we are reducing operational emissions and creating wider benefits. By applying the GHG intervention hierarchy we have optimised cost-effective and technically feasible emissions reduction activities. Critical to maintaining a science-based trajectory, we propose a £141 million net zero enhancement programme for wastewater to deliver immediate reductions in AMP8 and enable more than 2 million tonnes of emissions benefits by 2050. We have prioritised low regrets, strong value projects that deliver complementary benefits for water quality, water resource, cost efficiency, nature, and public health from improved air quality and recreation. To ensure bold progress in wastewater emissions, our net zero enhancement programme includes cutting edge proposals that would help set the standard for effective monitoring and management of process emissions, as well as tackling other priorities such as green fleet.

Challenges and opportunities

5.2.5 The unique climate, landscape and infrastructure of the North West presents significant challenges to wastewater management:

- The average annual urban surface water runoff in the North West is 40 per cent higher than the average for England and Wales, meaning more water enters the sewer network;
- 54 per cent of public sewers in the North West are combined (wastewater and surface water), compared to industry average of 33 per cent. Combined sewers are highly responsive to rainfall and have less hydraulic capacity during storms, increasing the risk of sewer flooding;
- There are over 2,000 storm overflows in the North West, which operate more frequently as a result of our combined sewer systems and higher urban rainfall that will require significant investment to improve performance;
- There are significant physical alterations of watercourses, particularly in the South of the region as a result of industrialisation, with the most significant being the transformation of the once natural river system draining Greater Manchester into the Manchester Ship Canal which drives high levels of investment to achieve water quality standards;
- The North West has an agriculture sector dominated by livestock farming, which contributes to high nutrient loading in catchments that require more effort to maintain the water quality;
- The North West has a significant number of protected habitats including many rivers, particularly in Cumbria, which are designated as Special Areas of Conservation (SACs), and require high levels of protection;
- UUW owns 45,000 hectares of catchment land, of which 84 per cent falls within a designated landscape and 41 per cent of our land holding is a SSSI, which create opportunities to improve the nature and performance of our catchments and a challenge in protecting and restoring SSSIs; and
- The region has an extensive coast with 29 designated bathing waters, 4 of which are inland bathing waters and have excellent bathing water quality, and 26 designated shellfish waters, which require additional, stringent standards of wastewater treatment.

5.2.6 Evolving pressures from climate change, population growth and increasing environmental expectations for wastewater services mean that we need to make significant investment in the short-term and into the future.

5.2.7 Our ambitions for wastewater support our broader purpose to provide great water for a stronger, greener and healthier North West. In addition to continuing to deliver excellent wastewater services to customers and support a step change improvement in the health of the natural environment.

5.2.8 Interconnectivity between different drainage systems is present in many areas across the North West, resulting in a multitude of interconnected issues for all drainage and land owners. Working

collaboratively is key in identifying integrated solutions and ways of working across organisations which support the delivery of system-wide benefits.

5.2.9 The North West covers an extensive geography, which means there are a large and diverse group of stakeholders, with shared responsibilities such as:

- Rainwater drains often directly or indirectly from field, roads and paved areas into the combined sewer system;
- Storm overflows in combined systems can, in heavy rainfall, discharge to rivers; and
- Recycled water from wastewater treatment works is safely returned to lakes, rivers and the sea.

5.2.10 As well as the sewer system, other activities taking place across a catchment can have both positive and negative impacts on the environment. For example:

- Land management practices in farming and agriculture influence water quality as a result of diffuse pollution of nutrients and water quantity as a result of soil management and run-off;
- Planning authorities and developers influence the amount of rainwater entering sewer systems and rivers; and
- Land management and planning activities can support rainfall attenuation through the delivery of better land management, sustainable drainage systems and natural flood management approaches.

5.2.11 In addition, there is a direct impact of customer action on the performance of the system – through awareness about their 'water footprint' and 'what not to flush' customers play a significant role in meeting current and future challenges.

5.2.12 Strong partnerships and collaboration between organisations are required to deliver the future vision we aspire to. Core stakeholders include the Environment Agency, Natural England, Natural Resources Wales, local councils, Rivers Trusts, Wildlife Trusts, communities, and other land owners.

Our long-term performance targets

5.2.13 Table 9 summarises the performance targets we aim to achieve over the period to 2050. It indicates the performance improvement we expect to deliver through our maintenance programmes (base expenditure), and the performance that is associated with specific investment to achieve new levels of service (enhancement expenditure). Table 10 describes the performance we aim to deliver through base expenditure alone.

Table 9: Our performance targets for wastewater outcomes from total expenditure

Outcome	Performance target					
	2024–25	2029–30	2034–35	2039–40	2044–45	2049–50
Internal sewer flooding – incidents per 10,000 properties	2.88	1.96	1.65	1.49	1.43	1.43
External sewer flooding – incidents per 10,000 properties	15.66	13.65	10.89	10.87	10.93	10.90
Biodiversity	0	0.64	6.09	15.48	25.65	35.82
Total pollution incidents	16.03	12.02	11.63	11.63	11.63	10.70
Serious pollution incidents	0	0	0	0	0	0
Bathing water quality	61.8	63.0%	63.0%	63.0%	64.1%	66.4%
River water quality (phosphorus)	-	0.2125	0.7635	0.8874	0.8874	0.8874
Storm overflows – average number of spills	29.21	19.60	17.17	13.10	10.90	8.50
Sewer collapses – per 1000km sewer	13.07	12.41	12.14	11.86	11.59	11.32
Operational greenhouse gases (wastewater) –tonnes of CO_2e	-	291257.86	329636.57	352945.99	363686.56	370482.75

Table 10: Our performance targets for wastewater outcomes from base expenditure

Outcome	Performance target				
	2029–30	2034–35	2039–40	2044–45	2049–50
Internal sewer flooding – incidents per 10,000 properties	1.99	1.88	1.88	1.88	1.88
External sewer flooding – incidents per 10,000 properties	13.72	11.14	11.14	11.14	11.14
Biodiversity	0.00	0.00	0.00	0.00	0.00
Total pollution incidents	12.02	11.63	11.63	11.63	10.70
Serious pollution incidents	0	0	0	0	0
Bathing water quality	N/A	N/A	N/A	N/A	N/A
River water quality (phosphorus)	N/A	N/A	N/A	N/A	N/A
Storm overflows – average number of spills	29.26	29.26	29.26	29.26	29.26
Sewer collapses – per 1000km sewer	12.41	12.14	11.86	11.59	11.32
Operational greenhouse gases (wastewater) –tonnes of CO_2e	287727.94	282209.06	281517.17	288664.12	291495.21

5.2.14 Base expenditure will allow us to make significant progress towards the delivery of our wastewater ambition. Examples of our planned base expenditure include:

- Investment in DNM to continue our pollution and flooding performance improvements;
- Improvements to external sewer flooding performance; and
- Resilience through reduced risk of sewer collapses.

5.2.15 While we are driving significant benefits from base expenditure, Table 9 also illustrates this will be insufficient to allow us to meet all aspects of our wastewater ambition. To balance this need for investment with customer preferences and affordability constraints, we expect our AMP8 enhancement expenditure to focus on:

- Investment to meet new statutory requirements outlined in the WINEP;
- Investment in rainwater management to reduce flood risk; and
- Investment in supply and demand schemes to increase the capacity of our wastewater treatment works (WwTWs) to accommodate growth.

5.3 Our core adaptive pathway to deliver our wastewater ambition

5.3.1 Our long-term strategy for wastewater acknowledges the extensive planning we already do in developing future plans e.g. through the DWMP and the WINEP:

- DWMP: we undertake extensive option development, testing and adaptive planning through the development of the plan. The DWMP, has a long-term planning horizon to 2050. Our DWMP aligns to Water UK's document 'A framework for the production of Drainage and Wastewater Management Plans'; and
- WINEP: we have completed extensive option development and testing to identify investments to improve the environment under the WINEP. Future planned WINEP schemes are concentrated over the period to 2035 (as required by the Environment Agency), however, they also provide a starting point for longer-term thinking cf. our Advanced WINEP proposal to commence in AMP8 the work on catchment components of future WINEP overflow schemes. Our WINEP programme aligns to the

Environment Agency's WINEP Methodology, which in turn addresses relevant aspects of the government's 25-Year Environment Plan.

- Storm overflows: our AMP8 enhancement programme is targeting spill reductions at 437 storm overflows. It is anticipated to deliver over 600,000 m^3 of new storage capacity, an increase in treatment capacity at 37 WwTWs, and implementation of over 170 sustainable drainage solutions (SuDs). This plan is the first phase of our longer term storm overflow reduction plan that meets government's new SODRP.

5.3.2 Addressing the challenges identified in section 5.2 requires an ambitious and holistic approach, utilising new technology, regulatory reform, partnerships, innovation and natural solutions alongside building new systems and capacity.

5.3.3 To develop our long-term plan for wastewater we have considered over 65,000 different options, with a particular focus on adaptive solutions, better surface water management and optimisation of our assets. The range of interventions identified are those which have the potential to mitigate against the long-term risks identified during the risk identification stages of the DWMP process.

5.3.4 The long-term plan sets out a pathway and direction of travel to meet our long-term planning objectives. It must, however, be continually reviewed as part of an adaptive approach given the levels of uncertainty regarding factors outside of management control such as climate change and policy changes.

5.3.5 The long-term plan considers a range of components:

(1) Wastewater treatment – activities that are mandated by legislation or are required to maintain compliance with discharge permits;

(2) Storm overflows – investment associated with meeting the targets within the government's SODRP;

(3) Our long-term ambitions for rivers in the North West, to:

a. make sure our operations progressively reduce impact to river health;

b. be open and transparent about our performance and plans;

c. make rivers beautiful, supporting others to improve and care for them; and

d. create more opportunities for everyone to enjoy rivers and waterways; and

(4) Service performance improvements – optimised outputs of the non-legislative aspects of the plan e.g. to reduce internal flooding.

5.3.6 We tested a range of approaches and scenarios and this has allowed us to understand the best set of activities at a regional level for meeting the long-term planning objectives. The two main approaches that were explored are the lowest whole life cost and best value. Following testing with stakeholders, the best value approach was used to been used to identify the best set of options to meet planning objectives.

5.3.7 Our core adaptive pathway is focused on the areas where we have greatest certainty, with a risk-based approach being taken for those areas of greater uncertainty, which are inherently higher risk.

5.3.8 In total, we forecast £30.3 billion of investment to ensure we can achieve the performance outcomes set out in Table 10 between 2025 and 2050. This includes circa £20 billion to meet the government's SODRP targets.

5.3.9 Our wastewater core pathway includes low regret investments for AMP8 to drive our forecast performance outcomes under a range of scenarios and uncertainties.

- Over AMP8 we plan to deliver £212 million of wider environmental outcomes (assessed using the Environment Agency's methodology for the WINEP). Further detail can be found in our WINEP enhancement cases. For this period, we also plan to:

- Improve 11,728 hectares of SSSIs;
- Restore 4,764 hectares of peatland to improve water quality;
- Address six barriers to fish passage and two risks of eel entrainment;
- Improve 36 discharges from septic tanks to deliver secondary treatment for the first time; and
- Deliver improvements to address nutrient enrichment in 219km of river designated as SACs, thereby supporting their recovery to favourable status.

5.3.10 Our wastewater core pathway aims for all short-term requirements to be met (this includes 2030 flooding targets, 2030 pollution targets, significant progress on storm overflows and WINEP statutory obligations). It also targets in the short-term (to 2030) the deliver our performance outcomes (Table 9) within the scenarios considered in our adaptive plan.

5.3.11 The core pathway targets delivery of our longer-term performance outcomes efficiently under the benign common reference scenarios (CRSs) and benign wider scenarios (see section 5.4 for our alternative pathways for wastewater). Key pieces of enhancement expenditure within the wastewater core pathway beyond AMP8 are as follows:

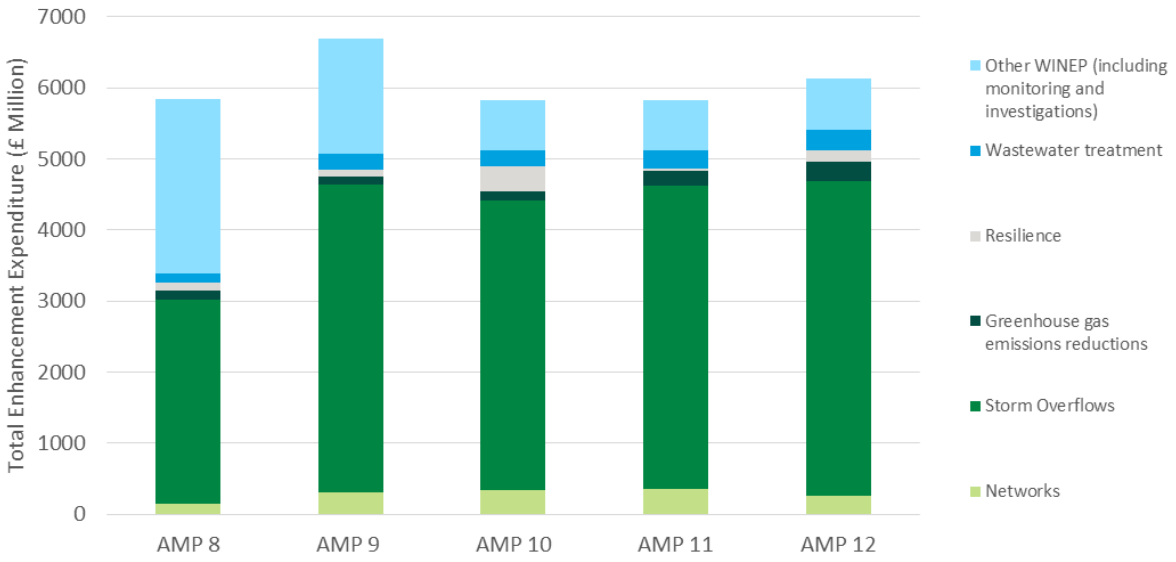
- £16.3 billion of investment to reduce the frequency of overflow operations;
- £294 million on investment in sustainable drainage systems (SuDS) to reduce the amount of rainwater entering sewer systems at peak times, supporting the capacity of the system;
- £940 million on improvements to treatment works to meet statutory drivers outlined in the WINEP;
- £419 million on DNM, further enhancing our pollution performance through the use of remote monitoring and artificial intelligence; and
- £1.13 billion for future wastewater supply and demand to ensure WwTW compliance.

5.3.12 Future options are kept open in our core adaptive pathway to ensure we can respond to future changes in scenarios, such as switching to an alternative pathway to manage an adverse scenario. This includes options such as strategic investigations. These are locations where we may need a radical change to achieve our ambitions. For example, the Irwell catchment is a wet catchment and has a long winter drain down which means that groundwater can impact on water quality in summer. The investigations will allow us to understand the nature of the problem and who we could work in partnership with to address the risk.

The detail of our core pathway for wastewater

5.3.13 The enhancement expenditure in our wastewater core pathway is summarised in Figure 22 by AMP and by broad expenditure grouping. Full details are provided in data table LS4.

Figure 22 Wastewater core pathway: summary of enhancement expenditure by type



Benefits we will deliver from base

5.3.14 We will make significant progress towards our long-term ambitions through base expenditure, especially when the benefits of innovations and improved efficiency are included. Examples of our planned base expenditure include a programme delivering continuing gradual improvements in performance, focused on avoiding maintenance/operational failures. This includes activities such as:

- 'What not to flush' and 'stop the block' customer awareness campaigns as well as engagement with FSEs regarding appropriate FOG disposal practices;
- Targeted planned cleaning and sewer serviceability programmes; and
- Ongoing maintenance costs for DNM monitors and platform and proactive interceptor trap removal.

5.3.15 Our base programme is therefore focused on 'controlling the controllable' through avoidance of flooding and other causes (FOC) flooding, i.e. flooding that is caused by operational issues such as blockages, tree roots, sewer collapses or mechanical failures.

5.3.16 Our core flooding strategy comprises of three complementary programmes of work. In addition to our base programme the remaining are covered by separate enhancement cases within our business plan submission, namely:

- A 'reducing risk of sewer flooding for properties' enhancement programme; and
- A rainwater management enhancement programme.

5.3.17 Extensive sewer network modelling was undertaken to develop our DWMP and WINEP programmes. We have extensive model coverage and our modelling approach follows industry code of practise which is accepted and specified by the Environment Agency and allows us to identify where new additional capacity is needed to meet new design performance requirements. This means that additional operating or maintenance expenditure to meet existing obligations are not included in the proposed enhancement investments for 2025-2050.

5.3.18 Given that the baseline for our modelling ensures that maintenance requirements are excluded, this provides confidence that the need for enhancement expenditure is certain, incremental and is driven by the new performance standard required rather than "double counting" existing obligations that should be met through base cost allowances

AMP8 forms the first five years of our long-term plan

5.3.19 Our AMP8 enhancement expenditure, focuses on:

- Investment to meet new statutory requirements outlined in the WINEP;
- Investment in rainwater management to reduce flood risk; and
- Investment in supply and demand schemes to increase the capacity of our wastewater treatment works (WwTWs) to accommodate growth.

5.3.20 Our Core Pathway for wastewater targets low regrets solutions and prioritises investment in the short-term where there is a current known need, i.e. all forecasts are verified by operational data. Consequently the earliest point for the diversion to an alternative pathway is AMP9.

5.3.21 As part of our AMP8 Rainwater Management enhancement case, we need to invest in surface water management measures across the North West to deliver the first steps in our 25-year plan for sustainable drainage. This is needed, critically, to increase the resilience of our wastewater network infrastructure to the excess rainfall that will drain through our networks as a result of drivers such as climate change and urban creep. A key benefit of managing rainwater at source is that it contributes to achieving multiple strategic objectives. We will be boosting biodiversity in our uplands and balancing surface water disconnections downstream through natural flood management. In our urban areas we will be contributing in part to reducing the risk of the capacity of the system being exceeded that disrupts public areas, rivers and customers.

5.3.22 Our core pathway tests against RCP8.5 in our sewer network models, a result of national modelling capabilities for wastewater network, and uses plan-based population growth for demand forecasting. The key trigger points for deviating from this scenario are like to be alterations in future permits at wastewater treatment works, or more stringent flooding prevention targets.

5.3.23 Our core pathway includes capacity to meet forecast demand across drainage areas, as well as specific assessment of short to medium-term significant growth areas (e.g. garden villages) and their impact on both wastewater networks and treatment. Assessments of changes in demand at a catchment scale had a negligible effect on treatment solution type. Our decision point for demand is consequently driven by legislative changes, which could have a more significant impact on investment needs to meet outcomes. The government 'Plan for Water' policy paper outlines actions including, bringing forward measures to end the sale of wet wipes containing plastic and rolling out standardised sustainable drainage systems in new developments. Additionally, a review of the Flood and Water Management Act is considering amendments to the 'right to connect' surface water to the sewer.

5.3.24 Our Core Pathway includes the rollout of smart sewer network management aligned to our Dynamic Network Management (DNM) approach in AMP8. As part of this, we plan to further optimise the operation of our wastewater network. This will include expanding our monitoring and control capabilities to enable smarter management of our network through increased modelling knowledge. System management will address the legacy of combined sewerage systems through better management and operation of the network we operate. This is optimising through both DNM and reducing the amount of rainwater we manage in the combined system. This will allow us to increase operational capacity by running our wastewater network with more efficiency, investigate and respond more quickly to overflow spills through better network knowledge and reduce pollution incidents.

Table 11 Our enhancement cases for wastewater

Enhancement Case	Background	Link to adaptive plan	Justification for AMP8 expenditure
Storm overflows	The frequency that storm overflows discharge is a growing concern for the industry. This has led to more stringent environmental and/or spill frequency requirements as outlined in The Water Environment (Water Framework Directive) Regulations 2017, The Bathing Water Regulations 2013 and the Environment Act 2021 This enhancement case covers expenditure required to meet the needs of these requirements in the short term, as well as set the foundation for further discharge reduction under a range of future scenarios.	Our long-term adaptive plan describes our approach to meeting our long-term ambitions on storm overflows under a range of scenarios. Our enhancement case puts us on track towards our long-term target of reducing storm overflow spills to fewer than 10 spills per overflow by 2050. We have made use of phasing and adaptive planning to ensure we meet statutory requirements in a way that balances costs across AMPs and prioritises delivery of least- low- or no-regret measures first. Where there is uncertainty we are proposing investigations ahead of action so subsequent investment can be best value. We are proposing drainage area catchment investigations, the outcome of these investigations will ensure that the most appropriate solutions for the drainage areas are planned to achieve the Environment Act targets Enhancement expenditure on overflow reductions therefore represent a significant proportion of the expenditure within our core pathway. Under a high impact climate scenario we would expect a more detrimental impact from rainwater, requiring further investment beyond that in AMP 8, as described in our wastewater adaptive plan we are not yet able to test the impacts of UKCP18 on storm overflows as these require time series data, this is something we plan to update in the next round of DWMP.	Storm overflows are a significant challenge for UU. Under all plausible future scenarios, significant capital investment is required to reduce spill frequency throughout the next 25 years. The scale of transition required is driven by a range of factors including: the extent of the existing combined sewer system, the high levels of rainfall in key urban areas, and the poor soil permeability in much of the region. We've profiled the investment required to meet both 2050 and interim targets. We have proposed investment in innovative hybrid solutions in AMP8 in order to drive forward improvements in spill performance. We are actively seeking partnerships to help spread costs across responsible and/or benefitting parties and our Advanced WINEP will enable us to work with regulators barriers to delivering rainwater management solutions required as part of the long-term adaptive plans While the proposed plan takes us beyond the Defra trajectory targets of 14 per cent of overflows improved and 38 per cent of high priority overflows, the programme is appropriate in the context of the overall targets we need to meet. As we move through the 25 year programme we anticipate the unit cost per spill reduction is going to increase as we tackle these overflows on large and complex trunk sewers which will require multi AMP programmes to resolve. We therefore envisage future AMPs will contain less overflows but still require similar levels of expenditure to AMP8. We will be using AMP8 to plan for some of this major investment The programme aims to invest in best value and least regret actions with a focus on driving rainwater management interventions which will reduce or eliminate the future requirement of investing in grey storage to meet the government targets.
Rainwater Management	By delivering rainwater management, we will reduce the amount of rainwater entering our combined sewer network through sustainable attenuation and disconnection. This will provide resilience against the forecast increased risk of sewer flooding as a result of more frequent and intense rainfall, primarily driven by climate change. This enhancement case proposes a shift from traditional grey storage solutions, towards blue-green infrastructure in the form of Sustainable Drainage Systems (SuDS).	Managing rainwater at source contributes to achieving our long-term targets in biodiversity and sewer flooding. We are at high risk of deteriorating sewer flooding performance due increased intense rainfall under climate change. In order to meet our long-term sewer flooding target of fewer than 1.43 sewer flooding events per 10,000 connections by 2050, we require phased investment over the next 25 years. This investment is aimed at protecting against the risk of future performance deterioration due to climate change. The scale of the operational change and total investment necessary to fundamentally reconfigure our network and control rainwater at source means that rainwater management investment must be staggered across multiple AMPs, with benefits being realised in the long-term.	Our proposed investment is in catchment and nature-based solutions; a proposed shift from traditional grey storage solutions to SuDS. We have identified opportunities to deliver this through partnership working. Investment is required now to ensure long-term functionality and resilience to the growing impacts of climate change, and to mitigate the risk of more significant future investment. A delay in investment will result in the deterioration of flooding performance despite investment through base expenditure due to the increased hydraulic risk the region is facing. Investing in rainwater management now mitigates increased future reactive maintenance, which could incur large cost for UUW in AMP9 and beyond. The implementation of SuDS to manage the increased surface water entering our network is a no-regret investment that allows us to plan adaptively and take a precautionary approach to managing future risk in the face of a future uncertainty.
Flooding	The North West has 40 per cent higher than the average rainfall urban and the highest proportion of legacy combined sewers in the industry. Therefore we face an elevated sewer flooding risk. Sewer flooding presents devastating impacts to customer's livelihoods and mental health. Significant investment is required to mitigate this risk.	Our long-term adaptive plan describes our approach to meet our sewer flooding targets in the long-term and short term. We aim to reduce internal sewer flooding to 1.65 incidents per 10,000 connections by 2035 and 1.43 incidents per 10,000 connections by 2050. Our core pathway proposes significant investment in grey and blue-green infrastructure to reduce sewer flooding, with increased expenditure in the long-term under the adverse climate scenario due to increased intense rainfall.	This programme of works will complement our rainwater management enhancement case in order to deliver the step change in network performance required to meet our ambitions. As well as preventing future deterioration in performance, we must mitigate existing sewer flooding issues and improve our performance. Our proposed investment will expand our network of sensors in order to facilitate proactive service. This will improve our performance at the system level in the long and short term. Improved sensor coverage on the network will also improve our innovative Dynamic Network Management capabilities to trial solutions to reduce future hydraulic flood risk.
Flow and EDM	The Environment Agency are varying our Environmental Permits to drive forward improvements in our service levels in order to protect the environment. This enhancement case describes our proposed investment in river water quality monitoring.	Protecting the environment is a key driver of our long-term Wastewater strategy. Continuous river water quality monitoring contributes to our River Water Quality target of an 80% reduction in phosphorous by 2038.	We have phased our investment in monitoring to allow for an adaptive approach in which further interventions are carried out at the most appropriate time.

Enhancement Case	Background	Link to adaptive plan	Justification for AMP8 expenditure
Coastal and River Erosion	UUW is situated in an operating region that is especially susceptible to coastal and river erosion. Climate change projections indicate that the North West will experience more frequent and intense winter storms, storms that can be expected to accelerate the rate of erosion of the land supporting our critical infrastructure.	Understanding and building resilience to erosion risk is critical in delivering our long-term ambition to reduce water supply interruptions, sewer collapses and pollution incidents. Understanding and mitigating risks of coastal and river erosion is therefore a significant component of our water and wastewater long-term strategy.	Due to the scale of the risk that coastal and river erosion imposes, AMP 8 investment is necessary to enhance the resilience of our asset base. Understanding and building resilience to erosion risk is critical in delivering our long-term ambitions in our water and wastewater services. Consequently we will phase our work, prioritising investigations sites with the highest risk in AMP8 to inform future intervention needs. By better understanding our erosion risk profile, we can ensure that interventions are scheduled appropriately as part of a long-term adaptive plan. As erosion rates are uncertain in the context of climate change we must complete preparatory work to enable quick adaptation to change in future price control periods.
First Time Sewerage	Section 101A Water Industry Act 1991 requires us to provide sewerage to first time applicants where the application meets the criteria. Investment in first time sewerage will protect and improve the environment and amenity value in the first time sewerage areas.	In our core pathway, we forecast a flat profile of expenditure across future AMPs as we deliver small-medium scale first time sewerage schemes from applications that meet criteria set out in legislation, as and when received. The proposed investment is sensitive to the Ofwat Demand CRS and our Changing Expectations wider scenario.	In the North West we estimate there are approximately 64,700 properties on private septic tanks who are eligible to enquire or submit an application for first time sewerage at any time. We have a statutory obligation to assess applications and provide sewerage where applications meet the criteria. The location and need for the service lies outside of the company control. However, to mitigate this risk we engage with stakeholders to understand where there may be upcoming applications.
Supply and Demand	Resident population in United Utilities operational area the North West is growing. We have an obligation under the Water Industry Act (1991) to ensure that new developments are effectively drained and the resultant wastewater is treated to the required standard to ensure there is no deterioration in environmental impact or customer service.	In order to meet our long-term wastewater targets under a growing population investment in wastewater treatment is required. Discharge permit compliance is statutory and we plan to achieve compliance across all of our long-term delivery strategy period.	In order to determine the extent to which future investment is needed to increase our treatment capacity we must assess the risk of growth in the region. We have developed alternative adaptive pathways in order to assess and amend our plans if growth forecasts change within the AMP. We are monitoring demand which may trigger a different pathway of investment. This investment is focused on pilot developments with the view to scale in the future, but the plan also at the network system level in the area in line with our systems thinking approach.
Wastewater Reservoirs	Under the Reservoir Act 1975 we have a duty to inspect and maintain reservoir structures. We have identified 10 legacy sludge sites (with multiple sludge lagoons) for further investigation and remediation to ensure compliance under the Act.	Compliance with the Reservoir Act protects people and the Environment. Sludge lagoons pose a risk to public and environmental safety which are both important drivers of our bioresources strategy.	The reservoir act is statutory so investment in monitoring, site surveys, action plans and any structural improvements and remediation is necessary both for our compliance and for the safety of customers and the environment.
Green Recovery	In order to meet Water Framework Directive standards, investment is needed to complete the schemes as agreed through Green Recovery to improve the water quality in the rivers Irwell, Mersey and the Manchester Ship Canal.	Our Wastewater strategy outlines long-term targets to improve river water quality by reducing phosphorous levels by 80 per cent by 2038. Our core pathway proposes investment in AMP 8 to set the foundation to meet these targets, with increased future investment forecasted under adverse climate and demand scenarios.	Necessary improvements water quality in the Ship Canal will be realised through partnership working such as through the Mersey Rivers Trust and Manchester Ship Canal Partnership Forum. Our collaboration with stakeholders focuses on innovative long-term multi beneficial environmental improvements. The accelerated completion of our green recovery schemes will result in an earlier improvement to the River Irwell which the long-term strategy for the Manchester Ship Canal will build upon in an adaptive way.
Power Resilience	This enhancement case describes investment required to address the threat of a regional or national power interruption to some of our most critical sites. To enable United Utilities to help to provide continuity of service and reduce the risks associated from of a supply side power loss.	Our long-term strategy outlines the ambitions of minimising service disruptions to customers and protecting the environment. To realise these ambitions we need our most critical assets to be supported by a reliable back-up source of power. This solution will deliver resilience now and in the future, accounting for climate change in both a benign and extreme future. With wetter winters and more extreme weather predicted, the likelihood of power disruptions and their impacts is heightened, with the increasing frequency and severity of storms and flood risk. Our most critical assets would have an extra layer of protection through the provision of a back-up power supply.	To help to manage and reduce the risk that power interruptions pose, enhancement expenditure is now being sought to provide an improved level of resilience in response to the changing risk landscape. We propose targeted interventions to our most critical sites, which could be scaled up in the future in an adaptive way. Investment in generator power will help to provide continuity of service at our critical sites in the event of a significant supply-side power interruption, to bridge the gap to grid power being restored.
DPC Final Effluent programmes	This enhancement case describes investment to prepare Manchester Ship Canal (BOD) programme for direct procurement for customers (DPC) delivery with the overall aim to meet stricter environmental permit requirements in AMP8.	Our long-term strategy describes our adaptive plan to meet our ambitions out to 2050. We aim to improve river water quality by reducing phosphorous by 80 per cent by 2038. To contribute to this ambition, we have developed an adaptive plan for managing water quality in the Manchester Ship Canal.	The canal experiences a range of impacts from our operational discharges and third party industrial discharges. Preparatory work outlined in this enhancement case will allow us to better understand the challenges posed by these discharges and allow us to plan adaptively to deliver water quality improvements within the upper River Mersey.

5.4 Our alternative adaptive pathways for wastewater

5.4.1 Our wastewater core pathway meets statutory requirements and, where there are choices, is resilient to the key future uncertainties we are likely to face. As such, the component solutions of our core adaptive pathway are low regret and we have high confidence in the need for this investment.

5.4.2 To deliver our forecast performance outcomes under specific, more extreme future scenarios, however, we would need to invest in different solutions. As these solutions are only needed under a single or small number of scenarios, they are higher regret. We have presented these higher regret solutions as alternative pathways which we would only propose to switch to if the need became clear.

Alternative adaptive pathway performance under scenario testing

5.4.3 Table 12 demonstrates the short and long-term outcomes achieved under each scenario tested, these are described in further detail below.

Table 12: Confidence in short and long-term outcomes being achieved under each scenario tested

Scenario	Short-term outcomes					Long-term outcomes				
	Pollution	Internal flooding	External flooding	Collapses	Storm overflows	Pollution	Internal flooding	External flooding	Collapses	Storm overflows
Benign (all)										
Climate change adverse										
Changing expectations adverse										
Demand adverse										

Benign (low) climate change

5.4.4 This pathway is based on low climate change impact on the baseline risk identified in DWMP. Our network models use RCP8.5 as a common assumption for 2050, within this scenario we have assumed risk stabilises from 2030 onwards aligned to the trajectory presented for RCP2.0. The result in the benign scenario is a less hydraulic flooding risk than an equivalent model with an RCP8.5 and a shift in focus to maximise investment to reduce flooding other causes, this flood mechanism generally results from blockages and collapses in the sewer network. Consequently, the range of options required to mitigate the baseline risk are less expensive than in other, more adverse scenarios. The key trigger point for deviating from this this scenario would be the rate of hydraulic flooding risk increase over time.

Adverse (high) climate change

5.4.5 Our decision point for climate change is driven by updated UK climate projection (UKCP) data, 2018, and a review of international scientific expectations on the most realistic low climate change scenario. Under the high climate change scenario, we assess the impact of UKCP18 would be a more detrimental impact on rainfall, driving further investment need in both sewer flooding and overflows, making these ambitions more challenging to meet at an affordable cost.

5.4.6 Our adverse pathway is centred on UKCP09 RCP8.5 testing as standard in wastewater network and wastewater treatment works programme which is built into the Core Pathway.

5.4.7 Our adverse pathway includes additional investment to improve the resilience of our infrastructure to flood risk.

Adverse (high) demand

5.4.8 Population growth and changes in business and industry directly impact the volume of wastewater we are required to treat. Our enhancement expenditure must increase our capacity to keep up with growth and development in the region both in the sewer network and capacity at the wastewater treatment works.

5.4.9 Network capacity has been assessed using population uplifts and has taken into account a number of 'high risk' future developments that have been identified through developer impact assessments.

5.4.10 Wastewater treatment capacity has been assessed by using potential variations on flow. For example, to understand the potential impact of a +/-30 per cent growth on flow.

5.4.11 A key option is to manage the timing of the growth, rather than the size, for example in areas that have potentially new significant growth, such as garden villages. Another aspect of demand which we have considered is the impact of network solutions on wastewater treatment works. Our storm overflows programme includes a combination of rainwater management and storage – where rainwater management need to ensure don't lose the cleansing velocity in the sewers or will have septic effluent, where storage very dilute flows which were previously spilling to river will now be stored and return to the wastewater treatment works, extending the period of peak flows and delivering dilute wastewater which could impact on solution design.

5.4.12 Our core pathway assumes no changes in legislation and no new large growth areas. In the adverse demand pathway, we consider the impact of further significant strategic growth (e.g. garden villages and significant new trade effluent). This results in additional spend in later AMPs which will be reviewed through our business as usual processes to manage growth and strategic development.

Adverse (slow) and benign (fast) technology

5.4.13 There are many technological trends that we monitor and are continually evaluating. We use information sources such as literature, industry forums, research centre relationships, and discussions with partners, subject matter experts and academia. These sources have helped to shape our technology scenario.

5.4.14 The faster (benign) technology scenario assumes a new wastewater approach by 2040 including monitoring and advanced forecasting of localised surface water rainfall and related pollution/ wastewater stresses, including intelligent sewer technology, enabling rapid response and preventative action. The new approach would also include automatic monitoring and enhanced sampling of environmental water quality. The faster technology scenario also assumes full open access to datasets across water companies and other utilities.

5.4.15 A key option selected in our plan is a wider role out of our DNM strategy, which was highlighted as a key initiative in the business plan submission for investment cycle 2020—2025. This uses machine learning and artificial intelligence across the sewer network to enable proactive targeting and performance improvements; something which would not have been possible just ten years ago.

5.4.16 64 strategically significant catchments are scheduled to have DNM technology installed by the end of AMP8, with many already complete and online. Through optimisation we have modelled our expenditure on the remaining four AMPs in our DWMP. The proliferation of DNM is to continue into AMP12.

5.4.17 Our adverse technology scenario considers the impact of a slower rollout than forecasted, which slows the realisation of pollution ambitions and sewer flooding.

5.4.18 In a benign scenario, low carbon concrete becomes ubiquitous and as cost effective as traditional concrete. This benefits our GHG emissions ambitions and reduces the challenges associated with delivering against this ambition.

Adverse expectations

5.4.19 This scenario delivers additional investment related to first time sewerage for wastewater. Whilst we anticipate there are likely to be further changes in legislation and public expectations around treatment standards these are largely unknown would be difficult to monitor, consequently these do not feature in our scenario testing. We will continue to monitor such changes through drivers for change analysis and support industry research into potential emerging contaminants for example through the chemicals investigation programme.

5.5 Opportunities to collaborate

5.5.1 In order to address the complex environmental challenges faced, and deliver best value for customers, we are taking a leading role in driving resilience across the North West and beyond that through our current capabilities. This is a vital part of delivering on the ambition to deliver wider environmental outcomes, while meeting our statutory obligations. As part of this approach, we are:

- **Piloting place-based planning:** Integrating the management of risks and issues around water and the environment in a way that is relevant and sensitive to each place. This requires deep engagement with key partners and is being developed first in the Upper Mersey, Eden and Wyre catchments. Through AMP7 we have been working with key partners, the Environment Agency and Greater Manchester Combined Authority to form a strategic partnership. With them we have developed an integrated water management plan for the city region which is endorsed by the city mayor and published to be accessible to all through the combined authority website[11]. The aim of this is to focus on all aspects of Greater Manchester's water cycle, bringing together strategic plans across sectors to drive holistic water management, enhance water quality, reduce flooding and increase biodiversity. Further details of the integrated water management plan are available in *UUW35 Environmental Strategy* supplementary document section 3.4.
- **Developing innovative finance models to engage markets and realise external funding**: Driving the development of new financial mechanisms through our role as a founding member of the Wyre Natural Flood Management (NFM) Community Interest company Board, as well as supporting the development of Eden catchment market governance;
- **Leading cross industry innovation projects to fully unlock CaST:** We have led collaboration across water companies to make a successful bid to the Ofwat Innovation fund for the CaST monitoring Cooperative (circa £7 million), which aims to find cost effective ways of increasing intelligence on catchment health. Throughout this project we will be able to share learning with other water companies and third party organisations to evolve our approach to monitoring and responding to catchment issues;
- **Driving the move to nature-based solutions to protect future service**: Investing in natural and hybrid infrastructure to protect water resources and improve water quality. To enable the delivery of Environment Act 2021 targets by 2050 we developed a successful Advanced WINEP proposal for Rainwater Management which will unlock earlier, innovative investment and partnerships on rainwater management and storm overflows. It will focus on unlocking rainwater management solutions in catchment areas where storm overflows need to be improved in order to meet SODRP targets after completion of the AMP8 WINEP. This programme aims to invest in 'best value' and 'least regret' actions, with a focus on driving rainwater management interventions which will reduce or eliminate the future requirement of investing in grey storage to meet the government targets.
- **Using a natural capital approach to align activity across the North West**: Continuing to develop a regional natural capital account for the North West for use with stakeholders to drive collaboration

[11] https://democracy.greatermanchester-ca.gov.uk/documents/s27343/10A%20Integrated%20Water%20Management%20Plan.pdf

and better outcomes for nature. Embedment of a natural capital assessment methodology to enhance the environment, while delivering outcome delivery incentive (ODI) outperformance; and

- **Aligning with the DWMP**: Assessing whether future risks and opportunities identified are occurring earlier than previously assessed, and any changes to programmes of work which could affect customers, stakeholders, communities and the environment.

5.5.2 We continue to drive these approaches described above well beyond the current period of WINEP options development and intend to unlock further benefits through AMP8 and beyond.

5.5.3 Our collaborative programmes with our stakeholders have already delivered a wide range of benefits. Actions, which are required from others to drive further delivery of our ambitions, include:

- Sharing investment plans and ideas early across organisations so that we can jointly identify any synergies that exist between plans;
- Alignment of funding cycles across organisations so that planning and investment takes place in alignment, to better enable the co-funding and delivery of projects;
- Introduction of legislative changes to remove the right to connect surface water to sewer systems;
- Source control of problem items including chemicals and ending the sale of products such as non-degradable wet wipes, which cause issues for sewer blockages;
- Implementation of planning guidance to mainstream the delivery of sustainable drainage on all new developments;
- Action to encourage the disconnection of surface water sources e.g. highway surface water drains, reducing the amount of rainwater entering the sewer system; and
- Fully embracing the polluter pays principle to ensure all parties address their impacts on the environment in an equitable and proportionate way.

5.6 How we will monitor and adapt our plans

5.6.1 For each of our wastewater alternative pathways, we have identified:

- The metrics that will be monitored, how these will be calculated and the source of the data;
- The frequency at which the metrics will be monitored and reviewed; and
- The thresholds that the metrics will be monitored against and what action will be taken when the thresholds are reached.

5.6.2 Table 13 presents our monitoring plan for the wastewater components of our LTDS. Our full LTDS monitoring plan in presented in Appendix B, including an explanation of how the LTDS monitoring plan is integrated within the UUW corporate risk management process.

Table 13 Monitoring plan for the wastewater component of our LTDS

Pathway name	Monitoring metric	Decision Threshold[12]	Current expected decision date	Trigger threshold	Current expected trigger date
Adverse (high) climate change	Pluvial and fluvial flood risk to assets	Reassessment following national flood risk assessment 2 (NaFRA2) corroborated by operational risk assessments	2028	Ofwat approval of future enhancement case for resilience	2030
	Increased risk associated with RCP8.5 in UKCP18	Reassessment of flood risk and storm overflow spills following the publication of sewer modelling tools using UKCP18	2028	Ofwat approval of future enhancement case for flooding or storm overflows	2030
Adverse (high) demand	Planning approvals	Garden villages approved in catchments where this necessitates WWTW upgrades	2038	Ofwat approval of future enhancement case for WWTW upgrade	2040
	Demand projection	Projection indicates need for additional first time sewerage provision	2028	Ofwat approval of future enhancement case for first time sewerage	2030
Adverse (increased) expectations	Amendment of S101A legislation.	Amendment of S101A legislation to make first time sewerage application more likely to be accepted.	2028	Ofwat approval of future enhancement case for first time sewerage	2030

6. Our long-term strategy for bioresources

Key points

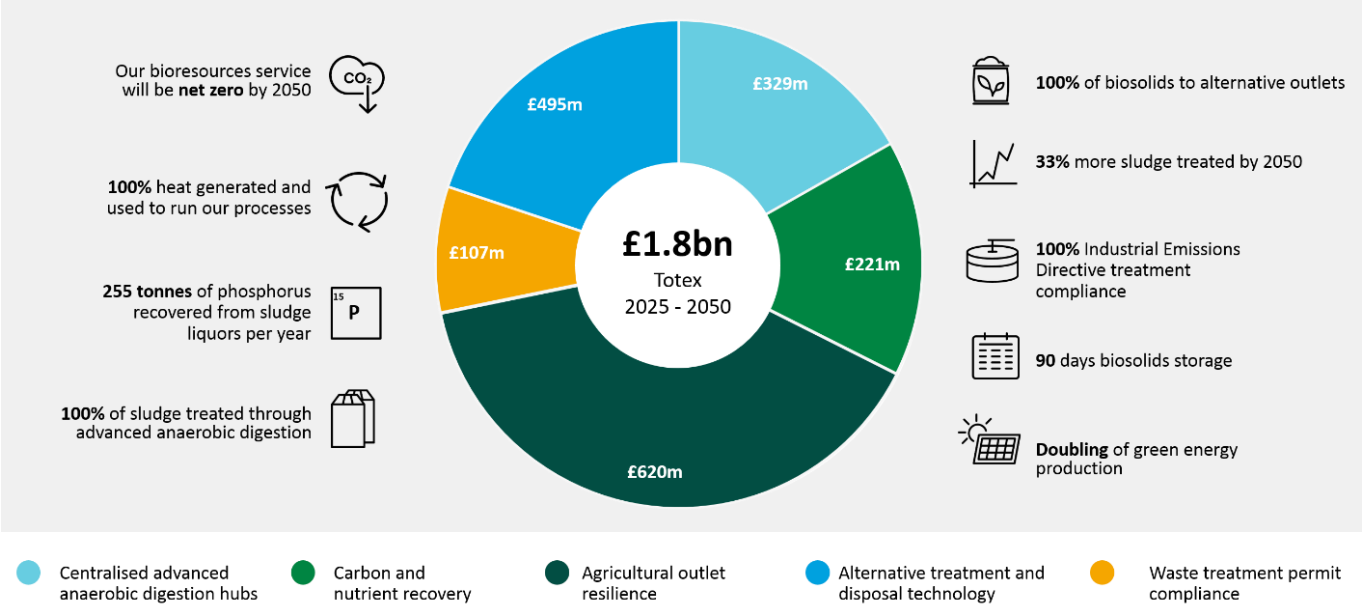
- **A transformational investment programme for the future:** Our long-term plan for bioresources identifies the need for £1.76 billion of enhancement expenditure over the next 25 years. We are anticipating a step–change in the bioresources business model, although there is significant uncertainty over the scale and the timing of the change.
- **Managing significant uncertainty:** The uncertainty in landbank availability for biosolids recycling means an adaptive plan is critical. The scale of change required, if landbank is no longer available, will take multiple AMPs to put in place the solutions to provide guaranteed alternative outlets. We have prioritised low regrets investment where we have certainty over the requirements. However, if regulators require an immediate (AMP8) move away from recycling biosolids to land (a deviation from our core pathway) this may require immediate costs of up to circa £300 million in AMP8 to divert biosolids away from agriculture, alongside commencing and committing to a further £700 million in AMP9 to deliver a resilient and long-term alternative outlet for biosolids. We therefore propose an in-AMP uncertainty mechanism (a Notified Item) for the bioresources price control.
- **Ensuring a resilient sludge treatment and disposal service:** AMP7 has seen multiple shocks to the biosolids market and we will deliver agreed WINEP investment of £170 million in AMP8 to improve the resilience of our biosolids recycling service. The risk of losing the sludge recycling outlet to land is increasing, requiring acceleration of investment aligned with our core pathway.
- **Providing additional sludge treatment capacity:** Population growth and increasing standards of wastewater treatment are leading to increasing raw sludge production, forecasted to be 33 per cent over the next 25 years. We anticipate needing to create 83,000 tonnes dry solids additional sludge treatment capacity per annum over this period and we will utilise markets for delivery where they provide best value.
- **Maximise recovery of value from bioresources:** Our long-term vision is for our sludge treatment centres to become 'bio-refineries' or resource recovery hubs where a multitude of products are recovered from sewage sludge across an integrated wastewater and sludge production line. We identify the need to collaborate with partners to innovate and accelerate new technologies for deployment and ensure that we unlock the full potential value of bioresources.
- **Protecting the environment through a phased reduction in reliance on agricultural landbank:** We will improve landbank resilience through a phased transition out of biosolids recycling to agriculture by 2050 to match the growing environmental ambitions of customers and regulators. We seek £10.4 million enhancement investment to undertake preparatory works for uncertain and long-term options for biosolids disposal aligned with our LTDS.

6.1 An overview of our long-term strategy for bioresources

6.1.1 Sludge and biosolids are transported around and outside the North West region, for treatment and recycling to agriculture. The network is managed at a regional scale, and a Systems Thinking approach is required to optimise interventions across the asset base. As such, a single adaptive plan has been prepared for the bioresources business looking across the entire value chain. This will enable us to plan investment and navigate significant uncertainties.

6.1.2 The bioresources business model will be transformed over the next 25 years. We anticipate that biosolids recycling to agriculture will reduce over time to match the changing environmental ambitions of customers and regulators. The bioresources long-term outcomes are presented in Figure 23.

Figure 23 – Our bioresources outcomes 2025-2050



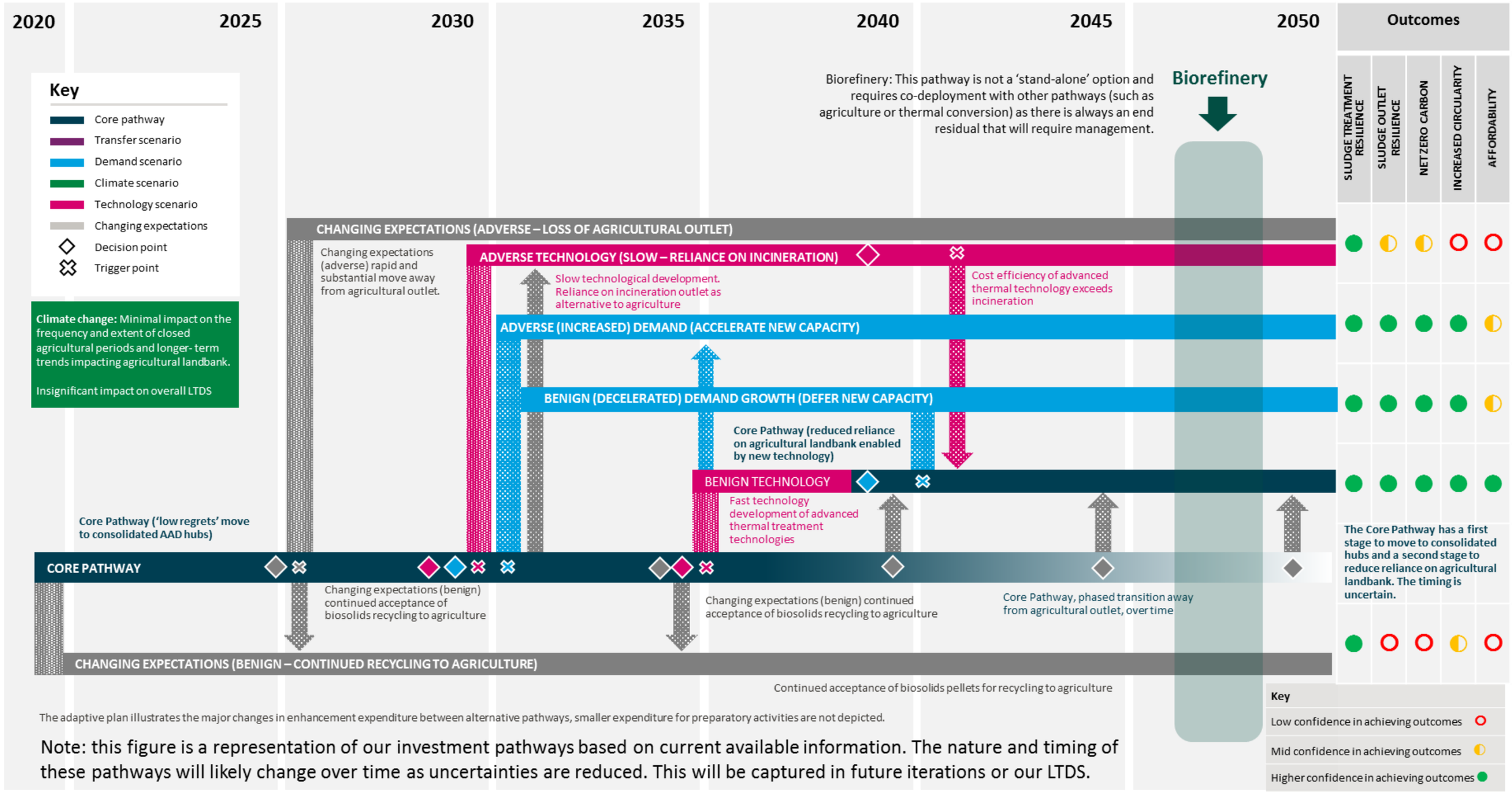
6.1.3 There is significant uncertainty over the future of the bioresources operating model and we have developed our adaptive plan to help us navigate through the uncertainty and make significant investment decisions at appropriate points in time. We consider that AMP7 has been a turning point in the evolution of the bioresources sector, as new environmental regulatory expectations on the sector have started to be revealed. This is driving additional investment requirements at PR24 as we need to invest to improve our resilience and comply with new environmental standards.

6.1.4 We will ensure maximum flexibility by keeping multiple strategic pathways open and have prioritised low regrets investment where we have certainty over the requirements. We have deferred significant investment to implement actions to move away from biosolids recycling to agriculture from AMP8, keeping bill impacts lower in AMP8.

6.1.5 There does, however, remain a risk that may require immediate costs of up to circa £300 million to divert biosolids away from agriculture alongside commencing and committing to a further £700 million of investment in AMP9 to deliver a resilient and long-term alternative outlet for biosolids. We therefore propose an in-AMP uncertainty mechanism for the bioresources price control. A summary of our AMP8 investment approach, to navigate through the uncertainties in 2025-2030 is presented in Figure 24.

6.1.6 A proactive strategy is necessary to adapt to drivers for change and ensure that we have taken reasonable precautions and measures to ensure provision of an efficient and sustainable biosolids service. As presented in Figure 24, to achieve our ambitions we have created a long-term adaptive plan to 2050. This plan incorporates the common reference scenarios plus a wider scenario considering changing expectations which includes landbank availability. We have identified through our LTDS that insufficient outlet for biosolids recycling to agriculture is the most significant uncertainty which could trigger the need to move to an alternative pathways in our long-term adaptive plan.

Figure 24 – Bioresources long-term adaptive pathway to 2050



The adaptive plan illustrates the major changes in enhancement expenditure between alternative pathways, smaller expenditure for preparatory activities are not depicted.

Note: this figure is a representation of our investment pathways based on current available information. The nature and timing of these pathways will likely change over time as uncertainties are reduced. This will be captured in future iterations or our LTDS.

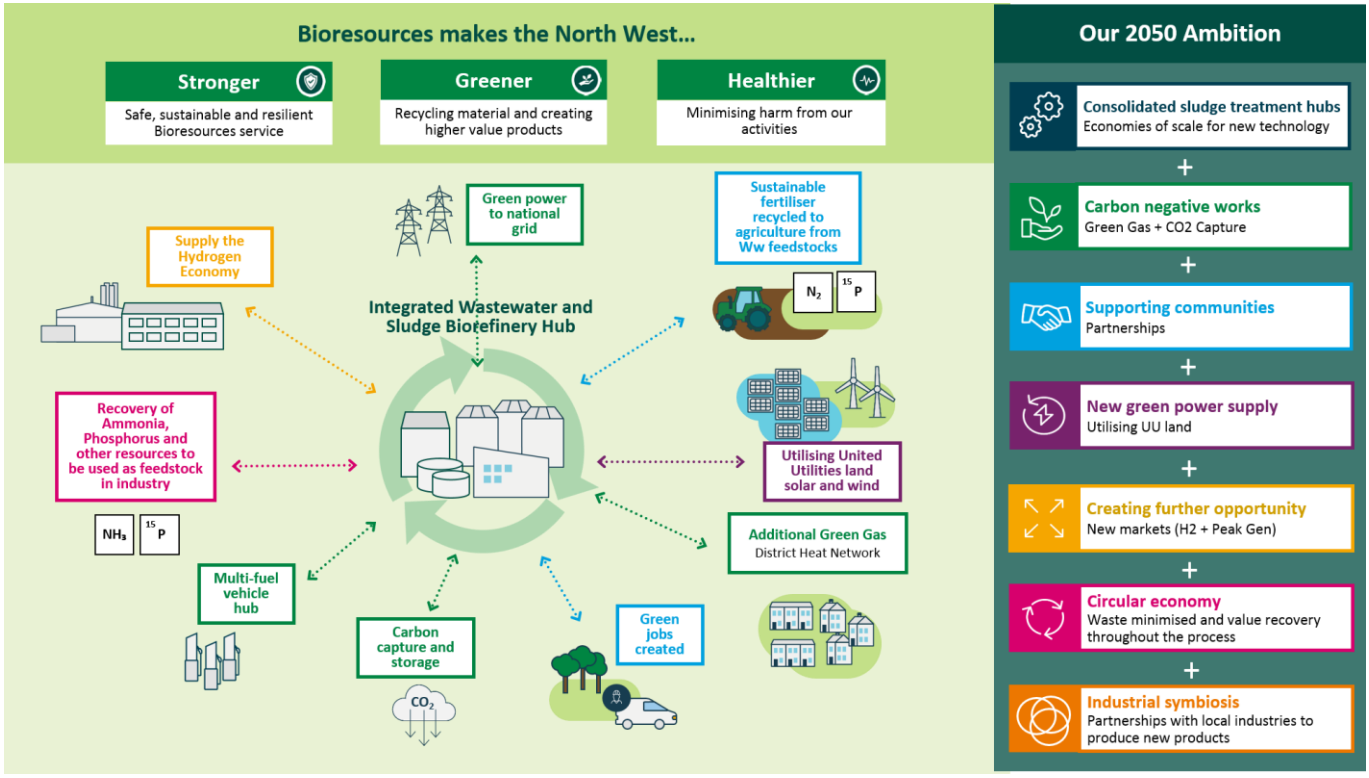
6.2 Our ambition for bioresource services in the North West

6.2.1 We are committed to providing efficient, effective and resilient bioresource services. Over 200,000 tonnes of sludge are produced a year and it is our responsibility to ensure that we continue to meet regulatory requirements and develop and maximise the value created through recovery and re-use of this valuable resource.

6.2.2 The bioresources business model will be transformed over the next 25 years. We anticipate that biosolids recycling to agriculture will reduce over time to match the growing environmental ambitions of customers and regulators. Innovation will be at the heart of our transformation to deliver new technologies to ensure that we embrace and realise the benefits of a more circular economy, generating higher value products that reduce our impact on the environment, lower greenhouse gas emissions and deliver significant benefits to society.

6.2.3 The sludge treatment centres of the future will become bio-refineries; we envision fewer, but large-scale treatment centres that will generate efficiencies and sufficient economies of scale to recover and capture value at every stage of an integrated wastewater and bioresources production line. We strive to work in partnership with the wider community and industrial and academic partners to develop new products and new markets. We will embrace markets for delivery and seek co-treatment opportunities where they add value for customers. Our ambitious business model is summarised in Figure 25.

Figure 25 – Bioresources 2050 ambitions



6.2.4 Our bioresources ambitions presented in Table 14 align to this vision. Successful management of our bioresources business aims to deliver beyond net zero to create carbon negative works, capturing and utilising greenhouse gases in innovative forms and products. Maximising resource productivity will allow us to support a zero-waste economy and improve the sustainability of our activities, while adding wider value to society.

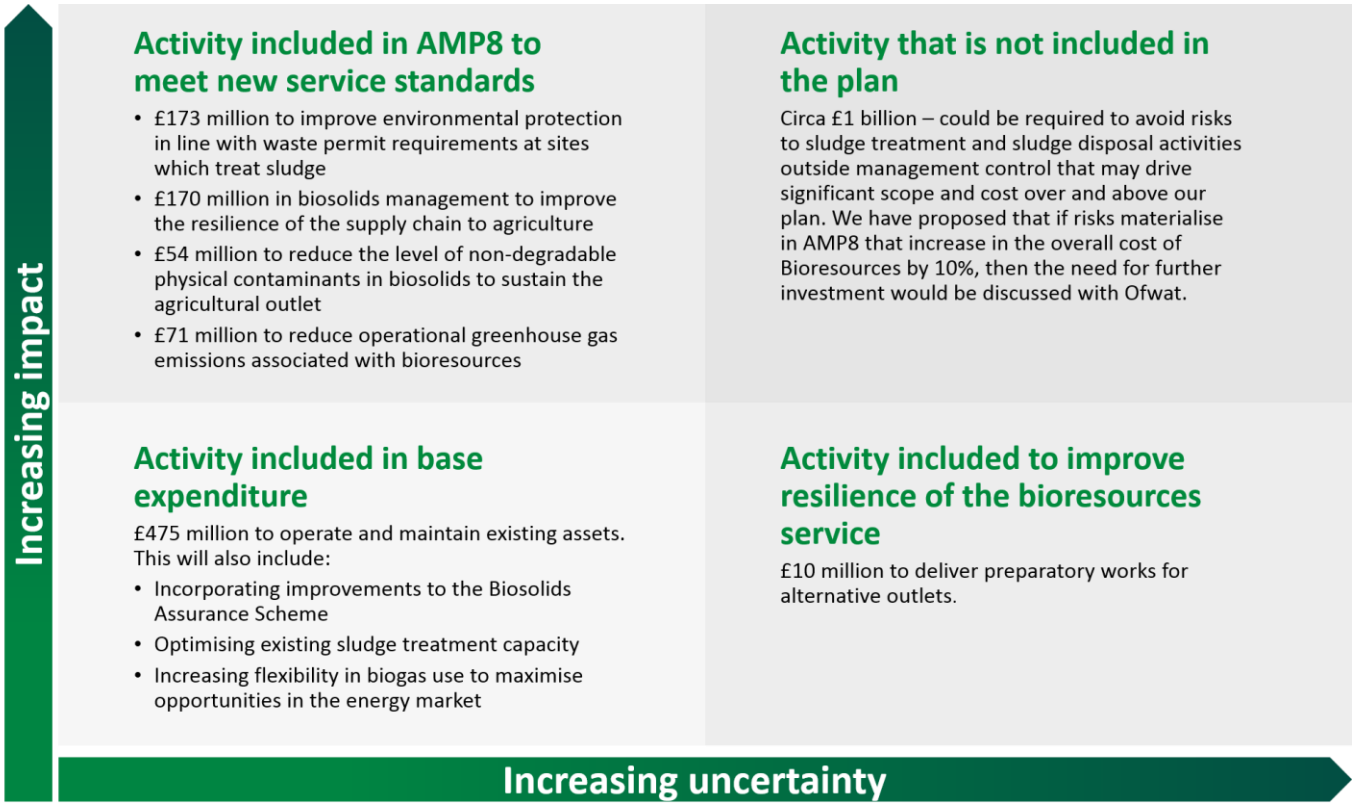
Table 14- Bioresources ambition

Ambition	Detail
We will enhance the resilience of our sludge management service	The availability of landbank for biosolids recycling is restricted by a number of factors. While our core pathway is to continue to recycle biosolids to land in the short term, we will maintain flexibility by keeping multiple strategic pathways open. We will improve resilience of the bioresources service and seek a phased reduction in reliance on landbank by 2050 to match the environmental ambitions of customers and regulators. **AMP8:** Through WINEP actions we will invest £170 million to improve resilience in the sludge management supply chain to agriculture. Through £10.4 million of enhancement investment we will deliver planning and design activities for uncertain and long-term options for biosolids disposal. This keeps our future options open.
We will protect, restore and improve the natural environment of the North West through our actions	We support our farming community through provision of sustainable organo-mineral nutrients to almost 20,000 hectares of agricultural land each year. We will work with others to understand the potential risks from emerging contaminants such as Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) and microplastics and play our part to deliver government objectives set out in the Environment Act to 'manage soils sustainably' by 2030. **AMP8:** Building on our record of 100 per cent compliance for the last two years with the voluntary Biosolids Assurance Scheme we plan to deliver £54.1 million of enhancement investment to deploy fine screening of all our sludges, going beyond current best practice, seeking to minimise as far as possible plastics and other non-degradable material in biosolids recycled to land. We plan to invest at our sludge treatment centres to improve environmental protection standards to comply with the latest 'best available technique' standards set out under the Industrial Emissions Directive and/or Environment Agency Appropriate Measures guidance.
We waste nothing and will continue to develop and maximise the value recovered from bioresources	Maximising resource productivity will support a zero waste economy, and generate higher value products that reduce our impact on the environment and deliver significant benefits to society. **AMP8:** By continuing to recycling biosolids to agriculture we aim to generate an equivalent financial value of almost £8.5 million worth of fertiliser to the farming sector each year. We will work with others to innovate and accelerate new technologies to increase resource productivity. We have leveraged partnership funding to pilot commercial-scale production of biopolymers and recovery of cellulose from sludge, and separately to produce graphene and hydrogen from biogas. At our largest sludge treatment centre, we will install a full scale phosphorus recovery plant, recovering 255 tonnes of phosphorus per year.
We will progressively reduce our greenhouse gas emissions	Bioresources operations are a significant contributor to our carbon footprint, but also have the greatest potential to reduce emissions to meet our overarching net zero carbon goals. A foundation of our long-term strategy is a move to consolidate smaller, aging anaerobic digestion sites to large scale Advanced Anaerobic Digestion (AAD) hubs. This technology is aligned with the lowest emissions pathway for the industry. **AMP8:** We will reduce fugitive emissions at our sludge treatment centres, covering all open tanks and secondary digesters. We will seek to transform our fleet, and are working in collaboration with other sectors to trial electric HGVs. We are developing a partnership scheme to work with Carlton Power to enable the Trafford Green Hydrogen energy hub and help us and others to reduce their carbon footprint by utilising low/zero emission fuels.

6.2.5 We recognise that the scale of potential change facing the bioresource business is immense. However, the degree of uncertainty about the timing, coordination and impact of reforms is significant. This means that, rather than being able to deliver changes to bioresources management in the short, medium and longer term, there is a risk that the industry becomes stuck in a state of inertia. We believe that the sector has reached a critical point and it is clear that greater understanding and consensus over the future direction of the sector is required. We have led the water industry in considerable efforts to work collaboratively with our regulators to clarify uncertainties and resolve challenges over the future of the bioresources sector.

6.2.6 Our AMP8 plan will ensure maximum flexibility by keeping multiple strategic pathways open and we have prioritised low regrets investment where we have certainty over the requirements. This approach has meant that we have deferred significant investment, however, there is a risk that additional new investment requirements will emerge in AMP8 that manifest as cost-shocks to the bioresources business. This may require immediate costs of circa £300 million to divert biosolids away from agriculture alongside commencing and committing to a further £700 million of investment in AMP9 to deliver a resilient and long-term alternative outlet for biosolids. To proactively manage the risk we propose that significant bioresources risks are recognised as Notified Items that would trigger an interim determination (iDoK) if risks materialise in-AMP.

Figure 26 – How we are responding to changes in the bioresources sector in our business plan submission



Challenges and opportunities

Demand

6.2.7 Bioresources management is inextricably linked to wastewater treatment sites, which control the location, quality and quantity of sludge produced. An integrated planning approach has been adopted between wastewater and bioresources to ensure optimal sludge management, and provision of sufficient capacity to treat return liquors from sludge treatment. Sludge management requirements have been built into the DWMP and, future demand scenarios for bioresource services are based on sludge production forecasts from the DWMP. Significant sludge demand is being driven by new requirements for phosphorus removal at our WwTW, and variations in the technology deployed or the speed of deployment, will materially impact demand scenarios within our LTDS.

6.2.8 We are forecasting an additional 15,000 tonnes of dry solids (TDS) of sludge to be produced per annum through wastewater enhancement activity above population growth by 2038. As well as a greater volume of sludge for treatment and disposal, we expect that more stringent phosphorus final effluent standards to lead to a doubling of phosphorus loading in biosolids. Phosphorus is a limiting factor in determining biosolids applications rates for agricultural recycling and greater concentrations will increase the biosolids application return rate, creating a greater landbank requirement.

Changing expectations

6.2.9 Biosolids recycling to agriculture is entirely dependent on access to third party landbank and acceptance of our products by farmers and land managers. The reliance on agricultural land as an outlet makes this area of the business vulnerable to changing market demands and an increasing number of factors that are out of company control threaten the availability of landbank for biosolids recycling.

6.2.10 Landbank resilience risks are particularly pressing in the North West, as landbank is already constrained with only 50 per cent of agricultural landbank being available for recycling. Of that agricultural land available, only 16 per cent is arable, which is the most flexible in the type of biosolids which can be recycled. To find adequate landbank we have a greater distance to travel to recycle than any other company, resulting in higher sludge recycling costs. Grieve Strategic, National Landbank Modelling (2022) demonstrates that under current regulatory conditions the average maximum haulage distance we are required to travel to recycle biosolids to land is 71km, compared to an industry average maximum haulage distance of 46km[13].

6.2.11 We led collaborative industry and EA national landbank modelling which has demonstrated that there is a significant risk of landbank shortfall for up to two thirds of biosolids nationally. The resilience of our biosolids disposal service is one of the company's top risks and is highlighted in our annual report. This risk, if realised, will drive significant additional enhancement investment aligned with our LTDS. Through our changing expectations wider scenario, we demonstrate the expenditure implications of needing to adopt alternative pathways for biosolids disposal. However, there remains significant uncertainty over changing environmental expectations, including the timing, coordination and impact of reforms.

6.2.12 To date, all water company planning and cost model allowances have been based on a surplus of available landbank nationally, and the assumption that companies do not need to compete for a finite landbank resource. Should a landbank deficit arise due to the changes described, we expect our base cost expenditure will be insufficient to deliver the scale of investment that would be required to move away from biosolids recycling to agriculture. The impact is anticipated to be a fundamental shift in the business model for bioresources, and would take many years to implement fully.

Bioresources quality

6.2.13 There is significant, and increasing, concern over the potential for environmental harm to be caused by emerging contaminants in biosolids recycled to agriculture. Loss of public sentiment and support for biosolids recycling across the food supply chain, due to contamination concerns, has the ability to drastically and rapidly cut acceptance rates for our biosolids products, risking a shortfall in available outlets for our product. It is notable that a loss of confidence in the market may be based on a perceived, rather than quantified risk, and accelerate ahead of regulation. Through low-regrets AMP8 actions we will deliver proactive monitoring of the final quality of biosolids. In a first for the industry we will deploy fine screening of all our sludges, going beyond current best practice, seeking to minimise as far as possible microplastics and other non-degradable material in biosolids recycled to land. In the longer term, source control is an opportunity to protect the environment from the impacts of emerging contaminants but this will require an integrated approach between industry, regulators and manufacturers.

Energy recovery

6.2.14 Energy recovery continues to provide a significant opportunity for bioresources. Each year we generate ~133GWh of electricity from combusting biogas, used predominantly to power our treatment works with some exported power to grid and we also supply green gas to the grid, equivalent to meeting the demand of 45,000 homes per year. The forecasted sludge growth provides more digestion feedstock to create biogas but changing wastewater treatment solutions will impact sludge composition and potentially reduce its calorific value thereby impacting on biogas yields. We will continue to grow our energy generation opportunities to create more value from this renewable resource.

[13] Grieve Strategic in association with RSK ADAS, National Landbank Assessment, 2023

New technologies and innovation

6.2.15 Innovation will be at the heart of our transformation to deliver new technologies that ensure that we embrace and realise the benefits of a more circular economy, generating higher value products that reduce our impact on the environment and deliver significant benefits to society. Collaborative delivery of the long-term strategy for bioresources in England[14] outputs could enable pathways through research, innovation, regulatory change and market development. Alternative disposal pathways are currently limited by technology readiness to deploy and the maturity of markets, specifications, regulations and potentially societal acceptance of outputs and products. Through £10.4 million of enhancement investment we expect to deliver planning and design activities for uncertain and long-term options for biosolids disposal. This keeps our future options open.

6.2.16 Our long-term performance forecast

6.2.17 Through delivery of our LTDS we aim to be 100 per cent compliant with our statutory obligations regardless of the pathway followed on our adaptive plan. In addition, the company voluntarily subscribes to the Biosolids Assurance Scheme and is audited annually to demonstrate best practice in our biosolids to agriculture recycling operations.

6.2.18 The EA ensures that the environment is protected in regard to sludge use and disposal and will monitor performance through the industry Environmental Performance Assessment (EPA) metrics for:

- Satisfactory sludge use/disposal.
- Waste Compliance: This is a new EPA measure for AMP8 and reflects the increased regulatory scrutiny and increasing regulatory expectations for our waste treatment activities.

6.2.19 Bioresources investment in AMP8 will contribute to delivery of the operational greenhouse gases (wastewater) (tonnes of CO_2e) Performance Commitment.

6.2.20 In the absence of bioresources specific performance commitments, we have developed a series of performance outcomes through our LTDS to be able to compare and understand the relative benefits of each pathway. Table 15 summarises the performance outcomes we aim to achieve over the period to 2050. It indicates the performance improvement we expect to deliver through our maintenance programmes (base expenditure), and the performance that is associated with specific investment to achieve new levels of service (enhancement expenditure).

Table 15 - Our performance forecasts for bioresources outcomes

Outcome		Performance forecast					
	Unit (per annum)	2025	2030	2035	2040	2045	2050
Sludge produced	ttDS	209	218	229	239	259	264
Sludge treated through conventional digestion	% sludge produced	32	29	-	-	-	-
Sludge treated through advanced digestion	% sludge produced	60	66	94	100	100	100
Biosolids produced	ttDS	115	113	113	120	134	136
Biosolids to agriculture	%	100	100	100	63	16	-
Biosolids to alternative outlets	%	-	-	-	37	84	100
Biogas produced	GWh[15]	501	472	519	559	610	621

[14] CIWEM(Water UK), *Developing a long- term strategy for bioresources in England*, 2023

[15] This represents the total recoverable energy from biogas as electricity and heat.

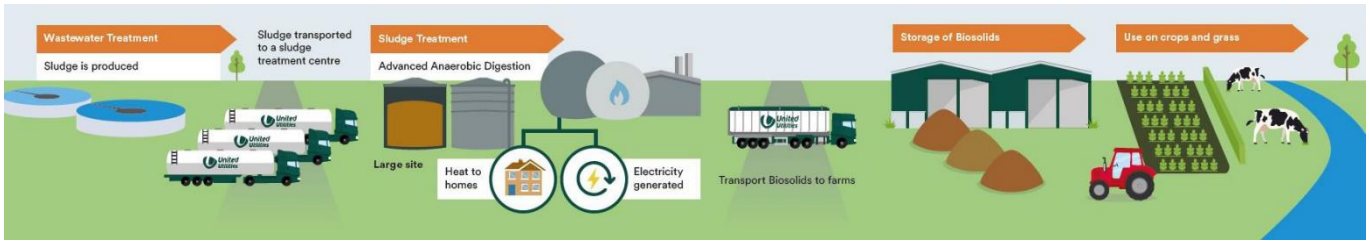
6.3 Our core pathway to deliver our bioresources ambition

6.3.1 To respond to the multiple challenges influencing the bioresources sector in the North West, it is clear that our business model will be transformed over the next 25 years. We anticipate that biosolids recycling to agriculture will reduce over time to match the changing environmental ambitions of customers and regulators, although there remains significant uncertainty over the timing and scale of the change.

6.3.2 Given the lack of certainty over the timing of moving away from landbank as an outlet, we have based our core pathway on the assumption that there will be a phased transition and sufficient time to progressively move to alternative outlets. In parallel, we will focus on continually improving biosolids quality to maximise the environmental value from continuing to recycle biosolids to land.

6.3.3 Our core pathway for bioresources identifies the need for £1.76 billion of enhancement expenditure over the next 25 years. It will allow us to deliver a progressive transformation in our capability to maximise the value recovered from sludge. We present the end-to-end sludge treatment and recycling process under the bioresources core pathway in Figure 27.

Figure 27 - Representation of the bioresources core pathway



6.3.4 Our bioresources core pathway, is a continuation of our approach for AMP7. It has three key overarching principles:

(a) Centralise sludge treatment into fewer, larger advanced anaerobic digestion (AAD) hubs: In addition to reducing the reliance on landbank, AAD supports the recovery of calorific and nutrient value, allowing renewable energy generation through green gas and, producing biosolids that can be used as an alternative fossil free fertiliser, supporting circular economy principles. The centralisation to AAD hubs becomes more important as the economies of scale provided by these large treatment centres provide the platform to generate greater value from recovering more biogas in the short term and subsequently bolt-on technologies and transition to any plausible adaptive pathway end point.

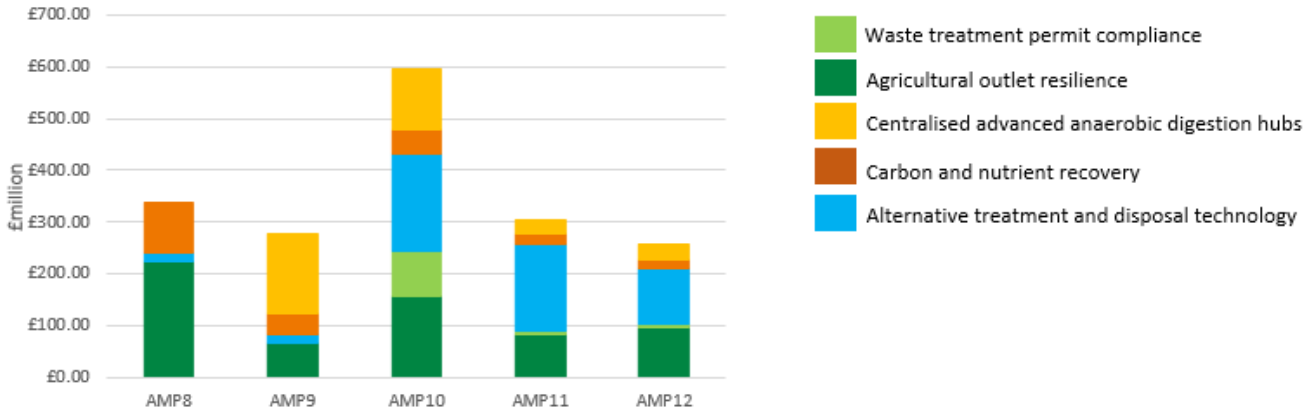
(b) Increase resilience against sludge supply chain disruption: A series of shocks and disruptions to the biosolids market in AMP7, combined with limited access to alternative outlets for biosolids disposal in the event of disruption, make it clear that we need to provide a greater level of resilience. We plan to increase flexibility and agility of the sludge asset base to allow operations to continue during closed periods for agricultural recycling. Through WINEP actions under the sewage sludge drivers we will invest £170 million to improve resilience in the sludge management supply chain to agriculture. This will deliver 60 days contingency sludge storage, and increase the proportion of enhanced quality biosolids that we take to land.

(c) Phased reduction in reliance on agricultural landbank over the longer-term: An increasing number of factors that are out of company control threaten the availability of landbank for biosolids recycling. While our core pathway in the short-term is to continue to recycle biosolids to land we will ensure maximum flexibility by keeping multiple strategic pathways open. We seek a phased reduction in reliance on landbank by 2050 to match the growing environmental ambitions of customers and regulators. Through £10.4 million of enhancement investment we aim to deliver planning and design activities for uncertain and long-term options for biosolids disposal.

6.3.5 Through our core pathway we plan for a gradual transition away from biosolids recycling to agriculture, enabled by technological development. This moves to a bioresources operating model of AAD and advanced thermal technologies. The pathway potentially delivers greater environment benefits than incineration, however, it requires technological development to prove benefits at scale. Therefore, it is more appropriate to deploy over a longer term and phased transition from biosolids recycling to agriculture. We expect this pathway to take a minimum of ten years to implement.

6.3.6 We present in Figure 28, a summary of our forecast enhancement expenditure aligned with our core pathway.

Figure 28 Enhancement expenditure in our core pathway for bioresources 2025 – 2050



6.3.7 Expenditure has been grouped to show key enhancement activities as follows:

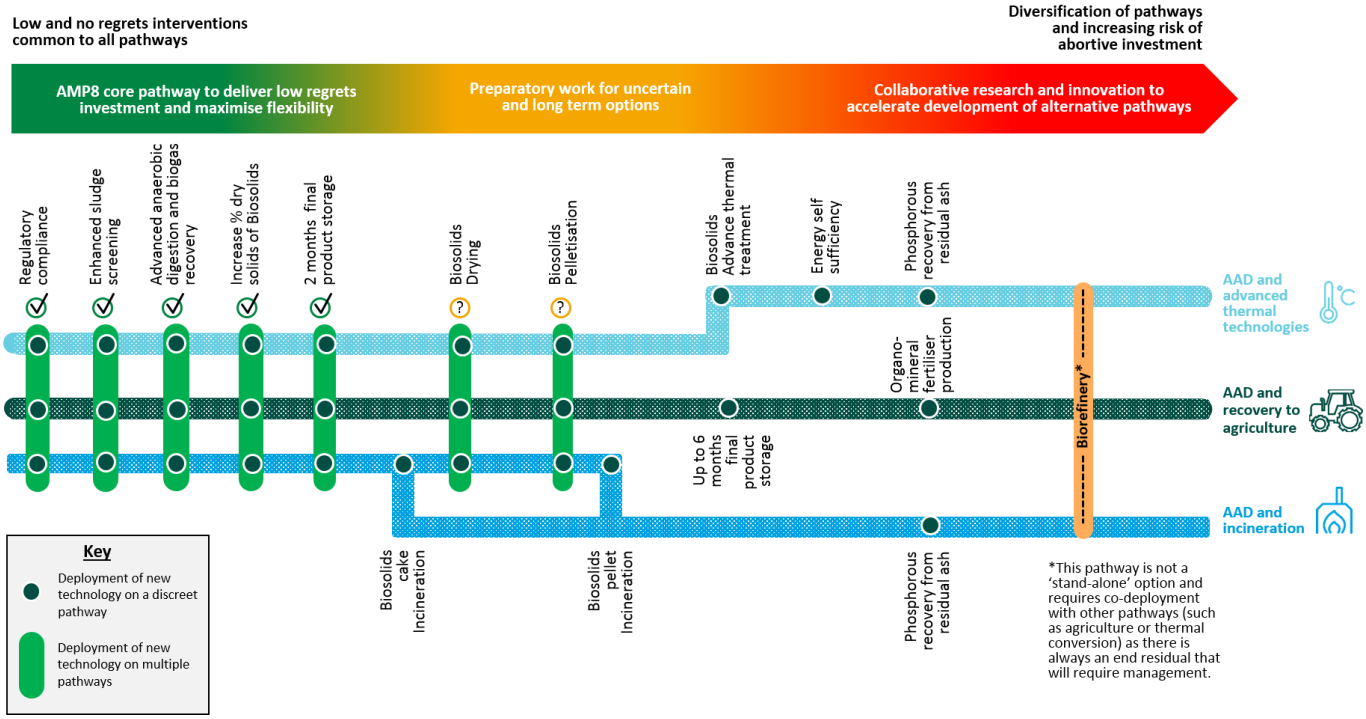
- **Waste treatment permit compliance** – measures to meet increasingly stringent Best Available Technique or 'BAT' standards under the Waste Framework Directive and the Industrial Emissions Directive. This includes accommodating new requirements assigned to "disposal" outlets from AMP10. We have not forecast further tightening of guidance or standards, beyond those currently known and therefore no costs have been included in our core pathway beyond those captured in our AMP8 plan. However, there is potential that further enhancement investment will be required before 2050, e.g. due to changes in Appropriate Measures guidance for biological treatment of waste.
- **Agricultural outlet resilience** – measures to improve biosolids product quality and increase farmer acceptance rates; and deliver increased flexibility and agility of the sludge asset base to allow operations to continue during closed periods for agricultural recycling.
- **Centralised AAD hubs** – support the movement from conventional digestion to AAD to deliver an enhanced quality biosolids, reduce the quantity of material for disposal and align to the lowest carbon sludge treatment technology. In the short-term this will maximise recovery of more biogas and subsequently facilitate bolt-on technologies to transition to any plausible adaptive pathway. It will also deliver increased sludge treatment capacity to meet a forecast 33 per cent sludge growth by 2050.
- **Nutrient recovery** – recovery of phosphorus from sludge liquors to become a feedstock to the inorganic fertiliser industry will add greater value than binding it inorganically within sewage sludge or returning it to the treatment works and cycling back to the river system. This ensures the value recovered from sludge will be maximised, and if we move to alternative outlets for biosolids recycling, the nutrient value of sludge is not lost.
- **Alternative treatment and disposal technology** – measures to adapt to reducing landbank availability and requiring a move to alternative outlets for biosolids disposal. Through our core pathway we have assumed that landbank loss will be gradual and phased, enabling a transition to advanced thermal treatment technologies that are not currently at a sufficient technology readiness level to deploy.

AMP8 forms the first five years of our long-term plan

6.3.8 In AMP8 our investment strategy will ensure maximum flexibility by keeping multiple strategic pathways open and we have prioritised low regrets investment where we have certainty over the requirements. Moving to an alternative disposal outlet is not considered as part of the core pathway in AMP8, as these actions may be considered as abortive investment in the longer term as there remains uncertainty over both timescales for change and the preferred alternative outlet for sludge disposal. These pathways will only be followed under a changing expectations wider scenario, and the additional activities may be described as 'higher-regret', relative to investments included in the core pathway. We have therefore deferred significant investment (an additional circa £1 billion) to implement actions to move away from biosolids recycling to agriculture.

6.3.9 We demonstrate in Figure 29 that low and no regrets actions that are beneficial across all potential pathways for biosolids disposal are prioritised. Delivery of low and no regrets actions in AMP8 ensures environmental outcomes can be delivered and the risk of inefficient investment is minimised.

Figure 29 - Indicative illustration of low and no regrets actions on our bioresources LTDS



6.3.10 Our proposed AMP8 bioresources enhancement expenditure (and our proposed cost adjustment claim) focus on actions to ensure regulatory compliance and low regrets activity to improve landbank resilience to sustain biosolids recycling to agriculture:

- **Industrial Emissions Directive compliance at anaerobic digestion sites. Document Reference ID: UUW_CAC_004**. This is an industry-wide adjustment (as it impacts on all companies) with a claim value for UUW of £173 million. This claim is specific to regulatory changes at our (biological) sludge digestion sites.
- **WINEP sewage sludge drivers UUW66**: A £170 million enhancement case to enable delivery of the statutory requirements identified in the WINEP under the sewage sludge drivers and targeted at delivering resilience in the sludge management supply chain to agriculture.
- **Improving resilience in biosolids recycling to agriculture UUW66:** A £54.1 million enhancement case to increase the resilience of the agricultural outlet for biosolids, by improving product quality through the enhanced removal of non-degradable contaminants (such as microplastics) and thereby support market acceptance of higher quality products.

6.3.11 In addition, we have proposed enhancement investment to accelerate planning works associated with moving to alternative pathways. Unless we undertake these critical planning activities now, we will lose flexibility within our LTDS to adopt the pathways when required, as the implementation time will be too great if we wait to exceed a trigger to move away from biosolids recycling to land:

- **Bioresources preparatory works for alternative outlets UUW66:** A £10.4 million enhancement case to deliver preparatory works for uncertain and long-term options for alternative biosolids disposal outlets.

6.3.1 We have proposed two bioresources Notified Items to manage significant but uncertain risks over new regulatory requirements and landbank availability. These will be used if new requirements emerge, or uncertainties resolve to exceed trigger points within our LTDS and we need to accelerate investment activity into AMP8. Details of the proposed uncertainty mechanism can be found in *UWW58 – Bioresources business plan* and *UUW09 - Risk, return and responsible behaviour*.

Developing our core pathway by testing against scenarios

6.3.2 Our core pathway was developed by testing a wide range of options against the Ofwat Common Reference Scenarios (CRS) and our bespoke scenario:

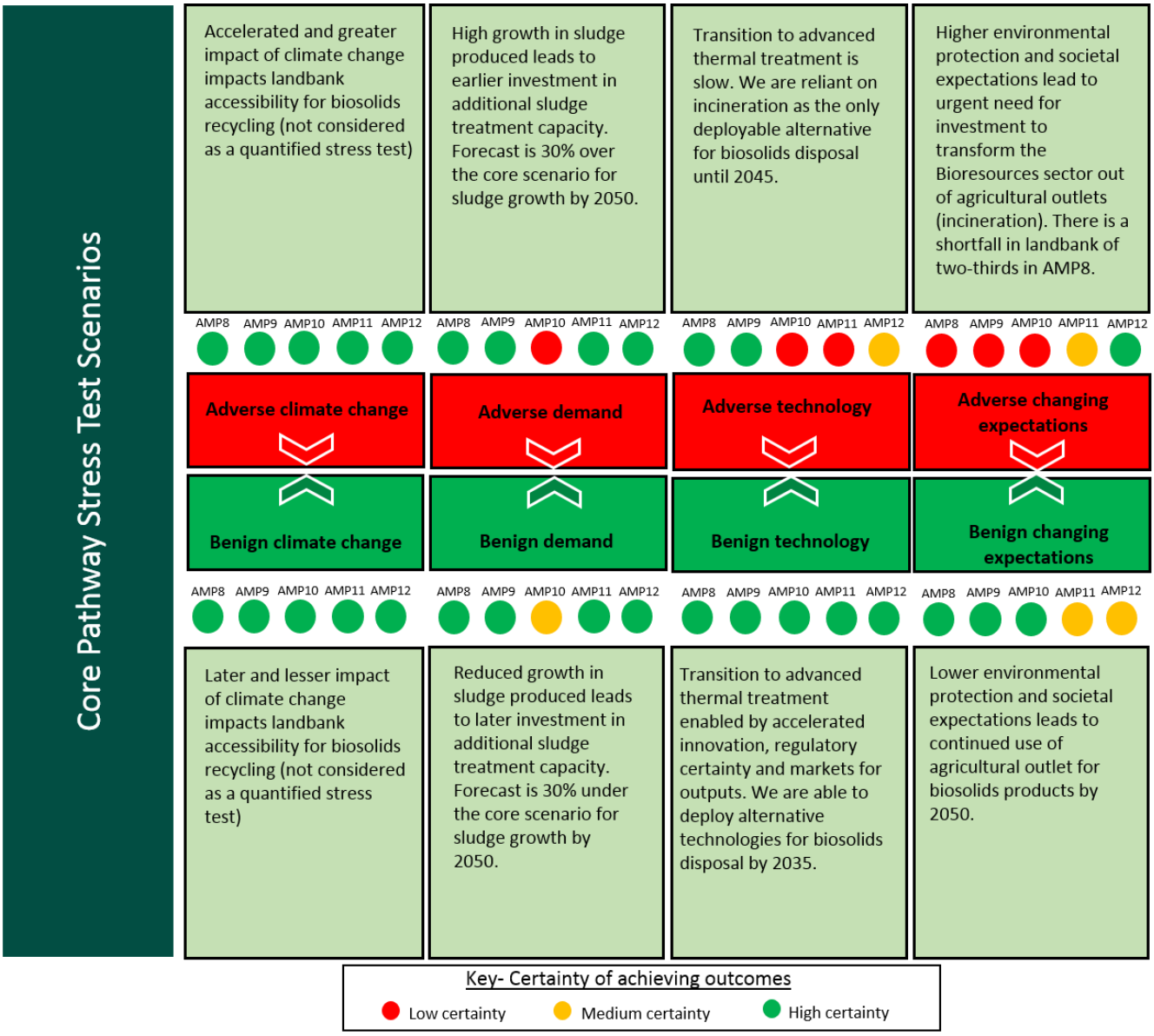
- **Demand**: Demand when applied to bioresources is a forecast of incumbent sludge production in TDS. This is a combination of increased population growth and higher standards of wastewater treatment increasing sludge production volumes. Bioresources demand forecasts are aligned to our DWMP.
- **Technology**: The Ofwat CRS does not include bioresources specific technologies. We consider that the predominant technological uncertainties impacting the bioresources core pathway are the rate of technological change and innovation to deploy alternative treatment and disposal solutions for sludge such as advanced thermal treatment technologies.
- **Climate change**: There is no quantifiable data to stress test our core scenario against climate change. We expect that climate change will impact bioresources through an increased frequency of adverse weather events impacting in year accessibility to agriculture, and this has been considered within the landbank modelling undertaken for the changing expectations wider scenario.
- **Changing expectations**: Our wider scenario considers the impact of increasing customer and stakeholder expectations for the sustainable treatment and disposal sewage sludge. This is predominantly impacting on the availability of landbank for biosolids recycling, for which we have aligned with the core, benign and adverse national landbank modelling scenarios for EA and water industry collaborative landbank modelling.

6.3.3 Our scenarios are aligned with the scenarios considered and developed through the long-term strategy for bioresources in England (CIWEM, 2023). Through this project a wide range of drivers for change were considered via a comprehensive PESTLE review, technology horizon scan, and interviews with a wide range of stakeholders to understand how scenarios might develop in the future to ensure that we have developed plausible scenarios for stress testing.

6.3.4 We have developed our regional, integrated package of core pathway enhancement interventions by using our strategic planning tool, Regional Integrated Asset Plan (RIAP). Strategic planning capability is central to our asset strategy over the next 25 years and enables us to understand and optimise the greenhouse gas footprint, capital and operational costs of planned actions across the entire bioresources system to ensure optimal outcomes and efficient delivery. Through use of the RIAP we have been able to stress test the scenarios to compare outcomes.

6.3.5 We present the results of the scenario testing of our investment options in Figure 30. This provides a short narrative on the key features of each adverse and benign stress test. Red, amber or green status indicates the outcome of an AMP by AMP assessment of the performance of the core pathway to deliver the desired outcomes against each stress test scenario.

Figure 30 - Summary of performance of the core pathway against scenario tests



6.3.6 Our core pathway delivers our bioresources ambitions under all the benign scenarios and the adverse climate change scenario. As indicated by the red circles, the core pathway is not sufficient to deliver our ambition under the adverse demand, technology and changing expectations scenarios, for which we require alternative pathways of investment.

6.3.7 We note that the most significant risk driving additional investment on our core pathways is the adverse changing expectation scenario in which there is a major risk of insufficient outlets nationally for biosolids. We are proposing an uncertainty mechanism (a Notified Item) in AMP8 so that, should this scenario materialise, we would be able to secure additional investment to adapt to changing circumstances and continue on a pathway to meeting our long-term ambitions.

6.3.8 The adverse changing expectations scenario is aligned to restrictions on biosolids recycling to agriculture. Landbank modelling has shown that the impact of the most likely environmental restrictions (as discussed with the EA) is insufficient agricultural land to recycle biosolids. If restrictions to biosolids recycling to agriculture are ultimately confirmed, there is a high likelihood that these combined issues will lead to a shortfall in landbank for up to two-thirds of biosolids nationally. If these changes materialise in AMP8, without sufficient time to adapt and transition to alternative outlets, this will lead to both additional capital costs to build alternative outlets (i.e. sludge incinerators) as well as additional operational costs to dispose of sludge to more expensive outlets (i.e. landfill) until the new outlets come into operation several years later (circa ten years).

6.3.9 The landbank risks are significant and too great to do nothing in AMP8. Without action we risk shutting off alternative options, as they have a significant lead time (circa ten years) to implement ahead of when they may be needed. The minimal, low regrets investment set out in the bioresources preparatory works for alternative outlets enhancement case will keep options open for the long-term and accelerate timescales for delivery, helping to mitigate the risk that we have no outlet in the event of a significant loss of landbank.

6.3.10 Under the benign changing expectations scenario, sludge to agriculture is still a viable outlet by 2050, through pelletised biosolids products. The investment in the core pathway to move to advanced thermal treatment technologies for sludge disposal in AMP10 and beyond, while delivering more resilience and a lower greenhouse gas footprint, may risk over investment and lead to more inefficient sludge disposal costs, if land bank can be maintained as an outlet.

6.3.11 The adverse demand scenario will lead to a shortfall in sludge treatment capacity by AMP10. This is a direct impact of sludge growth being at the upper end of sludge forecasts, and a large investment in wastewater treatment at this time to meet the phosphorus targets under the Environment Act. Conversely, under the benign demand scenarios, by later AMPs we risk having over-invested in capacity in the core pathways if sludge growth does not materialise as forecast.

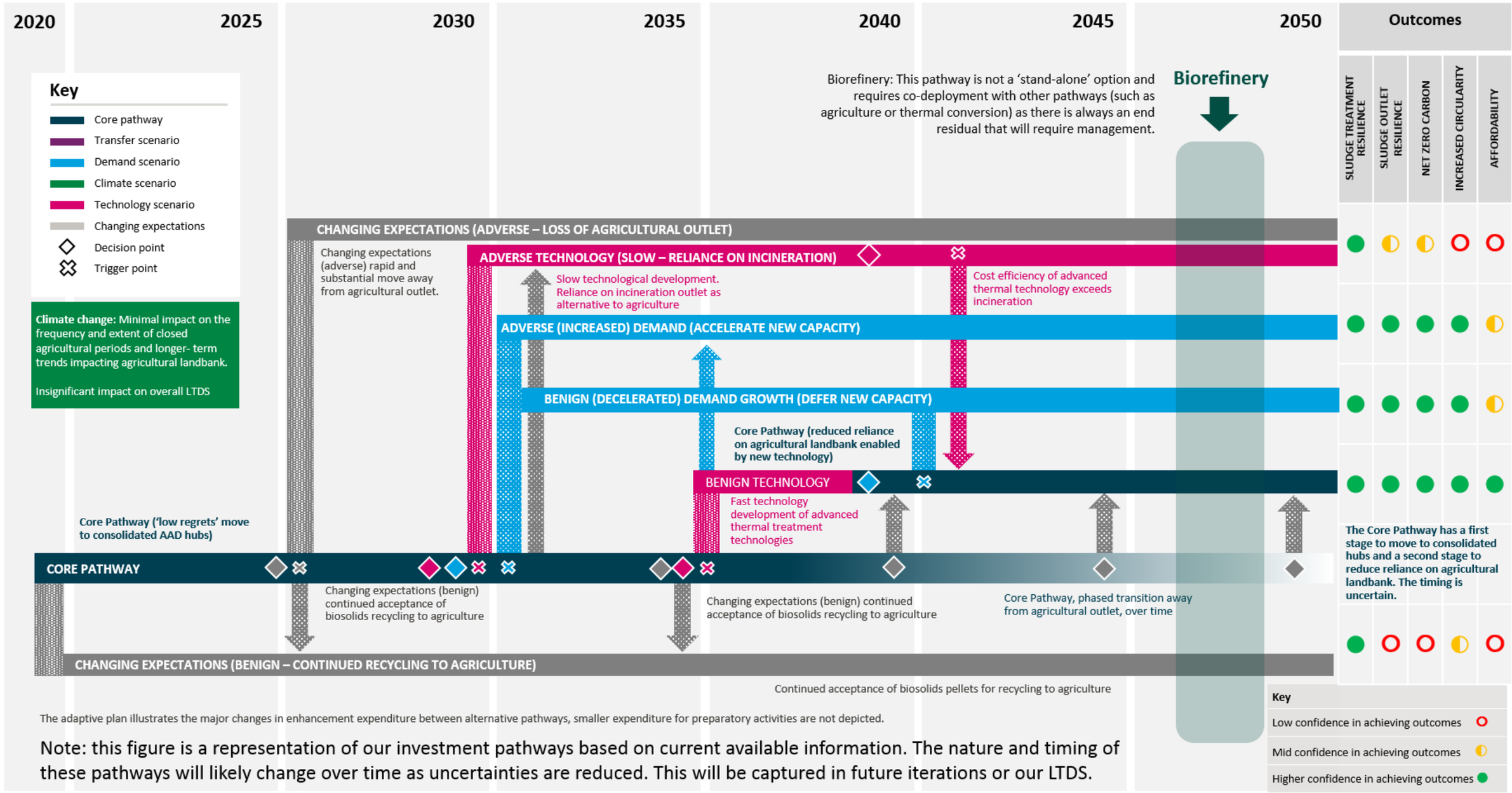
6.3.12 The adverse technology scenario leads to investment in less efficient incineration technologies, rather than advanced thermal treatment technologies to move away from biosolids recycling to agriculture. This has poorer environmental outcomes in future AMPs compared to the theoretical potential for advanced thermal treatment technologies. If advanced thermal treatment technologies are viable and more efficient than incineration, incineration will result in a higher unit cost.

6.4 Our alternative pathways for bioresources

6.4.1 Notwithstanding its ability to deliver our stretching ambitions under a wide range of scenarios, the bioresources core pathway will not deliver our ambitions in all scenarios. In Figure 31we show that we may need to follow alternative investment pathways under the adverse and benign technology, demand and changing expectation scenarios.

6.4.2 The annual investment profile for the core pathway and the alternatives pathways is shown in Figure 31. This shows that the core pathway in AMP8 is common to all pathways except for “changing expectations adverse” (i.e. uncertain agricultural outlet risks materialise), demonstrating that the AMP8 plan is low regrets in most circumstances as we address more certain requirements

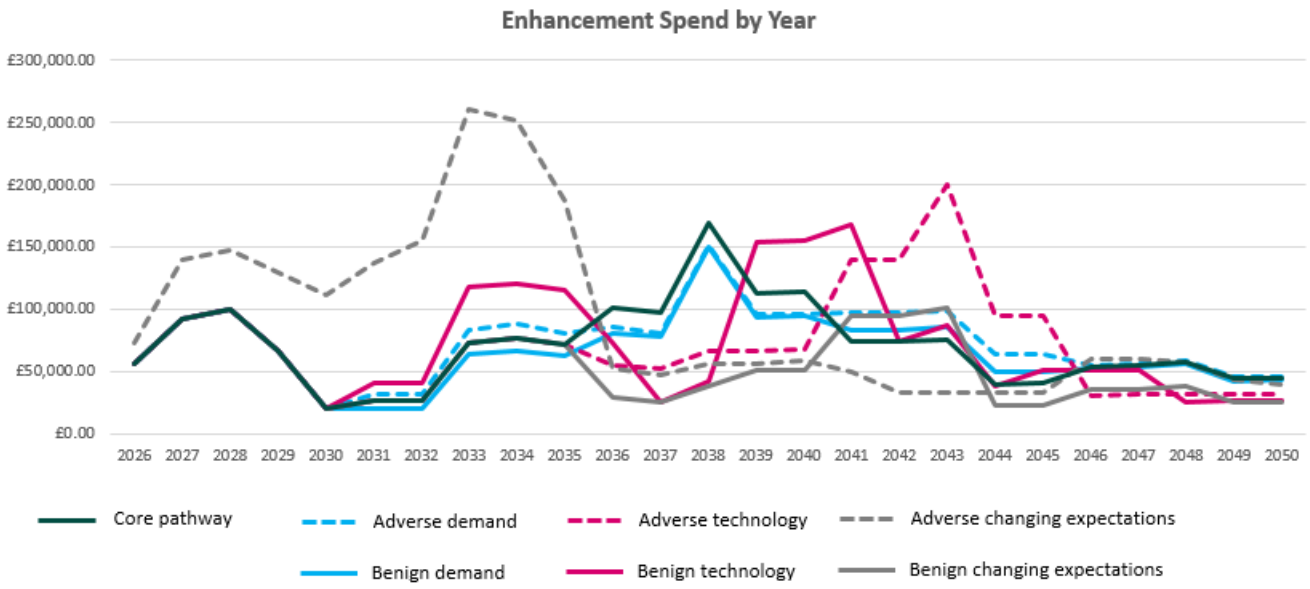
Figure 31 Bioresources long-term adaptive pathway to 2050



The adaptive plan illustrates the major changes in enhancement expenditure between alternative pathways, smaller expenditure for preparatory activities are not depicted.

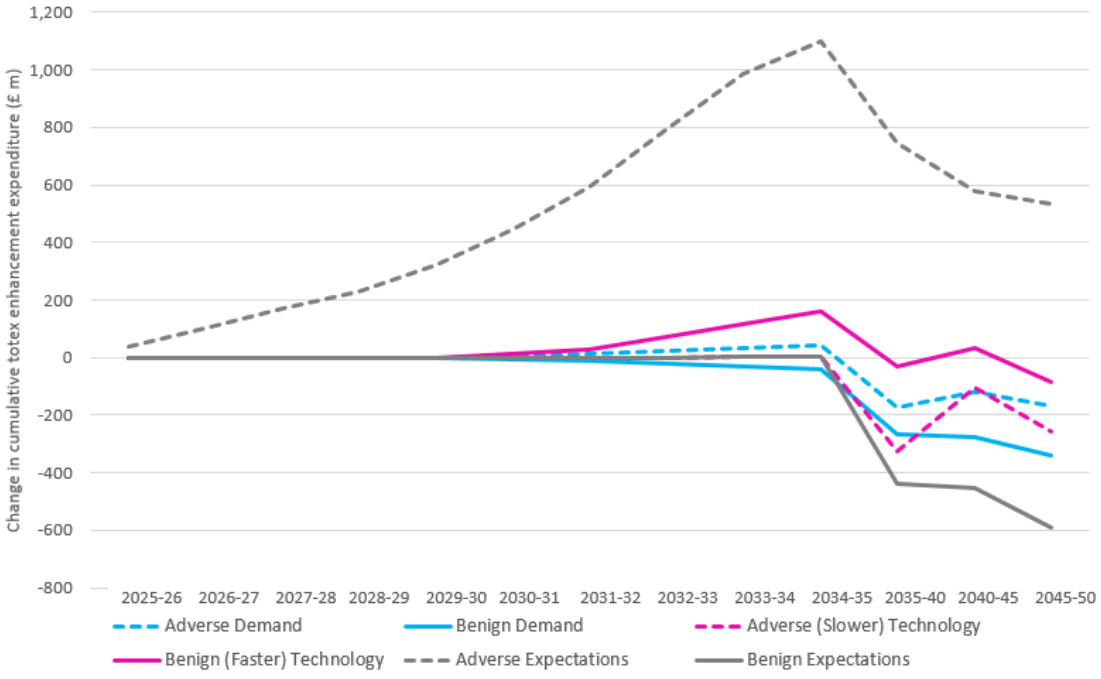
Note: this figure is a representation of our investment pathways based on current available information. The nature and timing of these pathways will likely change over time as uncertainties are reduced. This will be captured in future iterations or our LTDS.

Figure 32- Enhancement spend by year



6.4.3 The cumulative expenditure to 2050 for all pathways is shown in Figure 33. This is our current best estimate and will change as uncertainties are better understood and choices evolve. This shows that the changing expectations adverse scenario is significantly more expensive than other pathways and that the greatest variance in investment is in AMP8 and AMP9 as we rapidly transition to alternative outlets.

Figure 33 – Cumulative variance in expenditure from core pathway



6.4.4 Landbank availability, as considered under the changing expectations alternative pathways is the most significant factor driving additional investment in the Bioresources LTDS. We have identified three options for biosolids disposal (in additional to our core pathway of biosolids recycling to agriculture):

(i) **AAD and incineration** - Combustion of sewage sludge to remove any requirement for recycling to land. The resulting ash can be recovered in construction or disposal to landfill. The long-term strategy for bioresources in England warns against the use of short term, inflexible incineration solutions as an alternative to agricultural outlets as these will not increase the value recovered from bioresources.

(ii) **AAD and advanced thermal technologies** – A group of technologies including pyrolysis and gasification to convert sewage sludge feedstocks using high temperatures into outputs such as chars, oils and syngas. Outputs may be disposed of, used for energy generation or recovered and re-used in wider industrial markets. These are novel technologies not deployed at scale in the UK and there is a need for further work to assess feasibility and (if appropriate) accelerate deployment.

(iii) **Biorefinery** – A resource recovery hub whereby a multitude of products may be recovered from sewage sludge feedstocks. This pathway is not a 'standalone' option and requires co-deployment with other pathways (such as sustaining agriculture or advanced thermal technologies) as there is always an end residual that requires disposal via another route. The pathway is currently limited by technology readiness, the maturity of markets, specifications, regulations and potentially societal acceptance of outputs or products.

6.4.5 All alternative options for biosolids disposal require large-scale investment of circa £1 billion and will take multiple AMPs to deliver. A move to any of these alternative outlets represents an entire step-change in the bioresources business model. To keep these options open and progress low regrets investment to retain flexibility in our asset base, we are investing £10.4 million in AMP8 to research advanced thermal technologies and test whether they can be deployed at scale.

6.4.6 Under the adverse changing expectations pathway we have very limited time to adapt to loss of the agricultural outlet. Given the short timescales for implementation this pathway utilises conventional incineration technology. In AMP8, costs will increase to deliver enhancement investment for additional capital works to build sludge incinerators. This is accompanied by significant additional operational costs (above our plan) to dispose of sludge to more expensive outlets (i.e. landfill) until the alternative incineration outlet comes in to operation. This pathway uses established technologies, however, given the scale of transformation required and timescales for moving to an incineration outlet we would expect this to take a minimum of ten years.

6.5 Opportunities to collaborate

6.5.1 The need for partnership and collaboration is clear. The strategic challenge to optimise biosolids management, requires multiple parties to collaborate (private, public, third sector and academia). We need to widen our view and build open collaboration to tackle this challenge.

6.5.2 We think our collective approach to collaboration needs to embrace Systems Thinking principles, whereby we all consider bioresources as part of the wider, dynamic environmental system and the end-to-end wastewater treatment process. This approach is more likely to support transformational change for the sector which is endorsed by stakeholders and enabled through collaborative planning between environmental and economic regulators and companies. This will enable water companies and future market entrants to consider bioresources more fully, recognise interdependencies and deliver best value.

6.5.3 We are a thought leader in the sector calling for national collaboration. Our paper, "Unlocking greater value through a national bioresources strategy", published in November 2021 was the first call for development of such an approach and was the impetus for developing the long-term strategy for bioresources in England. The strategy identified that there are multiple alternative pathways for biosolids disposal, but there is need to innovate and develop the markets and technologies ahead of widespread deployment.

6.5.4 As such, collaborative innovation will be at the heart of our transformation and we have identified and led several key innovation opportunities in the sector. In AMP7 we have successfully leveraged additional partnership funding of over £16 million, and approximately, for every pound we have invested we have successfully leveraged a further four pounds from external sources.

6.5.5 The key collaborative opportunities we have identified for deployment in AMP8 are as follows:

- **Collaboration in electric HGV trials with other sectors**: We have been successful in securing almost £1 million from the Zero Emission Road Freight Demonstration programme (ZERFD) run by the Department for Transport, in partnership with Innovate UK. As part of a consortium, we are collaboratively working towards the development of national HGV charging infrastructure which aims to accelerate and inform the rapid decarbonisation of the UK's long haul HGV sector.
- **Production of new products from raw sludge**: £6 million funding from the Ofwat innovation fund to deliver a commercial scale pilot to produce biopolymers and recover cellulose at one of our wastewater treatment works.
- **Production of new products from biogas**: £3 million funding from the Department of Energy Security and Net Zero to produce graphene and hydrogen from biogas.
- **Phosphorus recovery**: At our largest WwTW, we will install a phosphorus recovery plant to recover 255kg of phosphorus per year from sludge liquors. In combination with further sewage treatment changes, this approach embraces circular economy principles to recover phosphorus, rather than using chemicals to lock it up in sewage sludge. This innovative solution forms part of the overall end to end improvements being delivered across the wastewater treatment works.
- **Supporting the hydrogen economy in the North West:** We are progressing a partnership with Carlton Power to enable the development of the Trafford Green hydrogen energy hub, adjacent to our largest sludge treatment centre. We are supporting development of the hub, which will produce green hydrogen fuel for industry, transport and heating. We are developing a solution to provide a guaranteed offtake of hydrogen to support the early development of the project, and use the fuel to displace fossil fuel use in our boilers, and help us to reduce our greenhouse gas footprint. How we will monitor and adapt our plans

6.6 How we will monitor and adapt our plans

6.6.1 Through our bioresources LTDS we have identified:

- The metrics that will be monitored, how these will be calculated and the source of the data;
- The frequency at which the metrics will be monitored and reviewed; and
- The thresholds that the metrics will be monitored against and what action will be taken when the thresholds are reached.

6.6.2 Table 16 presents our monitoring plan for the bioresources components of our LTDS. Our monitoring plan identifies a suite of metrics to evaluate whether the requirement is to move away from the core pathway and onto an alternative pathway.

Table 16 Monitoring plan for bioresources

Pathway name	Monitoring metric	Decision threshold	Decision date	Trigger threshold	Trigger date
Adverse (high) demand	Sufficient treatment capacity calculated from wastewater strategic planning frameworks (DWMP/WINEP) and bioresources market information treatment capacity.	Sludge treatment capacity shortfall forecast to be greater than 10% at end of next price review period. (A shortfall up to 10% may be tolerated by using restoration outlets or short term sludge trading).	2028	Invest in new sludge treatment capacity. Decision taken every five years in line with price review process. Next nearest decision date is the company business plan submission for the price review in 2028.	2030
Benign (slower) demand		No sludge treatment capacity shortfall forecast at end of the next price review period. (Available capacity may be offered for sludge trading imports until required to accommodate incumbent sludge growth.)	2028	Decision to delay investment in new treatment capacity. Decision taken every five years in line with price review process. Next nearest decision date is the company business plan submission for the price review in 2028.	2030
Adverse (slower) technology	Technology readiness review: Horizon scanning, participation in collaborative research and intelligence from innovation organisations and partnerships.	Technology readiness level and market evidence demonstrates the business case to move to alternative sludge treatment technology.	2028	Investment in new sludge treatment and disposal technology. Decision taken every five years in line with price review process, or on significant new information. Next nearest known decision date is the company business plan submission for the price review in 2028.	2030
Benign (faster) technology		Technology readiness level and market evidence demonstrates the business case to move to alternative sludge treatment technology.	2028	Investment in new sludge treatment and disposal technology. Decision taken every five years in line with price review process, or on significant new information. Next nearest known decision date is the company business plan submission for the price review in 2028.	2030
Adverse changing expectations	National landbank analysis: Modelled agricultural outlet availability.	Ratio of landbank available to landbank required falls below 2.0 (this is equivalent to a 10% reduction in agricultural availability beyond benign forecast).	2025	Investment to reduce reliance on the agricultural outlet for biosolids disposal. Decision taken every five years in line with price review process, or on significant new information.	2025

Pathway name	Monitoring metric	Decision threshold	Decision date	Trigger threshold	Trigger date
	National landbank analysis: Modelled distance to landbank.	Average distance to suitable agricultural landbank exceeds 75km.		Nearest time for new information is by September 2025 by which Defra statutory guidance on Farming Rules for Water must be reviewed. We propose new investment requirements are managed through an uncertainty mechanism (Notified Item) if the decision threshold is exceeded mid-AMP.	
Benign changing expectations	National landbank analysis: Modelled agricultural outlet availability.	Ratio of landbank available to landbank required remains above acceptable level.	2028	Decision to delay investment to reduce reliance on the agricultural outlet for biosolids disposal. Decision taken every five years in line with price review process, or on significant new information. Next nearest known decision date is the company business plan submission for the price review in 2028.	2030
	National landbank analysis: Modelled distance to landbank.	Average distance to suitable agricultural landbank remains below an acceptable distance.			

7. Bill impact over the long-term

7.1 Overview

7.1.1 We have projected future customer bills from 2030/31 to 2049/50. In generating these forecasts we have used 2029/30 projected bills as a base point, and then considered future investment requirements highlighted in our core pathway which should allow us to achieve our ambition under most future scenarios.

Table 17 Average total household bill associated with our core pathway

	2029/30	2034/35	2039/40	2044/45	2049/50
Average household bill (2022/23 FYA CPIH)	£552	£692	£731	£771	£802

7.1.2 We have calculated bill impacts associated with both the core and alternative pathways to 2050 in line with the guidance set out in 'PR24 and beyond: Final guidance on long-term delivery strategies', (April 2022, p. 65). We recognise that the level of investment in the LTDS presents a step change in the scale and pace of investment from AMP8 onwards. The biggest contributor to this in the North West is the delivery of the requirements of the Governments' Storm Overflow Discharge Reduction Plan. We recognise that such increases in bills are likely to give rise to greater affordability challenges for some customers in the North West. Whilst we have proposed a substantial affordability support programme for AMP8, the impact that increasing levels of investment might have on long-term changes to bills will impact many customers. Customers' ability and willingness to pay will need to be carefully considered as part of future price reviews and in future policy decisions by government and regulators about the scope and pace of improvements.

7.1.3 There are significant uncertainties in the bill impacts presented. We have included projected growth in customer numbers, but have not applied adjustments for wider factors that may affect future bills, such as future innovations and efficiencies, changing legislative and customer requirements, changes in the prevailing cost of capital, or any other external factor that may influence future bills.

7.1.4 This means that as well as drivers of cost increases, there will also be significant drivers that could mitigate these. For example, there are likely to be efficiencies in the future resulting from innovation and the increased availability of technology that are as yet unknown but could make a meaningful difference on a 30 year time horizon. We have accounted for some of this effect through our alternative technology pathways but it would be premature to think that the assumptions made today will factor in all future impacts on customer bills.

7.1.5 There is also considerable uncertainty about the future adoption of demand side reductions by customers and whether these will be as significant as – for example – some of the trends seen in the energy sector, or whether usage patterns are likely to remain embedded for a longer period of time. Again, future planning will need to take account of learning in that regard and whether demand side interventions turn out to be as impactful as is currently hoped.

7.1.6 While we recognise the challenges associated with testing long-term bill affordability with customers we have sought to test our long-term plans and service aspirations with customers as described in section 3.2. This work has shown that investment over the long-term is linked to customers' priorities, and that there is strong evidence of customer willingness to pay for proposed investment in areas where there is a degree of UUW discretion.

7.1.7 It remains the case that these bill projections represent a material AMP on AMP increase in the real terms cost of water services, and will need to be repeatedly tested with customers as part of future price review processes. Meanwhile, in AMP8 we are continuing our sector leading support for customers struggling to afford water bills and this will remain a priority over the long-term to ensure the delivery of

affordable water services remains a priority in all future scenarios. Our approach to pay as you go rates and RCV run off rates at PR24 means that we are not acting to increase the burden that future customers might have to bear and that the intergenerational impact of bill increases is fair between current and future customers.

7.2 Bill impacts for alternative adaptive pathways

7.2.1 There is variance in the water bill impact under different scenarios, as demonstrated in Figure 34 aligned to the adaptive pathways. This reflects the assumptions outlined in section 4, our long-term strategy for water, and consequent forecast enhancement expenditure in LS3(a-h) data tables.

7.2.2 Comparably, for wastewater there is little change in the forecast bill impact as demonstrated Figure 35. This is a result of scenario testing outputs in data tables LS4(a-h). As described in section 5, our long-term strategy for wastewater and section 6 our long-term strategy for bioresources, there are a combination of factors leading to the small change in LS4 and consequently wastewater bill impacts.

Figure 34 Average total water bills under the core and alternative pathways

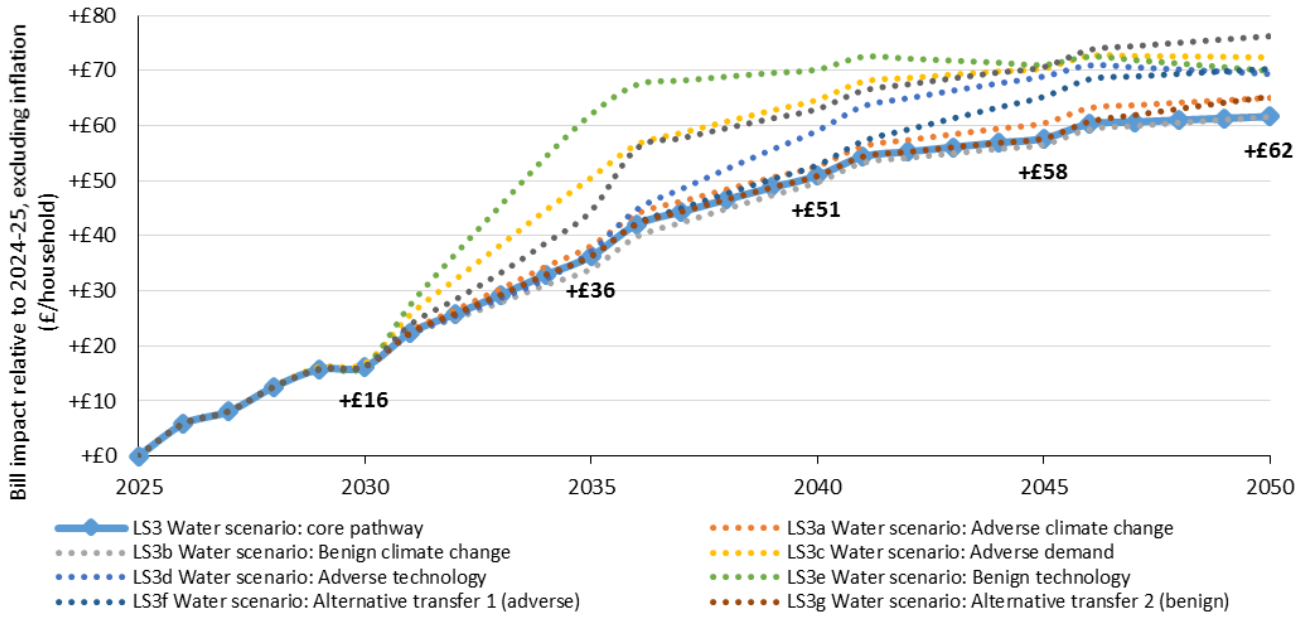
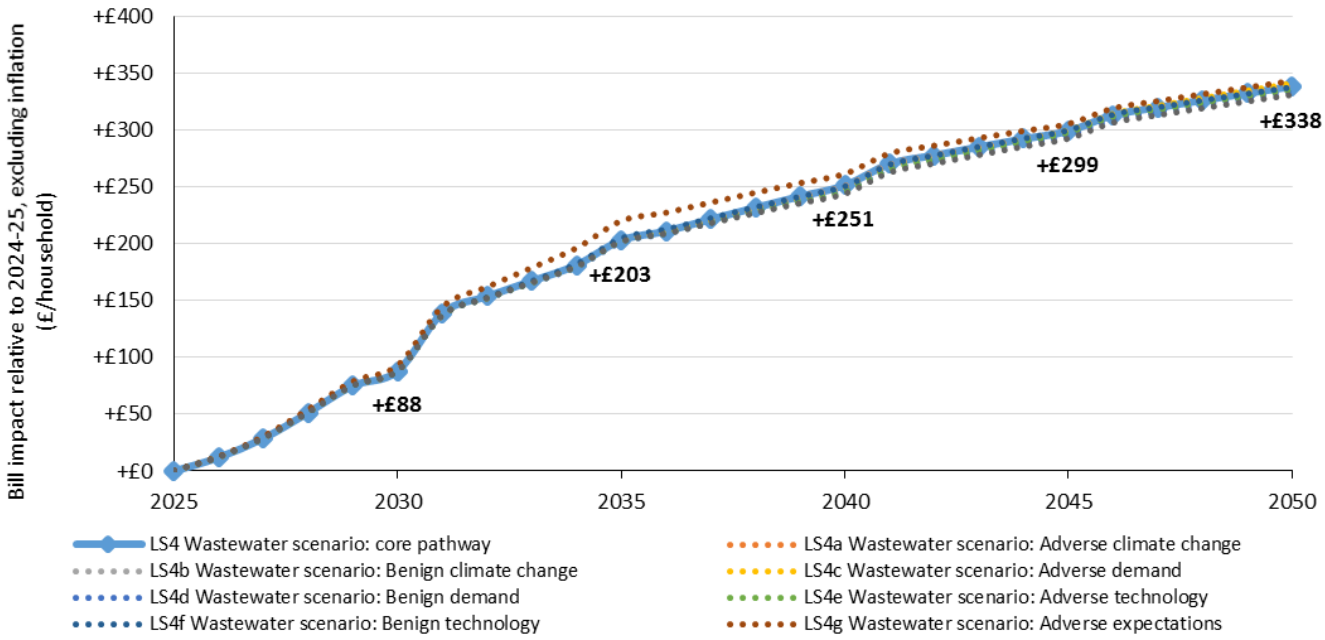


Figure 35 Average total wastewater bills under the core and alternative pathways



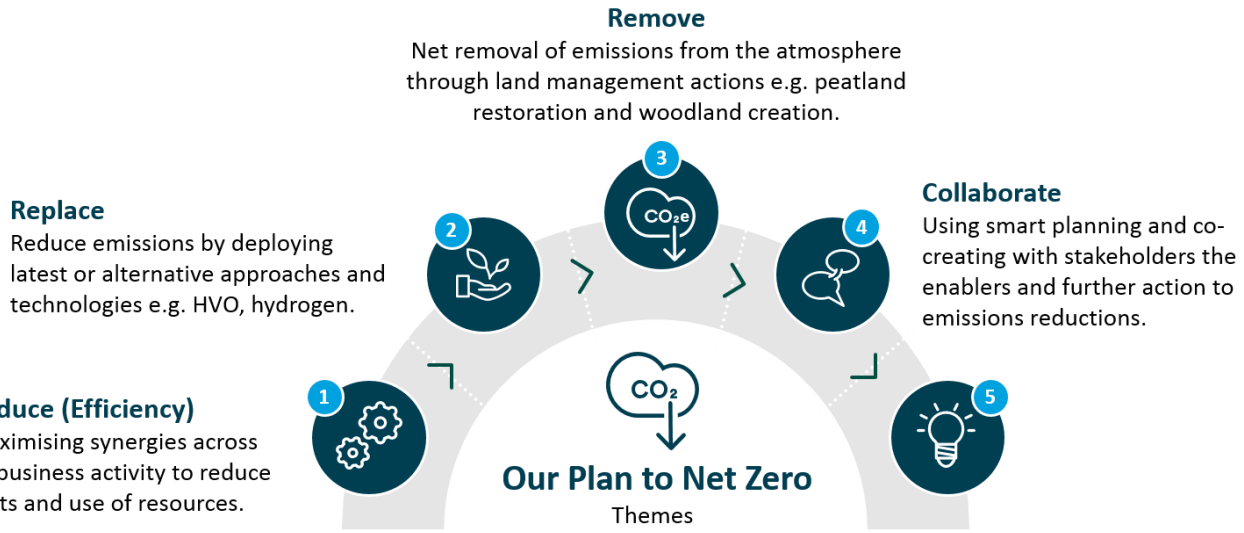
8. How our strategy delivers on cross cutting strategic priorities

8.1 Net zero greenhouse gas emissions

8.1.1 Our AMP8 plan is the next stage of our long-term adaptive strategy to net zero, focused on low regrets activities we can take with confidence of lasting benefits and strong value this is further described in supplementary document *UUW67 – Carbon net zero*. In this section we describe how we have built on that detailed plan to develop an ambitious strategy that will regularly evolve to overcome substantial growth pressures to achieve the national legal requirement for net zero in scope 1, 2 and 3 greenhouse gas (GHG) emissions by 2050. Our strategy also strives for a science-based trajectory to support the national legal carbon budgets every five years to 2050.

8.1.2 Our adaptive strategy is based on the GHG intervention hierarchy used in our AMP8 plan, summarised in Figure 36.

Figure 36: Our greenhouse gas intervention hierarchy



8.1.3 We will continue to pursue efficiency as the first priority, making the most of emerging innovation and technology. We will champion the sustainable use of natural resources, increased application of the waste hierarchy, and the principles of a circular economy in our processes and physical infrastructure. We will enable, encourage and reward action to protect and enhance the natural environment and promote the value of ecosystem services across our business and supply chain.

8.1.4 To ensure an efficient and effective approach, we focus on interventions that reduce emission at the same time as enabling multiple benefits for customers. There is often alignment between emission reduction and several other business strategies to secure benefits for service resilience, cost efficiency, recreation (public health) and nature.

8.1.5 In the long-term we are likely to retain a proportion of residual emissions. For example, it is highly challenging to entirely eliminate emissions from biological treatment processes integral to water and wastewater services and associated asset investment. Our strategy prioritises options to reduce these emissions as far as possible, including asset transformation over time. In the long-term we will consider the most effective ways to offset residual emissions as the last resort.

8.1.6 Looking to 2050, we predict that our environmental challenges and growth pressures will continue to increase and net zero regulations will heighten as more stakeholders and customers experience the increasing impacts of climate change. As a provider of essential public services, customers and stakeholders will rightly continue expecting the highest standards from us. We are committed to further

reducing our environmental footprint by delivering our AMP8 plan and going even further in AMP9 and beyond. We predict the need for on-going net zero enhancements in future AMPs to meet the growing challenge of delivering more service at the same time as reducing emissions.

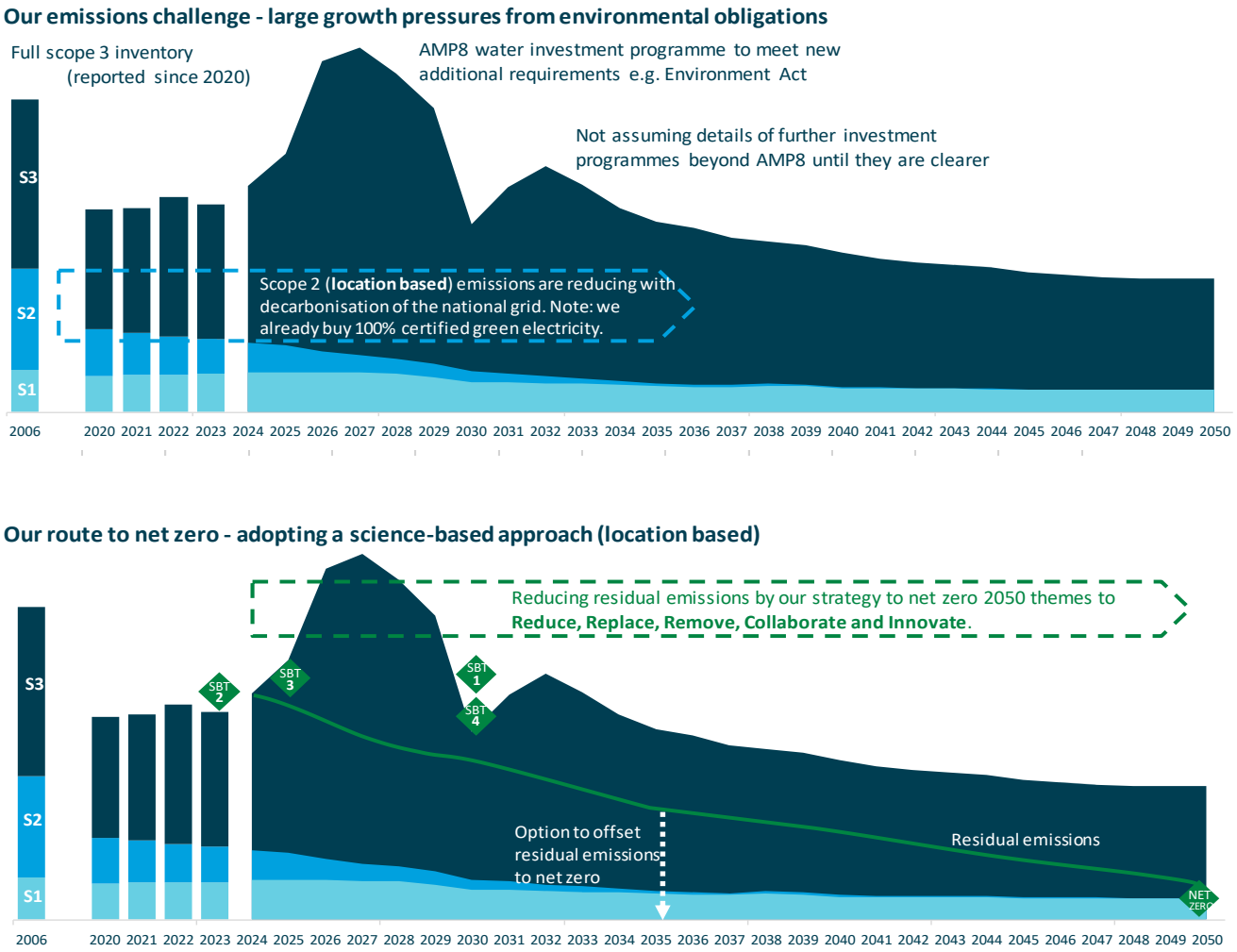
8.1.7 As a regulated service provider and infrastructure operator, there are risks to the success of our long-term strategy that are outside of control. Our short and long-term ability and approach to net zero is ultimately determined by national policy frameworks that are the single largest factor determining both the emissions growth pressures we need to counteract and the level of investment we can prioritise to emissions reductions. To achieve a science-based trajectory requires large and ongoing investment that is reliant on incentives and funding mechanisms with GHG emissions as the primary driver. Furthermore, legislative duties such as the new Environment Act, fundamentally influence the pace and scale of our GHG emissions reductions. Our strategy includes an ongoing engagement programme to inform effective policy that fully values GHG emissions to support sustainable development in the round, for example by providing ideas, data, evidence, case studies and pilot trials.

8.2 Our long-term transition plan

8.2.1 We published our first net zero transition plan in our recent Annual Report and Financial Statements (ARFS), ahead of the upcoming new national requirements. We have updated this work with the assessments and plans produced for PR24, showing AMP8 impact in our transition plan in Figure 37

8.2.2 The first graph shows our emissions challenge with strong growth pressures, particularly in scope 3 with investments to protect the water environment. This also adds ongoing pressure to our scope 1 and 2 emissions in operating new assets to higher standards for decades to come. In planning for PR24 we've innovated and optimised to minimise emissions but we cannot entirely mitigate the increased emissions from legal and regulatory requirements and other substantial growth pressures.

Figure 37: Our emissions challenge and our long-term route to net zero



8.2.3 The second graph shows our route to net zero, adopting a science-based approach. Our four near term science-based targets (SBTs) are shown in the green diamonds, and explained in more detail in our supplementary document – *UUW37 Net zero 2050 plan*. To best reflect our expected emissions in reality, these long-term plans incorporate latest CCC projections for decarbonisation across all sectors which are part of our supply chain. In doing so, these reflect expected improvements across sectors, such as further decarbonisation of the national grid.

8.2.4 Scope 2 emissions are shown here using the location-based reporting method to align with the focus in most of this document. In our ARFS we show the market-based method to align with our current SBTs, recognising the emissions benefits of our certified renewable electricity. The difference almost entirely disappears around 2035 with further decarbonisation in the national grid.

8.2.5 We have developed a short, medium and long-term action plan to 2050, aligned to the themes of the GHG intervention hierarchy (Figure 37). Headlines of the plan are shown in Table 18.

Table 18 Our GHG emissions action plan to 2050

Action plan	**Short term** (including recent progress)	**Medium term**	**Long-term**
Reduce through the efficient use of resources	• Colleague campaign 'Use Less, Save More' • Achieved ambitious targets for percentage of waste to beneficial reuse	• Optimise wastewater processes for GHG • Careful delivery of environment improvement programmes	• Continual search for efficiency opportunities
Replace processes and resources with more sustainable alternatives	• Renewable electricity sourcing • Substantial renewable energy generation capacity and capability • 60%+ sludge processing by low GHG advanced digestion • Electric vehicles rollout and trials for HGVs	• Grow further renewables capabilities and capacity • Bioresources planning and investment to increase sludge processing capacity • 100% green fleet supported by our net zero enhancement programme	• Replace fossil fuels with alternatives e.g. hydrogen • Nutrient recovery initiatives • Continual stretch for sustainability informed by latest innovations
Remove GHGs from the atmosphere	• Woodland creation – planning and first planting schemes • Peatland restoration – schemes started	• Land management for GHG emissions supported by our net zero enhancement programme • Pledges for 550ha woodland creation and 1000ha peatland restoration	• Growing benefits from created woodlands • Carbon capture, use and storage
Collaborate to tackle emissions in the supply chain	• Comprehensive scope 3 reporting • Encourage SBTs for capital delivery partners	• Inform national approach to water environmental improvements • Enriched sustainability criteria for suppliers • Quantify emissions using product/activity data	• Collaborate to decarbonise our infrastructure programmes and wider supply chain

Table 18 Our GHG emissions action plan to 2050

Action plan	Short term (including recent progress)	Medium term	Long-term
Innovate to address current technological or market gaps	• Carbon categories in United Utilities Innovation Labs • 'CEO Challenge' improvement projects on carbon	• Low-carbon capital delivery options e.g. nature-based solutions and low-carbon concrete • Process emissions monitoring • Nutrient recovery research	• Transformation in water and wastewater processing e.g. nature-based solutions • Opportunities for circular economy • Eradicate use of remaining fossil fuels

8.3 GHG emissions in our LTDS

8.3.1 As part of our LTDS we have ensured a holistic and integrated approach by assessing the range of potential impacts on GHG emissions from our water, wastewater and bioresources core and adaptive plans. We have assessed a range of scenarios to consider the potential impacts of a complex mix of variables shaping our approach, including those set out by the Climate Change Committee (CCC). Figure 38 summarises our assessment of these scenarios and pathways for GHG emissions and the goal for net zero. In our LTDS core pathway it shows us seeking to manage substantial growth pressures in embodied and operational emissions. Our low regrets AMP8 plan strives to keep us on track to 2030, but to maintain a science-based trajectory to net zero 2050 will need substantial ongoing adaptation. This will be achieved through transformational innovation and investment for GHG emissions reduction as a primary driver, and the full valuation of GHG emissions throughout national policy frameworks to secure sustainable approaches in the round.

8.3.2 In the long-term strategy data tables (LS3 and LS4) we have summarised the cost to mitigate the change in GHG emissions as a result of delivering the core pathway alongside alternative pathways for water, wastewater and bioresources.

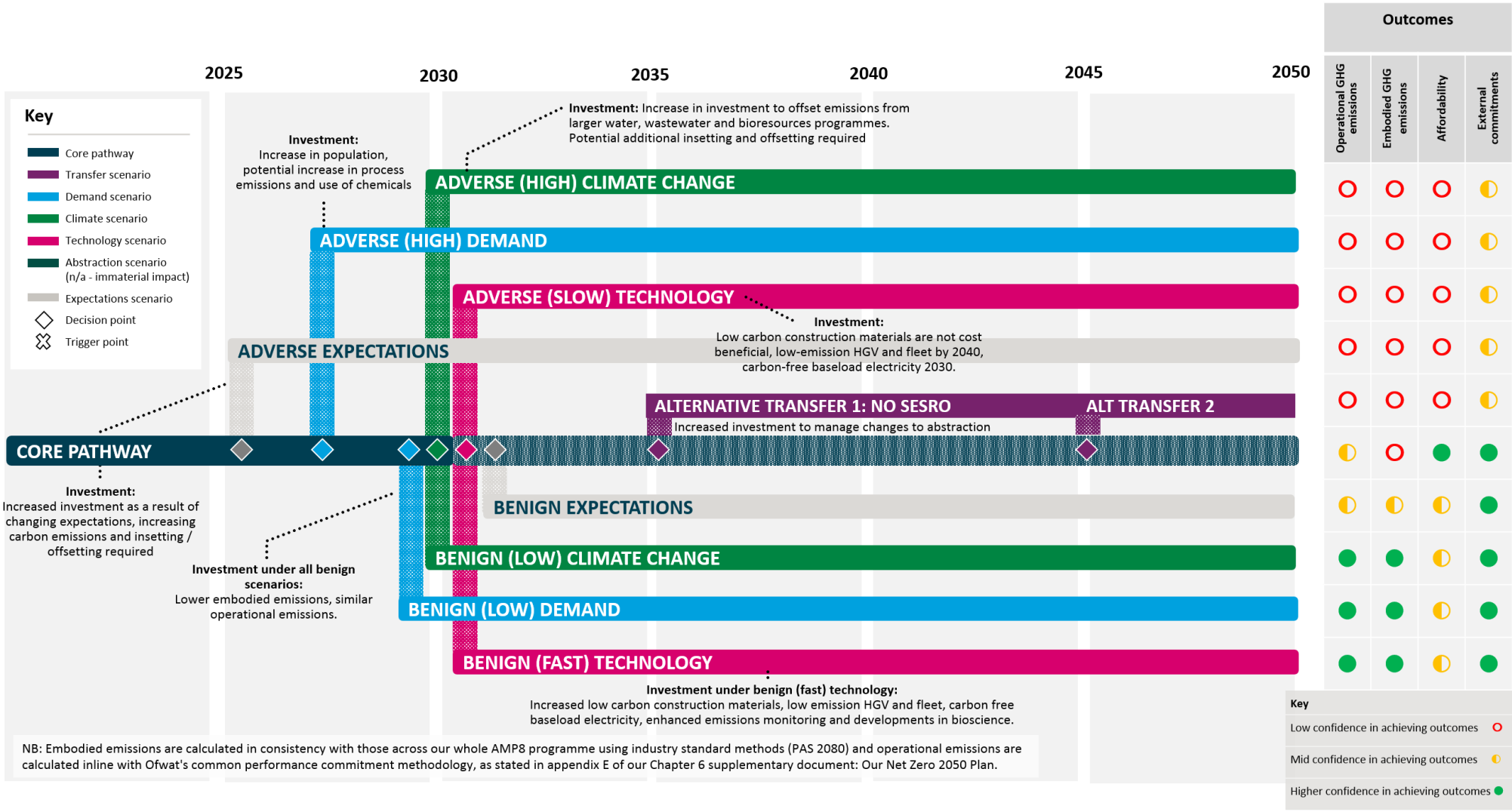
8.3.3 These take an estimated operational GHG emissions impact (tCO_2e) for each pathway. This is then multiplied by the government emissions value for the relevant year (£/tCO_2e) to give a cost for mitigating the emissions impact of each pathway[16]. This shows a long-term cost to mitigate growth in GHG emissions of circa £73 million for the water core pathway and circa £892 million for the wastewater core pathway. Figure 38 shows that we are likely to need alternative investment pathways to confidently meet net zero in the longer term, beyond AMP8.

8.3.4 In the long-term strategy data tables, costs range from £64 million to £151 million to mitigate growth in GHG emissions from water adaptive pathways and £862 million to £895 million to mitigate growth in GHG emissions from wastewater adaptive pathways.

8.3.5 To support our adaptive planning to net zero we have undertaken assessments of two benign pathways for changing expectations and fast technology, specifically with a view to meeting net zero 2050 targets. These pathways are favourable for GHG emissions, with increased costs from the core pathway. These additional costs would be to deliver further net zero enhancement programmes, beyond AMP8, to enable us to meet net zero. These costs are not reflected in the LS data tables.

[16] BEIS (2021): https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation

Figure 38 The GHG impacts of our LTDS and our adaptive plan to net zero



NB: Embodied emissions are calculated in consistency with those across our whole AMP8 programme using industry standard methods (PAS 2080) and operational emissions are calculated inline with Ofwat's common performance commitment methodology, as stated in appendix E of our Chapter 6 supplementary document: Our Net Zero 2050 Plan.

8.3.6 Within our long-term planning for net zero we have forecast our expected position against the new AMP8 common performance commitments for operational GHG emissions which are shown in LS1 and LS2. By 2049-50 GHG emissions are expected to increase using the PC methodology by circa 59,163 tCO_2e or 14 per cent from 2029-30. Our bespoke PC for embodied emissions programme is only applicable within AMP8 so performance has not been forecast beyond 2030. However, the learning gained could be applied to a common or future bespoke PC beyond AMP8.

8.3.7 Aligned to Science-Based Targets initiative (SBTi) requirements we intend to re-baseline our SBTs towards the end of AMP7. This will incorporate changes as a result of our AMP8 plan and enable us to set long-term SBTs targeting emissions reduction for the next 25 years across all 3 emission scopes aligned to SBTi's corporate net zero standard. It is likely that this will require a reduction of at least 90% in GHG emissions by 2050. This aligns with our transition plan to meet UK government carbon budgets aligned to the UK Climate Act.

8.3.8 We will review our plan cyclically each AMP to ensure we're always acting in the short term with clarity and confidence. We will evolve the plan over time to always act on latest national policy, climate science and the technical feasibility and cost-benefit of potential interventions.

8.4 Climate resilience

Current priorities and future ambitions for climate resilience

8.4.1 We have developed a mature 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 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. We are taking steps to adapt to climate change and continue to provide a resilient service. At the heart of our response is systems thinking.

8.4.2 In understanding how systems (both UUW-owned and non-owned /partner led) interact and depend on each other, we account for and anticipate likely cascade failure risks associated with climate resilience and develop appropriate strategies to absorb, react, and recover.

Our current position and considerations for climate resilience

8.4.3 Climate change presents a systemic and often compounding risk throughout our operations and services, to which all water companies are susceptible dependent on their geographies and asset mix. It affects not only the reliability and quality of our raw water supply, but also influences customers' use patterns, for example with increasing demand for water during warm periods.

8.4.4 Rainfall patterns are changing, leading to increased flood risk. Susceptibility to the effects of climate change are most significant where water companies, such as UUW, have a high dependency on surface waters for public supplies. This is because surface waters are more exposed to the effects of evapotranspiration, increased warming and sunlight driving biological activity. This also relates to the effects of flash storms, causing surface run off and flooding.

8.4.5 Relatively high rainfall and a hilly topography in the North of England and many parts of Wales, means that water resource systems are dominated by surface water sources including large numbers of impounding reservoirs. In the region, in a typical year, 93 per cent of the water we supply comes from river or reservoir sources, and only six per cent comes from groundwater. This contrasts with the South and East of the country where extensive groundwater supplies typically make up a higher proportion of water resource systems (e.g. 65 per cent, on average, of one water company's supply in the South of England).

8.4.6 Similarly, wildfires are a known issue and are more likely in drier weather. This impacts the quality of water in many of our source catchments, and can increase operating costs and reduce resilience. This is prevalent in the North West with high levels of peatland. This also links to GHG emissions and further accelerates climate change through the release of large carbon stores in the peat.

8.4.7 We have a more direct dependency on seasonal rainfall patterns and susceptibility to 'in-year' dry weather periods. Therefore, we are more exposed to long-term trends in climate as well as the acute risks that come from greater and more frequent climatic extremes. This is in contrast to companies that have a greater proportion of groundwater sources, where the hydrological processes help to buffer out the 'in-year' acute shocks that are forecast to increase in frequency and intensity as a result of further climate change.

What our long-term plan delivers for climate resilience

8.4.8 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. In responding to this, we see substantial opportunity to deliver lasting value for customers and the North West.

8.4.9 We are prioritising approaches which support long-term resilience of services and supplies. Our rainwater management programme will start on our journey to deliver sustainable drainage and provide protection against climate change and the increased rainfall forecast. Investment in leakage programmes, demand reduction and catchment management also forms an important part of our long-term strategy to build resilience in supplies. Through reducing losses we aim to reduce pressure on our water supplies and through slowing the flow and reducing erosion in catchments we aim to reduce water quality.

8.5 Environment

Current priorities and future ambitions for the environment

8.5.1 As a provider of water and wastewater services, our relationship with the environment must be symbiotic. We rely on a well-functioning environment to deliver vital services to the North West, and we play an important role in supporting a healthy water environment. The environment of the North West (and wider) is dependent on us delivering those services in ways that protect and enhance catchments and reverse decline. It is vital that when protecting the local environment we act at a system level to enhance its wider recovery and the value that brings. Key environmental priorities now, and forecast to continue into the future include:

- Investment in renewable energy generation to support in reducing our carbon footprint and input on the environment, while also allowing us to meet our net zero GHG ambitions;
- Sustainably managing our water resources and promoting water efficiency;
- Adapting to the impacts of climate change on the services which we deliver;
- Reducing the impact of our operations on the environment by improving our wastewater treatment discharges and reducing reliance on storm overflows; and
- Protecting and enhancing the natural environment, delivering social and environmental value with a focus on natural capital and biodiversity.

Current position and considerations for the environment

8.5.2 Forecasts for more frequent drier summers have already been experienced and will create pressure on water resources. Climate change is both increasing the frequency of dryer summers and creating less certain rainfall distribution - combined with an increasing population growth this places strain on raw water storage capacity, with more customers requiring water supply day-to-day, and overall system capacity peak demand periods getting higher and longer.

8.5.3 More extreme storm events and wet weather conditions are forecast to lead to an increase in extreme rainfall, more frequently exceeding drainage capacity and increasing the risk of flood and storm overflow spills. Similarly, a forecast increase in North West population will create additional wastewater

load requiring collection and treatment, and additional flows that can increase risk of flooding and the activation of overflows.

8.5.4 To address these twin challenges, we are working across many strategic programmes, such as the Water Resources Management Plan (WRMP) and the Drainage and Wastewater Management Plan (DWMP) for example, to enable joined up planning and solutions to strategic environmental problems.

What our long-term plan delivers for the environment

8.5.5 The next 25 years represents our most ambitious plan for delivering improvements for the environment, with action to reduce on storm overflows going beyond any previous enhancement proposals in response to new government targets. An increased focus on, and the upskilling of, our colleagues and supply chain to deliver nature-based solutions, where appropriate, will deliver wider environmental and social benefits from undertaking this work. UUW can't solve these challenges alone and working with other partners at a catchment level will be required.

8.5.6 Our rainwater management strategy underpins our response to the new storm overflows targets, acting close to the source of the problem will allow us to deliver low regrets solutions, maximise performance and maximise environmental and social value. Rather than starting with conventional (asset level) solutions and optimising performance later with catchment/rainwater management, we reverse this sequence. The rainwater management at a catchment level (upfront) has multiple solution-side benefits (direct drainage and wider benefits) but also serves to reduce the potential scale of multiple future drivers – permanent reductions in network flow/variability reduce the scale of future blue/green and/or conventional network and downstream treatment solutions (if needed). Implementing rainwater management upfront also allows for the optimisation of those interventions to maximise the benefit they can deliver – we can use our sector leading approach to Dynamic Network Management (DNM) to monitor and control rainwater management where those interventions are active rather than passive.

8.6 Customer service

Current priorities and future ambitions for customers

8.6.1 We aim to provide the best service to customers at the lowest sustainable cost, and in a responsible manner. When considering the lowest sustainable cost, affordability is a priority for the North West, which is home to 4 in 10 of England's most deprived neighbourhoods.

8.6.2 When considering our impact on customers and people of the North West, UUW also plays a significant role in supporting the regional growth. Our investment provides, directly and indirectly, 22,700 jobs. Our investment programmes will continue to support local jobs and communities.

8.6.3 Working with stakeholders is critical in delivering more for less for customers. From regular engagement with local authorities we understand key North West priorities for the future: growing the economy, delivering social benefits for people, and improving the environment. As key partners in the North West, it is important that our work supports local authority plans and outcomes.

What our long-term plan delivers for customers

8.6.4 Our plan proposes a range of service improvements for customers, we will invest to ensure customer disruptions and the need to contact us is progressively improved over the next 25 years.

8.6.5 Due to the scale of proposed programmes to meet statutory requirements over the next 25 years, bill increases will be required in order to support investment. UUW will continue to support customers through affordability schemes and priority services. We aim to keep customers bill increases as low as possible, ensuring affordability for customers across the region. Recognising the challenges of bills in the next five years, our AMP8 plan aims to support more than 590,000 customers through an unprecedented £525 million of affordability support to those in need, including direct financial contributions from shareholders of £200 million and which is prioritised over dividend.

8.6.6 Working with customers forms an important part of our 25 year plan. Supporting customers to manage the amount of water used within the home, supporting national proposals such as water labelling to allow customers to make informed choices about their water use and engaging with current and future customers to reduce per capita consumption. Additionally, continuing to engage with customers on 'what not to flush' to increase understanding of the causes of sewer flooding and reduce the likelihood of issues affecting customers in their homes.

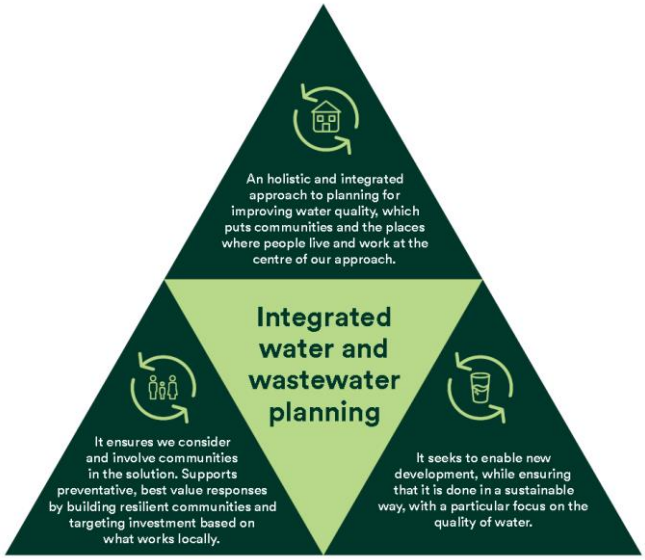
8.7 Partnerships and collaboration

8.7.1 Managing water is complex and involves multiple agencies; we are aware that the challenges of the future cannot be met through the actions of individual organisations alone.

8.7.2 Strong partnerships and collaboration between organisations are required to deliver a more resilient future. Core stakeholders include the Environment Agency, Natural England, Natural Resources Wales, local councils, Rivers Trusts, Wildlife Trusts, communities and other land owners.

8.7.3 This collaboration will be driven by pilots of place-based planning in priority areas, where there is significant potential to work more closely with stakeholders. The place-based planning concept and outcomes are outlined in Figure 39.

Figure 39 The principles of UUW's place-based planning approach



8.7.4 We recognise that climate change and environmental improvements cannot be addressed in organisational silos, therefore, partnership working will support cost effective investment and planning within local areas. Place-based planning will help to diversify solutions to include a combination of traditional hard engineering approaches, nature-based solutions and behavioural change initiatives. Together, these will help to safeguard water resources for future generations. During our current business plan period 2020–2025, we are trialling place-based planning within the Eden and Esk, Wyre and Upper Mersey catchments.

8.7.5 Place-based planning will help to support the delivery of our Catchment Systems Thinking (CaST) approach. By working with local authorities and planning agencies, we will be better equipped to manage water close to where it falls and tackle issues at source. This will allow us to extend the work completed through the Wyre Natural Flood Management project, for example, to tackle the challenge of pesticide use within the Wyre catchment.

8.7.6 Through the WINEP we will continue to work with partners to raise awareness of water quality and support measures to reduce risk and improve resilience within catchment safeguard zones. To achieve

our ambitions to sustainably improve the taste and odour of drinking water we seek to build on our 2020—2022 investigations in nine catchments to better understand the sources and formation of geosmin and 2-methylisoborneol concentrations in conjunction with our existing algal monitoring plans and taste and odour management plans. We propose to trial the new investigative approaches as recommended by the current project at further sites including Cowpe, Lamaload, and Hurleston.

8.7.7 By 2030 we seek to deliver a second phase of catchment resilience schemes related to improving the condition of habitat on our land holdings at Thirlmere, Haweswater, West Pennine Moors, Bowland Fells and South Pennine Moors. This is supported by the WINEP, if approved through the PR24 process. This will help to improve raw water quality in the long-term by restoring the underlying ecosystems and natural processes, building on the legacy of long-term catchment management delivered at these sites since 2005. We will go beyond the extent of our land holding to deliver catchment resilience schemes in Cumbria and Lancashire working in partnership with stakeholders at a landscape scale in the Lune (Lancaster), Wyre (Franklaw) Eden (Castle Carrock and Cumwhinton), Upper Duddon (Ulpha) and Poaka Beck catchments to improve habitat condition and hence the long-term resilience of raw water quality.

8.7.8 Our collaborative programmes with our stakeholders have already delivered a wide range of benefits. Actions to drive further collaboration with partners include:

- Sharing investment plans and ideas early across organisations so that we can identify any synergies that exist between plans; and
- Fully embracing the polluter pays principle to ensure all parties address their impacts on the environment in an equitable way.

9. Rationale – how we have developed a robust strategy and adaptive plans

9.1 Our approach to developing the LTDS

9.1.1 Our LTDS represents a comprehensive and adaptive strategy for the next 25 years which embraces uncertainty and identifies robust pathways to deliver ambitions that customers and stakeholders endorse. The first five years of this long-term strategy is our PR24 Business Plan.

9.1.2 We have adapted our long-term planning approach in response to Ofwat feedback and guidance for the sector. We have integrated the long-term and adaptive planning activity already carried out within a wider and more holistic overarching framework, which aligns to Ofwat's guidance. The principles we have followed in developing our LTDS are:

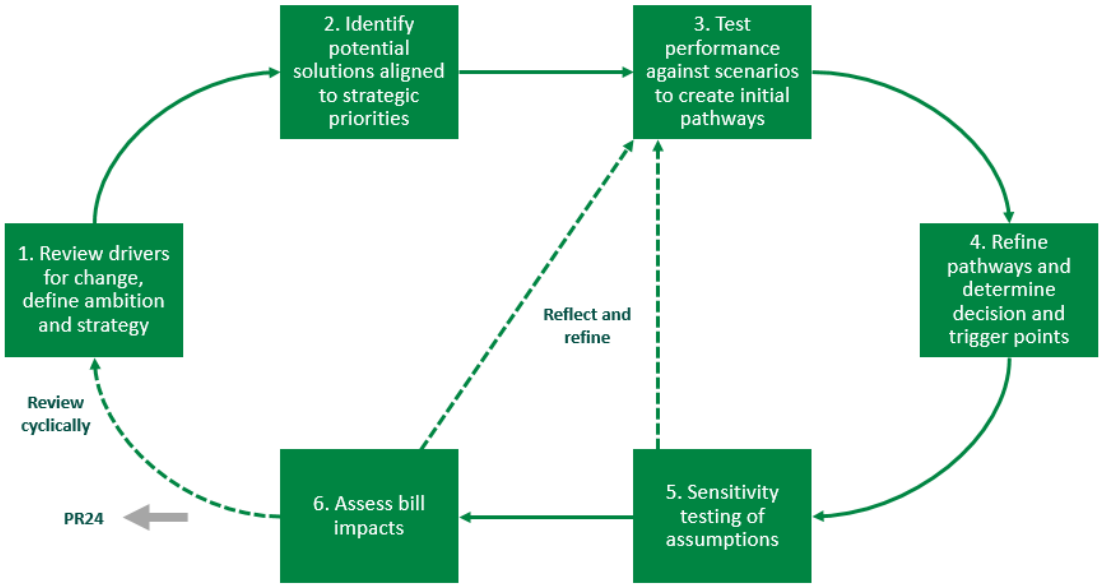
- **Holistic:** we have used our existing planning frameworks as a starting point and brought these together under an overarching framework. These include:
    - Our Water Resources Management Plan (WRMP);
    - Our Drinking Water Quality Plan (DWQP);
    - Our Drainage and Wastewater Management Plan (DWMP);
    - Our Regional Integrated Asset Plan for bioresources (RIAP); and
    - Our approach to asset management, which has been certified to ISO55001.
- **Iterative:** we have progressed through multiple iterations of our core pathway and alternative pathways to progressively refine their component investments as data becomes available and is improved. This helps ensure delivery of our ambition as efficiently as possible.
- **Transparent:** we have followed a clear process and been open about how the uncertainties that impact our decision making have been managed. We do not have all the answers yet, but we have

identified how we will progressively improve our understanding so that we can take future action when it is needed. These areas are all explored openly in this document.

9.1.3 ***Figure 40*** presents a simplified view of our approach to developing our LTDS (explained in detail in section 9.1). It comprises six broad steps in an iterative cycle and aligns with good practice principles of adaptive planning from the following sources:

- BS 8631:2021 Adaptation to Climate Change: using adaptation pathways for decision making;
- The Government Office for Science Futures Toolkit, particularly its approach to scenario testing and sensitivity testing;
- The Environment Agency's Adaptation Pathway Programme which is developing adaptation pathways in four key locations of national significance; and
- Adaptive planning insights in other geographies and sectors, for example the 50-year water security strategy for Greater Melbourne, Australia and the Thames Estuary 2100 Plan which sets out an adaptive strategy for flood risk management along the Thames in London.

Figure 40: Overview of our approach to developing our LTDS

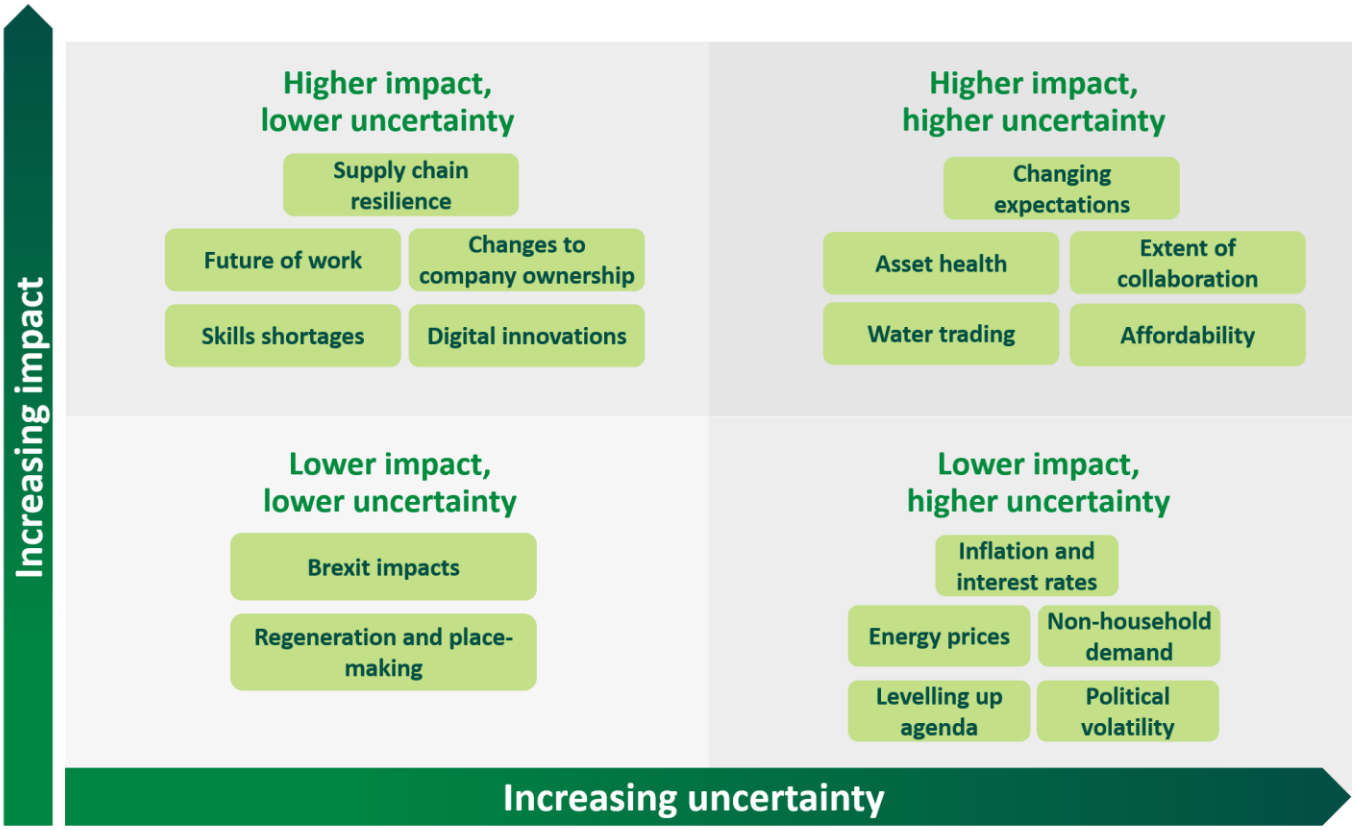


Managing uncertainty

9.1.4 In developing our LTDS, we have followed a systematic process to identify drivers of uncertainty that may impact our ability to deliver our ambition. We have treated these drivers differently, depending on how uncertain they are and how significant their impact on our planned expenditure could be, described in Figure 41.

9.1.5 We used scenario testing to explore the potential impacts of high impact, high uncertainty drivers on our long-term strategy. Ofwat has defined four scenarios (climate change, technology, demand, abstraction reductions – together termed the common reference scenarios – CRSs) and we have defined wider scenarios which we believe are plausible scenarios that are important for the North West (described in section 9.4).

Figure 41 Our approach to addressing uncertainty and identifying relevant drivers for wider scenarios



Continually reviewing and updating our LTDS

9.1.6 Our LTDS will be reviewed and updated in a number of ways:

- The transition to our alternative pathways is contingent on the passing of decision and trigger points. These points are linked to specific data thresholds. Appendix B presents our monitoring plan for the LTDS and how this data will be collected, analysed and reported;
- We will continue to monitor trends and uncertainties in our external environment through horizon scanning. This process will allow us to understand if uncertainties are materialising as we have assumed and/or tested or whether other assumptions and testing approaches are required; and
- We will continue to collaborate with our stakeholders to understand how we can work together to deliver more for society and the environment.

9.1.7 Our LTDS will be formally updated once every five years. We will also conduct an internal annual review outlining the progress we have made and what our monitoring of the external environment is telling us. If required to maintain our trajectory towards our long-term ambition, we will revise our LTDS outside the five-year review cycle.

9.2 Our approach to best value

9.2.1 Value-based decision making is not a new approach in UUW. Our consistent and robust approach to assessing value has helped us to improve our planning with a richer understanding of how our decisions affect customers, society and the environment now, and in the future.

9.2.2 We understand best value investments as ones which generate the greatest long-term economic benefit for customers, the environment and society, taking into account the costs of the schemes in question. Our approach to best value is informed by the six capitals thinking and makes use of qualitative, quantitative and monetised information to support robust decision making. The wide range of topics important to customers, as well as making sure that the basic services we provide are done to a high

standard at low cost, highlights the need for a holistic decision making framework that allows us to consider environmental and social value alongside core performance. The six capitals are:

- Social capital – Delivering better performance for customers and creating social value;
- Manufactured capital – Improving asset performance, asset health and systems resilience;
- Financial capital – Reducing risk, improving our efficiency and financial resilience;
- Natural capital – Improving the environment and reducing carbon;
- Human capital – Improving the skills, knowledge and health, safety and wellbeing of our colleagues; and
- Intellectual capital – Improving our knowledge base and how we do things (for example better system monitoring/systems thinking).

9.2.3 We believe our approach to best value allows us to optimise our future investments in line with customer's expectations as well as those of our stakeholders and regulators. Our approach also allows us to account for the impact of our decisions on multiple stakeholders.

How we have applied our best value framework

9.2.4 In our AMP8 business plan, all of our enhancement expenditure has been assessed for best value. Building on our previous approach to go even further in PR24, we have developed and applied our 'PR24 Value Tool' which allows us to monetise best value, and has been assured by a third party to give us confidence on the robustness of value estimates. For base expenditure, we have assessed greenhouse gas (GHG) emissions, cost and performance as primary drivers for decision making.

9.2.5 When we assess options for enhancement expenditure, our default selection is always the best value option. Recognising that our value framework is intended to inform decisions, not to make them for us, we may deviate from best value where appropriate, for example where the following factors are present but a solution is not the 'best value' solution:

- There is a significant financial cost saving to protect affordability for customers; or
- There is a significant GHG saving to protect climate resilience; or
- There is an opportunity for a blue-green solution (which may not be the best value option due to current understanding of cost or unquantified benefits).

9.2.6 Our approach to best value is applied across our business, including to help us develop our long-term plans (WRMP, DWMP, WINEP, Bioresources RIAP, DWQP and LTDS). The requirements of these planning frameworks may mean that certain value metrics are omitted in particular applications however the breadth of our best value approach means we always include a spread of metrics across the six capitals and can link back all solutions to their impact on our service measures and strategic objectives. The different metrics used for each of the long-term plans are:

- WRMP – we have completed a monetised value assessment of our plan using a value framework we co-designed with our Water Resources West partners. There is strong alignment between this value framework and our six capitals approach;
- DWMP – we have completed a qualitative six capitals assessment as part of our approach to secure the best value plan. This approach assigned scores to different intervention types of the value they create across the six capitals, where schemes from the WINEP inform the DWMP they have been assessed using the PR24 Value Tool, as described below;
- WINEP – we have undertaken a value assessment, using the PR24 Value Tool, aligned to the Environment Agency's guidance on wider environmental outcomes. A majority of the expenditure identified through the DWMP is delivered via the WINEP;
- Bioresources RIAP – in the absence of a strategic planning framework for Bioresources, we use our regional integrated asset plan (RIAP) to ensure that we deliver end to end optimisation of our

system through a regionally integrated system of assets. The process ensures we select options that are efficient and that deliver lowest carbon solutions;

- DWQP – we have remained consistent with the long-term planning frameworks which has integrated the six capitals approach throughout our DWQP. Social capital remains fundamental to our plan through ensuring public health or service improvements; and
- LTDS – the LTDS adopts the value assessment completed under our existing long-term frameworks. For any planned expenditure not covered by an existing planning framework, we apply the PR24 Value Tool.

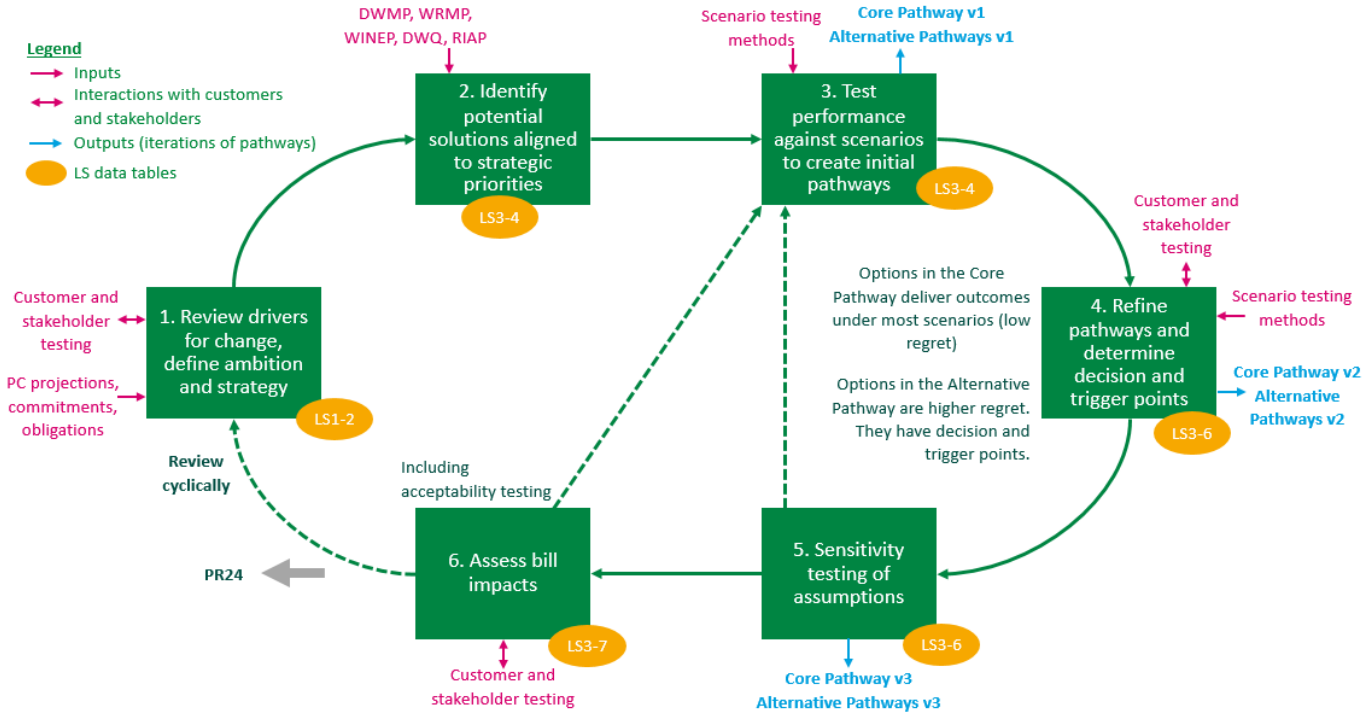
9.2.7 We are continuing to mature our approach to value-based decision making to give us an ever richer view that helps further enhance how we serve customers and stakeholders. This helps us serve their differing needs, and is increasingly important and valuable at a time where the sector is facing many significant drivers of change, at the same time as ensuring bills remain affordable. Our approach to assessing value at PR24 has been reviewed by third party assurance, which concluded that our approach is fit for purpose. We will continue to improve and further embed our approach to drive value-based decisions throughout everything we do. For more details on our approach to best value, see supplementary document *UUW45 - Our approach to deliver best value totex.*

9.3 Our approach to developing our core and alternative adaptive pathways

9.3.1 Our Core Pathway and alternative pathways have been defined and refined via an iterative process based on clear and transparent decision making.

9.3.2 Figure 42 presents our adaptive planning approach, comprised of six steps and a series of iterations. Each of these steps is described in the following subsections.

Figure 42: Our approach to developing our LTDS, with each step detailed below



Step 1: Review drivers for change, define ambition and strategy

9.3.3 The first stage of our adaptive planning process is to be clear about what we are aiming for. By listening to customers, stakeholders and regulators, and by challenging our teams, we have defined a clear, long-term purpose and vision – "to provide great water for a stronger, greener and healthier North West".

9.3.4 Our vision is supported by six strategic objectives and a suite of long-term ambitions (section 2). These have been developed following our analysis of customer and stakeholder priorities, our service performance, our operating environment today and how this may change in the future.

9.3.5 During this step we also considered drivers for change and key uncertainties that could impact our business and services in the future. We started with existing data captured in our ongoing corporate risk and horizon scanning activities, and reviewed and updated these through a series of workshops with a range of subject matter experts. We structured our thinking via a political, environment, social, technology, legal and economic (PESTLE) framework to understand the range of uncertainties influencing how we work and the services we deliver. We then refined this long list to identify those uncertainties that:

- Have the potential to drive significant change in the way we run our business;
- Are outside management control; and
- Can be tested to understand their impact and how these impacts might impact future plans.

9.3.6 This process identified the wider scenarios we have tested our planned future expenditure against (in addition to the common reference scenarios) and identified the other important but more certain factors that we have addressed through assumptions and sensitivity testing (see section 9.4).

9.3.7 Alongside our vision, we have developed ambitions, which include stretching but deliverable performance commitment forecasts to 2050 and broader aims for services that don't have direct performance commitments.

Step 2: Identify potential solutions required under a range of scenarios

9.3.8 Together, our various strategic plans (the DWMP, WRMP, DWQP and WINEP) address the vast majority of expenditure we deliver (addressing 93 of the 102 lines in data tables LS3 and LS4). The development of our strategic plans has involved a thorough and comprehensive evaluation of options and optimisation of programmes in accordance with our value assessment framework (see section 9.4). The strategic plans are cyclical and substantial activities that are developed in response to regulated processes and statutory requirements, and as such, were already well developed when Ofwat confirmed requirements for the LTDS. However, we were able to shape and build on these strategic plans as we developed the LTDS and applied good practice in adaptive planning.

9.3.9 The starting point in each of these planning frameworks is to consider a broad range of innovative and value-adding options to address the challenges we face and the opportunities open to us in striving to deliver our ambition. We do this by:

- Exploring a full range of options, including those that enable further efficiency, for example by reducing leakage and demand for water (aligned with our WRMP) and surface water management (aligned to our DWMP) and isolating those which were determined to be low regrets. We have also explored ways to optimise system operation, create additional supply, create additional treatment capacity and manage risk through catchment approaches;
- Assessing nature-based and infrastructure solutions and understanding how potential solutions can be delivered most efficiently and effectively, including through partnership with others; and
- Carrying out external investigations to drive innovation and the consideration of alternative approaches. This has considered not only our own options, but has engaged other risk management authorities, water companies globally, academia, land owners, non-governmental organisations and suppliers, all of whom were invited to submit their ideas to manage long-term challenges.
- Considering options with application at different scales:
  - Regional options: for example, customer-side management options, operational strategies and water or sludge transfer solutions.

- System level options: for example, catchment management options such as diffuse offsetting and flexible permitting, as well as transfer options involving multiple tactical planning units; and
- Local options: for example, increasing wastewater treatment works capacity, delivery of sustainable drainage systems (SuDS) locally.

9.3.10 Our broad approach to option identification means we initially consider a very long list of potential solutions. Our LTDS further built on these plans by testing that options were required under a range of plausible scenarios to meet ambitions and exploring overarching and supporting solutions that maximise the efficiency and effectiveness of our combined long-term plan.

What customers told us about our solutions

In our option selection customer research, recurring themes across all audiences were to harness technology to innovate and make use of what we already have. There was acknowledgement that all stakeholders have a role to play and a need to work collaboratively to deliver solutions. When it comes to specific drainage and wastewater management initiatives, there was strong endorsement of measures that encourage more responsible behaviour at a household level. The highest ranked initiatives were customer engagement, water efficiency and using technology to control sewers and monitor for problems.

For water resources, prioritised initiatives included leakage, promoting water efficiency and reusing water.

Across the breadth of initiatives (i.e. water and wastewater), no option types were rejected outright, but customers had reservations about the large-scale movement of water and wastewater around the region and the fairness of fees/charges. Further details of our customer research are included in section 3.

Step 3: Test option performance against scenarios to create initial pathways

9.3.11 In line with Ofwat's guidance, the options we have included in our core pathway and alternative pathways have been selected by considering how they perform under different future scenarios. Those options that are needed to deliver our ambition under most or all scenarios, including all of Ofwat's benign common reference scenarios (CRSs), are considered low regret and included in our core pathway. Those options that are only needed under one or a small number of scenarios are considered higher regret and included in an alternative pathway.

9.3.12 Our approach to testing the performance of options under different scenarios has varied to ensure alignment with existing planning frameworks (Table 19). Our aim has been to apply a transparent set of processes that embrace uncertainty (rather than try to solve it via a single solution set) and that are clear about where we have high and low confidence, and how confidence will be progressively improved (see section 9.4 for full details).

Table 19 Summary of our approach to scenario testing

Component strategy	Approach to scenario testing
Water resources, aligned to our WRMP	The process of developing our WRMP has involved developing programmes of investment under a range of scenarios, including the CRSs and our wider scenarios. We used an optimisation model to generate investment profiles under each scenario.
Drinking water quality, aligned to our DWQP	The development of our DWQP has involved understanding the impacts of the CRSs and our wider scenarios and working with operational and engineering subject matter experts to understand the potential and preferred options to address those impacts and deliver our ambition.

Component strategy	Approach to scenario testing
Wastewater, aligned to our DWMP	The development of our DWMP used optimisation models to generate investment profiles under a series of scenarios. The DWMP had already considered the impact of uncertainty in demand on solution types. For the LTDS additional work has been undertaken to test the technology scenario. This means that we have tested DWMP expenditure against all the CRSs and our wider scenarios.
WINEP	In developing our WINEP we have considered long-term and adaptive plans for those drivers that require a long-term approach, including storm overflows, wastewater treatment drivers for phosphorus, investment to raw water quality and abstraction impacts aligned to our WRMP. The majority of proposed AMP8 wastewater investment is delivered through the WINEP, this is also reflected in our DWMP. Our short-term investment in phosphorus, raw water quality and abstraction align to our long-term plans in the associated long-term strategies (DWMP, DWQP and WRMP). We have worked with our subject matter experts to consider how all the CRSs and our wider scenarios might impact our planned future expenditure.
Bioresources	Our bioresources long-term plan has considered the impact of the CRSs and our wider scenarios on bioresources. The impact of scenarios was determined through workshops with strategy, engineering and operational subject matter experts, and the resulting needs were tested through our RIAP. The impacts of the CRSs manifest in different ways for bioresources. Changes in demand are seen in the volume of sludge production. Climate change influences landbank availability. The technology CRS does not include bioresource-specific technologies but we have assessed how these could impact our strategy. For bioresources, our wider scenario on changing expectations comprises landbank modelling to test future landbank scenarios.

9.3.13 To streamline the process of scenario testing, our subject matter leads identified which components of our planned expenditure had the potential to be impacted by each scenario. This process enabled us to identify where scenario testing was required.

9.3.14 We then took each scenario in turn (the adverse and benign versions of the CRSs and our wider scenarios) to consider which options were needed to deliver the ambition:

- If a given option was selected under a majority of scenarios, we considered it low regret and moved it to the core pathway. This is an important step which ensures we do not unduly filter out options that are optimal across a wide range of plausible scenarios; or
- If an option is only required under one or a small number of scenarios, it was placed in an alternative pathway.

Step 4: Refine pathways and determine decision and trigger points

9.3.15 In Step 3, we tested options against each scenario in turn. This created an initial core pathway and set of alternative pathways. In Step 4, we then considered whether any of the alternative pathways could be combined such that a given alternative pathway addressed multiple scenarios.

9.3.16 We also identified whether expenditure in alternative pathways required enabling works or other preparatory activity to keep the option of switching to that alternative pathway open. Where this was required, enabling work was included in the core pathway.

9.3.17 For each alternative pathway, we then identified the decision point and trigger point that would initiate a change to that pathway.

Step 5: Sensitivity testing of assumptions

9.3.18 In addition to scenario testing of drivers we identified as highly uncertain and having a high potential impact on our planned expenditure to 2050, we also conducted sensitivity testing of drivers that we considered more certain. These drivers are described in Appendix A.

9.3.19 We varied each assumption in turn and recorded its impact on our pathways. This process has enabled us to optimise our assumptions and has resulted in minor changes to the core pathway and alternative pathways.

Step 6: Assess bill impacts

9.3.20 This step involved assessing the bill impacts of each of our pathways (core and alternative). The process is described in detail in section 7.

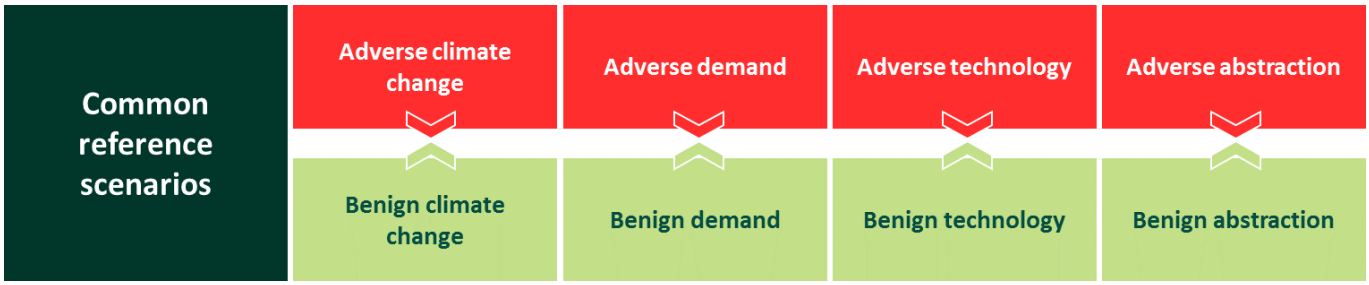
9.4 Our approach to scenario testing

9.4.1 A range of uncertainties have been considered in the development of our LTDS:

- Uncertainties that are highly impactful and highly uncertain have been addressed through scenario testing;
- Uncertainties that are highly impactful and less uncertain have been addressed through assumptions; and
- Uncertainties that are less impactful have been recorded for reassessment as our LTDS is implemented and maintained.

9.4.2 Throughout this section we refer to CRSs and wider scenarios. CRSs are specified in the LTDS guidance (Figure 43), wider scenarios are other scenarios we have identified as being important for the North West and meeting Ofwat's planning expectations.

Figure 43 A summary of the CRSs tested through the LTDS



9.4.3 The following subsections describe our approach to defining and testing scenarios across all the component strategies of our LTDS.

Climate change

9.4.4 Climate change is one of the common reference scenarios and we have tested all components of our LTDS against its benign and adverse scenarios.

9.4.5 We have tested our plans to a range of climate change projections, using the latest best available information from the Met Office's UKCP18 climate change projections. These projections are categorised by their Representative Concentration Pathways or RCPs. Each RCP is associated with a predicted level of future greenhouse gases relative to preindustrial levels. The relative concentrations will have different levels of consequences on average global temperatures, through a mechanism called radiative forcing. These temperature ranges are detailed below in Table 20.

Table 20 Relative average global warming for each RCP

RCP	Change in temperature (°C) by 2081–2100	Range of temperatures (°C) by 2081–2100
RCP2.6	1.6	0.9 – 2.3
RCP4.5	2.4	1.7 – 3.2
RCP6.0	2.8	2.0 – 3.7
RCP8.5	4.3	3.2 – 5.4

The increase in global mean surface temperature averaged over 2081–2100 compared to the pre-industrial period (average between 1850-1900) for the RCP pathways (best estimate, 5–95 per cent range). From IPCC AR5 WG1 Table 12.3

9.4.6 In developing our LTDS we have always considered a range of credible climate change scenarios. This includes benign (RCP2.6), central (RCP 6.0) and extreme (RCP8.5) pathways. However, it is increasingly apparent that projected benign climate change scenarios are no longer credible. Planning for this pathway would likely see the UK water sector ill prepared for the future, unable to secure services that are resilient to climate change.

9.4.7 A report from the UN in October 2022[17] concludes that the 1.5°C (RCP2.6) is no longer a credible pathway, with no plan in place to meet the emissions reductions required internationally despite the legally binding promises made at the UN Climate Change Conference (COP21) held in Paris in 2015. The report forecasts that the world is on a trajectory for a temperature rise of between 2.4°C and 2.6°C by 2100 – this better aligns with climate projections RCP4.5/RCP6.0.

Water resources, aligned to our WRMP

9.4.8 Climate change impacts water availability and water quality in the natural environment. Climate change, therefore, has a large impact on our ability to provide water to customers at the levels of service they prefer, and is responsible for a significant proportion of our planned expenditure in this area. It is important that we plan for plausible futures, and the choice of climate change projection is significant. We have, therefore, chosen to test a mid-range climate scenario (RCP6.0) in addition to Ofwat's benign scenario (RCP 2.6) and adverse scenario (RCP 8.5). This combination of testing helps us to test and secure a low regrets approach to both efficiency and resilience.

Drinking water quality, aligned to our DWQP and WINEP

9.4.9 Climate change influences the quality of water through its influence on temperature which can in turn promote changes in taste and odour. We have tested both the benign and adverse version of the climate change CRS and have determined that this scenario could drive the need for different planned expenditure profiles.

Wastewater, aligned to our DWMP and WINEP

9.4.10 Climate change is increasing the frequency and intensity of storm events experienced in the North West; this is projected to get more exaggerated over time. Increased surface water runoff means our

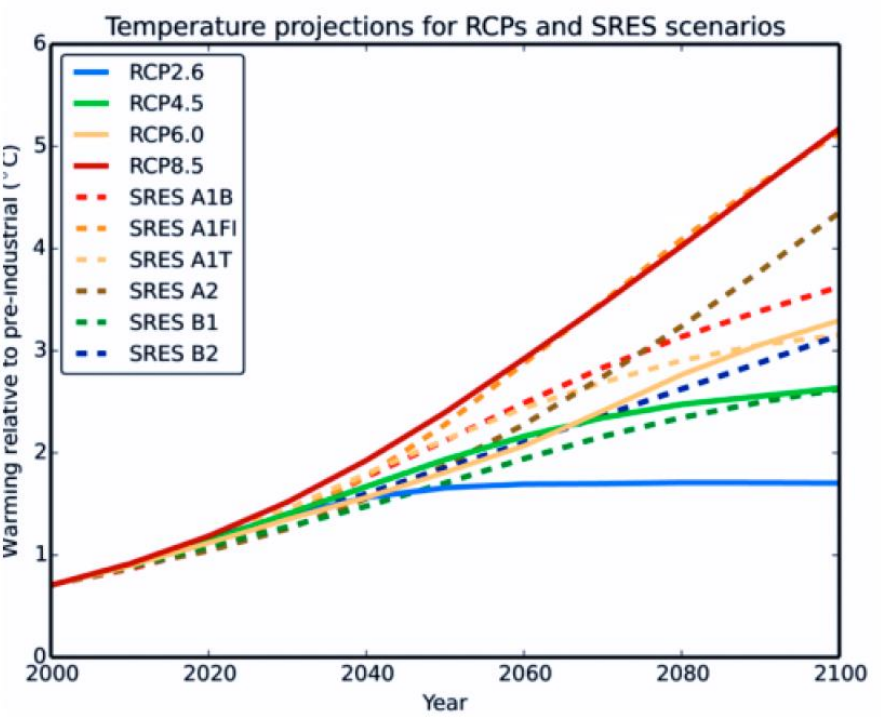
[17] Emissions Gap Report 2022 - https://www.unep.org/resources/emissions-gap-report-2022

combined sewers reach capacity more often and sewer overflows are more likely to discharge into the environment, which is increasingly unacceptable to customers and stakeholders, and can have a detrimental impact on the natural environment. A significant amount of our investment therefore must enhance the resilience and capacity of our wastewater network. It is important that we plan for plausible futures, and the choice of climate change projection is significant for this.

9.4.11 The warmer, drier periods brought by climate change lead to warmer rivers and more extreme low flows. In these conditions, treated wastewater discharges to rivers is likely to have a greater impact on wildlife and amenity value. The warmer temperatures associated with climate change also mean there is a greater likelihood of hazards such as algal blooms. We have modelled the impact of this in SIMCAT SAGIS and the outputs of this work are reflected in our planned expenditure.

9.4.12 Strategic investment scenarios have been created using optimisation software to match potential solutions to risks such as flooding, pollution and sewer collapses based on sewer models. A low climate change scenario was modelled to emulate climate change associated with RCP2.6. For the low climate scenario we retained the forecast asset deterioration to 2050 and adapted rainfall forecasts to reflect a benign climate change scenario. Rainfall levels were stabilised from 2030 to 2050 representing the forecast stabilisation of temperature increases under RCP2.6, as demonstrated in Figure 44.

Figure 44 Temperature projections for RCPs and Special Report Emissions Scenarios, RCP2.6 is demonstrated to stabilise between 2030 and 2040[18]



Bioresources

9.4.13 Climate change is a key future uncertainty for the effective management of bioresources. The greatest risk is from more extreme weather patterns reducing the potential to recycle sludge to land because spreading has to be timed to the farmers growing season and cannot be undertaken when wet.

9.4.14 Climate change considerations have been included in our biosolids storage assessment (SNC Lavalin, 2022), and qualitatively through national and company landbank modelling (Grieve Strategic, 2022). Climate change impact on demand is difficult to model without a readily available dataset, but is understood to be a minor factor influencing landbank availability. Area of landbank and distance to

[18] *https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-guidance---representative-concentration-pathways.pdf*

landbank, which incorporate climate change, are considered to be the driving factors on planned bioresources expenditure in our LTDS.

Resilience

9.4.15 In the LTDS we have explored an overarching long-term adaptive plan for the imperative to maintain and improve resilience across water, waste and bioresources services. Climate change is a major driver for change with regards to resilience, and we have used the Ofwat CRS to test our expenditure. We have also considered other resilience priorities.

GHG emissions

9.4.16 With climate change a fundamental issue to the affordability and resilience of our services in the long-term, we are leading by example, and leading others to join us, in working towards the global and national goal for net zero by 2050. We have a large carbon footprint and face substantial emissions growth pressures from the activity required to achieve our vision and ambition. The impact of climate scenarios on our overarching planned investment programme has a knock on impact on both embedded and operational carbon emissions. As a strategic priority and challenge, we have developed a long-term adaptive plan for net zero as part of our LTDS. More information can be found in section 8.1.

Demand

9.4.17 Demand is one of Ofwat's CRSs and we have tested all components of our LTDS against its benign and adverse components.

Water resources, aligned to our WRMP

9.4.18 Population growth and changes in business and industry directly impact the demand for our water service. The CRSs do not address business demand which is a material component of our overall demand and we have, therefore, also tested benign and adverse scenarios of non-domestic demand.

9.4.19 Our WRMP also considers other alternative futures. These futures include less effective delivery of our demand management plan, achieving the outcome more slowly than we are aiming for. We make assumptions about these futures for the purposes of our LTDS.

Wastewater, aligned to our DWMP and WINEP

9.4.20 Population growth and changes in business and industry directly impact the volume of wastewater we are required to treat. Our enhancement expenditure must increase our capacity to keep up with growth and development in the region.

Bioresources

9.4.21 Increased production of raw sludge is being driven by population growth and enhanced wastewater treatment standards. Through our DWMP we have ensured that we have modelled forecast demand for sludge services to 2050 and aligned our wastewater and bioresources planning processes.

9.4.22 Sludge growth is accelerated by stringent wastewater final effluent standards to meet Environment Act phosphorus targets. WINEP notional solutions are predicting an average growth of 2,500 tonnes of dry solids (TDS) year-on-year to 2037, beyond previous forecasts.

9.4.23 Sludge growth, as well as impacting sludge treatment capacity requirements, has a direct impact on biosolids resilience as it is likely to lead to a greater landbank requirement for recycling. Moreover, we expect stringent phosphorus final effluent standards to lead to a doubling of phosphorus loading in biosolids over the same period. Phosphorus is a limiting factor in determining biosolids application rates and greater concentrations will exclude more areas from application for risk of over applying phosphorus, or increase the return rate, creating a greater landbank requirement.

Technology

The technology CRS

9.4.24 Technology is one of Ofwat's CRSs and we have tested all components of our LTDS against its benign and adverse components. We believe innovation in technology is a fundamental enabler for achieving our ambition. Examples of how we are promoting innovations across our business include:

- **Wetlands:** we have been continually accelerating the development and adoption of nature-based treatment solutions for many years, including wetlands. From AMP6 into AMP7 we have moved from lab-scale and demonstration projects to implementing full-scale solutions at a number of sites. One AMP7 example is at Southwaite Wastewater Treatment Works (WwTW), which treats the sewage from a population of 140 people, plus the users of the service station on the M6. Once treated, the water is returned to the water course, making its way into the River Petteril to deliver a 'good' watercourse status. The final effluent quality of the WwTW needed to achieve a 5mg/l Phosphorus limit on an annual average basis, in combination with catchment interventions upstream of the WwTW.
- **Sewer misconnections:** building on the success of using sniffer dogs to detect water leaks in AMP7, we wanted to explore what other problems the dogs could tackle where above-ground sensing was crucial and today's manual processes were in need of improvement. A natural extension was identifying sewer misconnections, which lead to river pollution. We knew that dogs highly trained in clean water leak detection could not simply transfer to other applications that needed different training. So we formulated new trials with the advantage of the water experience and learning. These trials found that dogs can detect misconnections >80 per cent of the time faster than conventional methods. Transferring our learning reduced trialling time and saved £135k. This innovative approach has high potential and we are optimising by end of AMP7.
- **Circular economy:** we care about the circular economy; keeping materials in useful life for longer makes environmental and economic sense. We led the 'Industrial Symbiosis' bid in the first Ofwat competition with four established partners and one new entrant to test if barriers to circular economy principles could be overcome in the water sector. For this collaborative project, UUW set out to prove the new circular economy concepts within our capital programme. We proposed 24,000 tonnes of material available for resource matching, 60 'hidden' opportunities, converting 20 of these – realising over £55k financial saving and saving 200 tonnes of GHG emissions. We are working hard to make this a success and have not stopped since the end of the Ofwat funded project. We have delivered even more savings, and are on target to deliver a further £100k saving and 500 tonnes of GHG emissions by the end of AMP7.

9.4.25 Table 21 shows how we have interpreted each component of the technology CRS. The benign version of the CRS is indicated by blue text, the adverse by red. Through our scenario testing processes we have developed alternative pathways for benign (slow) and adverse (slow) technology.

Table 21: Our interpretation of the Technology CRS, blue text indicates benign scenario, red text is adverse scenario

Component of the Technology CRS	How we have interpreted this component
Smart water supply network by 2035/2045: •Automatic detection of potential leaks. •Robust real-time asset condition information – including telemetry, robotic and drone inspection – enabling a risk-based maintenance approach across the business.	Smart water supply network by 2035/2045: •Real-time detection of potential leaks occurring across entire water network. •Robust real-time asset condition information for pipes and pump stations – including telemetry, robotic and drone inspection – enabling a risk-based maintenance approach across the entire water network.
Full smart meter penetration by 2035/2045.	Smart meters on all properties (domestic and non-domestic) by 2035/2045. Note that this requires legislative change to allow UU to install meters on properties.

Component of the Technology CRS	How we have interpreted this component
New wastewater approach by 2040/2045: •Monitoring and advance forecasting of localised surface water rainfall and related pollution/wastewater stresses, including intelligent sewer technology, enabling rapid response and/or prior action. •Automatic monitoring and enhanced sampling of environmental water quality.	As per Ofwat description.
Low-emission HGVs and fleet by 2030/2040 and carbon-free baseload electricity by 2035.	As per Ofwat description.
Full open access to datasets across water companies and other utilities, through common data sharing protocols by 2035/Progress on open data across the sector is limited throughout the period to 2050.	Full open access to datasets across water companies (WaSCs, WoCs, Retailers and NAVs), other utilities, and government entities (local authorities and government bodies) through common data sharing protocols which ensure appropriate quality by 2035/Progress on open data across the sector is limited throughout the period to 2050.
The whole-life financial cost of low-carbon construction materials equals that of conventional building materials by 2035/The whole-life financial cost of low-carbon construction materials continues to fall, but conventional building materials remain cheaper throughout the period to 2050.	As per Ofwat description.
Increasing reliance on technology produces progressively higher risks of failure and threats from cybercrime, creating possible need for non-digital backups throughout the period to 2050/Cyber and digital protection stays ahead of cybercrime and digital networks remain resilient throughout the period to 2050.	As per Ofwat description.

Application of the technology CRS to water resources, aligned to our WRMP

9.4.26 The pace of technological development was considered in the scenarios in line with guidance published by Ofwat. The Ofwat faster technology scenario assumes full smart meter penetration by 2035 and implementation of a smart water supply by 2035. The Ofwat slower technology scenario assumes full smart meter penetration by 2045 and implementation of smart water supply by 2040. These scenarios have been implemented using the selection of different demand options within our demand management plan.

Application of the technology CRS to wastewater, aligned to our DWMP and WINEP

9.4.27 The pace of technological development was considered in the scenarios in line with guidance published by Ofwat. The Ofwat faster technology scenario assumes a new wastewater approach by 2040 including monitoring and advanced forecasting of localised surface water rainfall and related pollution/ wastewater stresses, including intelligent sewer technology, enabling rapid response and preventative action. The new approach would also include automatic monitoring and enhanced sampling of environmental water quality. The faster technology scenario also assumes full open access to datasets across water companies and other utilities.

9.4.28 A key option selected in our plan is a wider roll out of our Dynamic Network Management (DNM) strategy, which was highlighted as a key initiative in the business plan submission for investment cycle 2020—2025. This uses machine learning and artificial intelligence across the sewer network to enable

proactive targeting and performance improvements; something which would not have been possible just ten years ago. 17,500 intelligent sensors have been installed and enhanced monitoring implemented on more than 1,500 sites (pumping stations, detention tanks and storm overflows).

9.4.29 Advancement of new technologies is a staple of UUW's network delivery strategy and long-term plans for the future. During the investment period 2020 – 2025 we have transformed wastewater network monitoring through installing DNM in 160 drainage areas. As a result of the high proportion of technological investment already undertaken, and inclusion of technological improvements placing highly on the option hierarchy option selection philosophy modelling a slower rate of technological rollout shows little distinction from UUW's core pathway.

Application of the technology CRS to Bioresources

9.4.30 The technology CRS does not include any technologies that are relevant to bioresources. However we believe technological development forms an important aspect of our long-term strategy for bioresources.

9.4.31 Innovation is required to maximise the benefits of sludge recycling while mitigating the potential environmental harm. The National Bioresources Strategy (see CIWEM, 2022) will develop an innovation pathway to support determination of what is the best overall routes for biosolids management in England. Through our adaptive plan we will monitor technology readiness levels, and seek to deploy innovation, where appropriate, to manage our outlet resilience risk. This also requires that we engage with stakeholders and regulators to assess, support and deploy new technologies where appropriate.

Technology components outside the CRS

9.4.32 Beyond the specific aspects of the Technology CRS, there are many other technological trends that we monitor and are continually evaluating. Ofwat identified some of these in the LTDS guidance but we are monitoring several others. To understand how our long-term strategies could embrace these trends, our innovation and digital teams identified the technological trends most likely to have influence on our long-term strategies. We then held workshops with our technical staff in water, wastewater and bioresources to understand what these trends could mean for specific investment choices and how our long-term plans could be optimised accordingly.

9.4.33 Table 22 identifies the technological trends identified by Ofwat but reported outside the Technology CRS, as well as additional trends identified by our innovation and digital teams.

9.4.34 Table 23 summarises how these trends could influence our long-term strategies. Dark blue indicates a potential significant influence. Light blue indicates a weaker influence and grey indicates no influence. This assessment has been conducted at a point in time and will be regularly revisited and updated.

9.4.35 We maintain a regularly updated view of key strategic technologies in and out of sector and filter to those relevant to UUW and the water sector with a longer-term view of trends and technologies that may affect the services that UUW provides. We use information sources such as literature, industry forums, research centre relationships, and discussions with partners, subject matter experts and academia.

9.4.36 We will continue to track the development of emerging technologies and support these where appropriate. Future iterations of our LTDS will consider how and when emerging technologies might help us to extend our ambition and/or deliver our existing ambition more efficiently.

Table 22: Wider trends outside the Technology CRS that could influence our long-term strategy

Wider technology trends (outside the CRS) identified by Ofwat	Other technological trends we think could influence our long-term strategy
Internet of things: • Smart metering and network telemetry • AI/data interrogation • Common data sharing protocols • Remote inspection/repair, including through the use of drones, robotics, and self-driving fleets **Wastewater network improvements:** •High resolution grid square advanced warning and forecasting of surface water events, and related pollution and wastewater stresses. •Intelligent sewer technology •Enhanced monitoring and sampling capability and capacity, including remote monitoring of water bodies **Fifth industrial revolution:** •Self-healing networks •Developments in bioscience, for example to reduce carbon emissions and treat wastewater more efficiently **Nature-based solutions:** •State of the art nature-based solutions toolkit, enabled by monitoring and/or blockchain platforms **Emissions-reducing technologies:** •Increasing availability, higher quality and lower cost of low-carbon construction materials •Carbon-free baseload electricity and low-emission HGVs and fleet **Societal attitudes:** •Varying speed of economy-wide openness to behaviour change **Resilience:** •Possible need for low-tech fall backs as reliance on digital solutions increases: ensuring resilience to electricity/digital outages **Demand impacts:** •Possible increases in demand from new technologies, such as carbon capture and storage, and blue/green hydrogen production	**Blockchain/trust architecture** Improvements in the security of supply chain and immutability of information (e.g. in water quality supply chain, or water/sludge trading scenarios). **Next generation/quantum computing** Next generation computing likely to unlock more real-time modelling/AI to enable proactive network and other improvements. **Digitally extended realities/VR/metaverse** Virtual reality (VR)/augmented reality (AR) likely to be applicable to engineering/BIM (building information modelling), but other applications likely. **Green Energy** As a both a major land owner and a high energy consumer, UUW has a potential role to play in green energy production and usage. **Collaborative economy (peer-to-peer, P2P)** Business-to-consumer (B2C) and business-to-business (B2B) sharing economies promote energy efficiency, maximise collective utilisation and aim to reduce waste. Collaboration across water companies and collaboration with customers, land owners may unlock new opportunities. **3D printing** 3D printed reactive materials may pose an opportunity to create new devices or assets which are cheaper and more easily controlled in the water supply chain. **Mass personalisation** Mass personalisation creates highly customised user experiences and/or products based on data held about the customers at segmentation level or lower. This should enable a more personalised experience for customers aligned to their needs.

Table 23 How wider technological trends could influence our long-term strategy

Area of our business	Wider technology trends (outside the CRS) identified by Ofwat						Other technological trends we think could influence our long-term strategy						
	Internet of things	Wastewater network improvement	5th industrial revolution	Nature based solutions	Emissions-reducing technologies	Demand impacts	Blockchain / trust architecture	Next Gen Computing	Digitally extended realities / VR	Green energy	Collaborative economy (P2P)	4D printing	Mass personalisation
Environmental enhancement													
Water resources													
Drinking water quality													
Wastewater monitoring													
Overflows													
Wastewater networks													
Wastewater treatment													
Bioresources													
Resilience													
SEMD and Cyber													
Greenhouse Gas Reduction													
Applicability	Widespread applications and opportunities across UUW	Strongly linked to IoT (internet of things)	Widespread applications and opportunities across UUW	Widespread applications and opportunities across UUW	Widespread applications and opportunities across UUW	New technologies could demand water and / or wastewater	Improvements in the security of supply chain and immutability of information could support trading and markets	Next Gen computing likely to unlock real-time modelling/AI to enable proactive asset operation	VR/AR likely applicable to engineering/ BIM, but other applications also possible	Green energy opportunities from wastewater and by utilising UUW land	B2C and B2B sharing economies promote energy efficiency, maximise collective utilisation and aim to reduce waste	4D printed reactive materials may by cheaper and more easily controlled	More personalised experiences could support demand reduction

Abstraction reductions

9.4.37 Abstraction reductions is one of Ofwat's CRSs and we have tested all components of our LTDS against its benign and adverse components. Our assessments found the Ofwat CRS for abstraction reductions is immaterial to our wastewater, bioresources, resilience or carbon strategies.

Water resources, aligned to our WRMP

9.4.38 In the production of the National Framework for Water Resources, environmental destination scenarios[19] were derived to help us predict the long-term sustainability reductions that we may need to protect the natural environment. Four scenarios were made available, along with corresponding abstraction reductions, which would be needed to meet the environmental flow indicator (EFI). As part of the 'adverse scenario' for abstraction, additional licence reductions (over and above BAU+) were applied to Sites of Special Scientific Interest (SSSIs) and other protected areas in specific waterbodies we abstract from.

9.4.39 To consider this uncertainty, we have used Ofwat's benign and adverse CRSs. The results of scenario testing show that the impacts of abstraction reductions are immaterial for the North West.

9.5 How we have defined our wider scenarios

9.5.1 We refer to wider scenarios as those outside Ofwat's CRSs that address uncertainties which are important for the North West.

9.5.2 To identify our wider scenarios, we followed an extensive, systematic screening processes outlined in Figure 45.

9.5.3 We first collated a comprehensive list of drivers of uncertainty from a series of internal and external sources. We grouped these into the PESTLE categories: Political, Environment, Social, Technology, Legal and Economic.

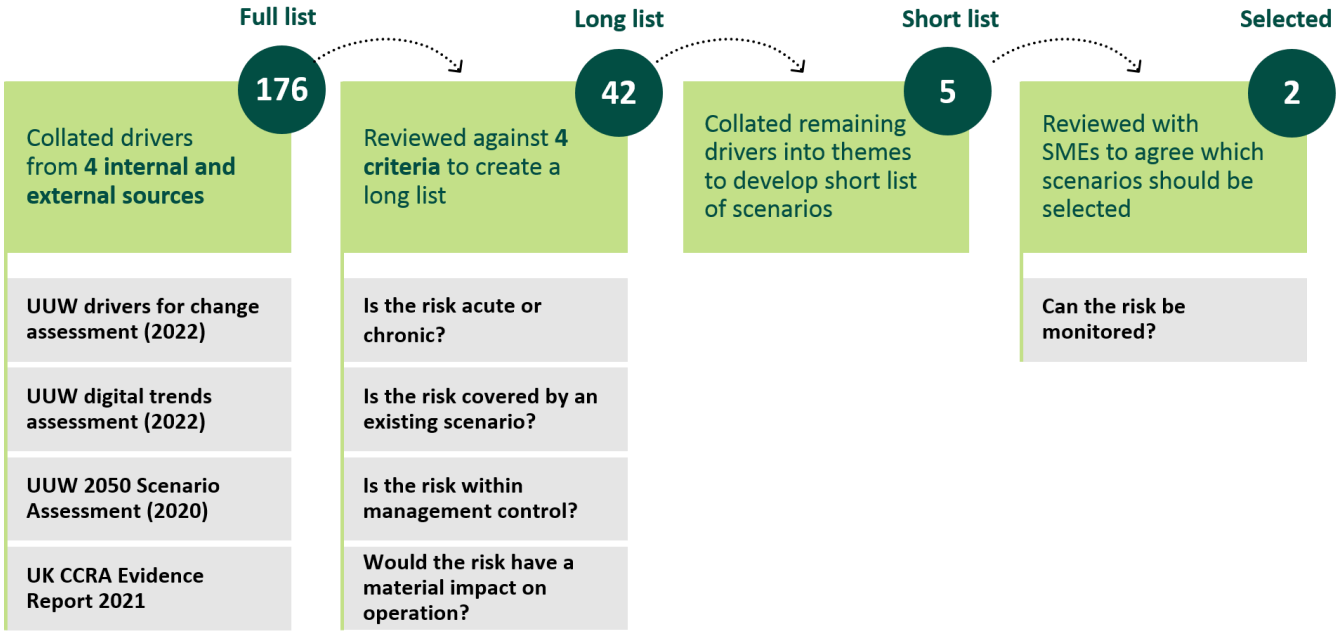
9.5.4 We used four criteria to move from the full list to a long list, recording evidence in a rejection register so that this can be revisited in future. This allowed us to focus on scenarios that would have a material impact on the way we deliver our services, and that are outside our control (trends within our control are management through our normal business practices). Each was assessed for potential impact and uncertainty, with the intention that scenario testing would be more appropriate for higher impact and higher uncertainty drivers.

9.5.5 We then grouped drivers of uncertainty in the long list into logical themes and used these to develop a short list of five wider scenarios. Working with subject matter experts, we developed a benign and adverse version for every shortlisted wider scenario (in the style of the Ofwat CRSs). We then worked with our teams to assess which shortlisted scenarios were most appropriate to use as wider scenarios. This process focused on ensuring any wider scenario we took forward for testing met Ofwat's expectations, principally that it could be effectively monitored with clear decision and trigger points for action.

9.5.6 The result of this process is two wider scenarios (water transfers and changing expectations) which we have applied across our LTDS.

[19] National Framework Appendix 4: Longer term environmental water needs, Environment Agency (March 2020).

Figure 45 Approach to determining wider scenarios for the North West



Our water transfer wider scenario

9.5.7 We recognise the significant challenges that water companies elsewhere in England may face in the future due to the impacts of climate change, population change, and the need for enhanced environmental protection. We are in a strong position to provide support to other regions in times of need, and it is our ambition to do so.

9.5.8 We are a key member of the regional water resources planning group, Water Resources West, and play a major part in the Regulators' Alliance for Progressing Infrastructure Development (RAPID) processes through our Strategic Resource Option (SRO), the North West Transfer (NWT). It is our objective to facilitate this transfer, while improving the service we provide to customers in the North West and enhancing our environment.

9.5.9 Between April and June 2022, regional groups came together for the reconciliation process. The needs for water transfer were set out by each region and a series of best value tests were carried out to confirm the availability and reliability of requests in a number of scenarios. The reconciliation process culminated in a final position, agreed on 6th June 2022.

9.5.10 Through the reconciliation process, the group set out transfer requirements in a number of different scenarios. Regions then compared the value impact that different transfer scenarios had on each of the water company plans. Following a series of stress tests, a final planning position for SROs was agreed nationally for this stage in the planning process. These stress tests have been used in developing our wider scenario for water transfers. In our WRMP and long-term delivery strategy we have considered four scenarios associated with water transfers, as described in Table 24

Table 24 Summary of WRMP transfer scenarios

WRMP transfer scenario	Maximum transfer capacity over planning horizon (Ml/d)	Corresponding LTDS scenario
Reconciled plan	25	Not included in LTDS
WRSE No SESRO	180	Alternative transfer scenario 1
WRSE higher demand	165	Alternative transfer scenario 2
Maximum transfer by 2040	180	Not included in LTDS

Our changing expectations wider scenario

9.5.11 Changes in the expectations of customers, the public, stakeholders and regulators significantly impact our future investments. We engage with customers, stakeholders and regulators regularly and we understand the general trends in their expectations. The specific nature and timings of future changes are hard to predict however and they can drive the need for major new projects. Areas that might be particularly influential on our future investments include:

- The introduction of environmental requirements related to micro plastics and/or contaminants such as polyfluoroalkyl substances (PFAS);
- Expectations to enhance the natural environment;
- The designation of new bathing waters; and
- The availability of agricultural landbank for the use of bioresources. This will be influenced by government policy, regulation, competition and farmer acceptance.

Table 25 Summary of changing expectations wider scenario

Version of scenario	Description
Benign	No significant change in customer or stakeholder expectations
Adverse	**Drinking water quality** • Higher expectations mean that our target to remove lead pipes is brought forward from 2070 to 2050. • Expectation that water quality improvements address PFAS from 2030. **Bioresources management** • The adverse changing expectations scenario is aligned to restrictions on biosolids recycling to agriculture. Landbank modelling has shown that the impact of the most likely environmental restrictions (as discussed with the EA) is insufficient agricultural land to recycle biosolids

9.6 How we have dealt with other uncertainties in our LTDS

Potential future wider scenarios

9.6.1 Our process for identifying wider scenarios highlighted three uncertainties that, though important for our long-term plans in the North West and highly uncertain, were not appropriate for scenario testing. This was because we had existing, robust approaches in place to manage the uncertainty or the uncertainty did not meet the requirements for wider scenarios set out by Ofwat, principally the need for wider scenarios to be based on clear metrics that can be easily monitored.

Asset health

9.6.2 The health of our assets underpins their ability to deliver our services to customers and the environment and understanding this helps to focus our maintenance appropriately. Maintaining a stable level of asset health often requires significant investment to address external pressures such as climate change and growth and their influence on an ageing system of assets.

9.6.3 Our approach to maintaining asset health is risk based and focussed on harnessing the rapid advances in technology the sector is experiencing to maximise the value we obtain from our assets. Our lifecycle asset management system is now certified against ISO 55001, an endorsement that reflects the wide range of improvements we have made to our approach to asset management system over many years.

9.6.4 Reflecting our robust asset management approach, and acknowledging the role that technology is and will continue to play in helping us to better understand and manage our assets, we have assumed that our base allowance allows us to continue to deliver stable asset heath in to the long-term, this assumption will be reviewed during the next cycle of LTDS.

Affordability

9.6.5 We recognise the cost challenge associated with delivering against significant new statutory drivers. We also recognise the external economic pressures that are impacting customers.

9.6.6 We have engaged with all customer groups to understand their perspectives on the investments in our core pathway and how these could be sequenced over time. Our core pathway of investment has undergone significant refinement to align to their views. Customer's opinions were heavily influenced by affordability constraints but also considered generational equality and the performance outcomes they would like to see in the short, medium and long-term.

9.6.7 The external factors influencing affordability are inherently volatile and therefore difficult to monitor and as such, are unsuitable for a wider scenario. However, the decisions we make about future investment will always take account of customer's views and will always seek to ensure affordability whilst balancing our statutory obligations and regulator's expectations.

Collaboration

9.6.8 We have a major role to play in supporting a healthy natural environment and a range of other stakeholders have important roles to play too. Many different stakeholders have responsibilities, interests in and/or impacts on the natural environment and many of these organisations operate under different forms of regulation and governance.

9.6.9 As such, there is scope for greater collaborative delivery across catchments and our plans for AMP8 and beyond include investments and activities to further promote and deliver such schemes. We work with Catchment Based Approach (CaBA) partnerships across the North West with a focus on the water environment. These relationships have directly enabled partnership working on capital delivery schemes during the investment period 2020–2025, such as work with the Ribble Rivers Trust to deliver water quality improvements in the catchment.

9.6.10 The vision we present in our LTDS has been informed by other stakeholders in the region and requires us all to act to deliver it. If government and regulation could enable greater collaboration, the outcomes for the environment and the public could be increased, and efficiencies secured in their delivery.

9.6.11 It is challenging to define a measurable factor with clear and observable metrics related to collaboration and therefore, in line with Ofwat guidance, we have not included this source of uncertainty as a wider scenario. We do however think it is an important influence on our planned expenditure and will work with Ofwat and our stakeholders to promote opportunities for collaboration.

9.6.12 We will regularly reappraise the latest understanding and evidence for areas of uncertainty. As required, we will develop formal scenarios and, potentially, investment pathways to address them in future iterations of our LTDS.

Other uncertainties

9.6.13 During the selection process for our wider scenarios (***Figure 46***) we identified several drivers of uncertainty which have:

- Higher potential impact but are less uncertain – we have therefore made assumptions about these sources of uncertainty in our LTDS; and
- Lower potential impact (with either higher or lower uncertainty) – these sources of uncertainty have been recorded for future re-evaluation.

Figure 46 Selection of uncertainties considered (not exhaustive)

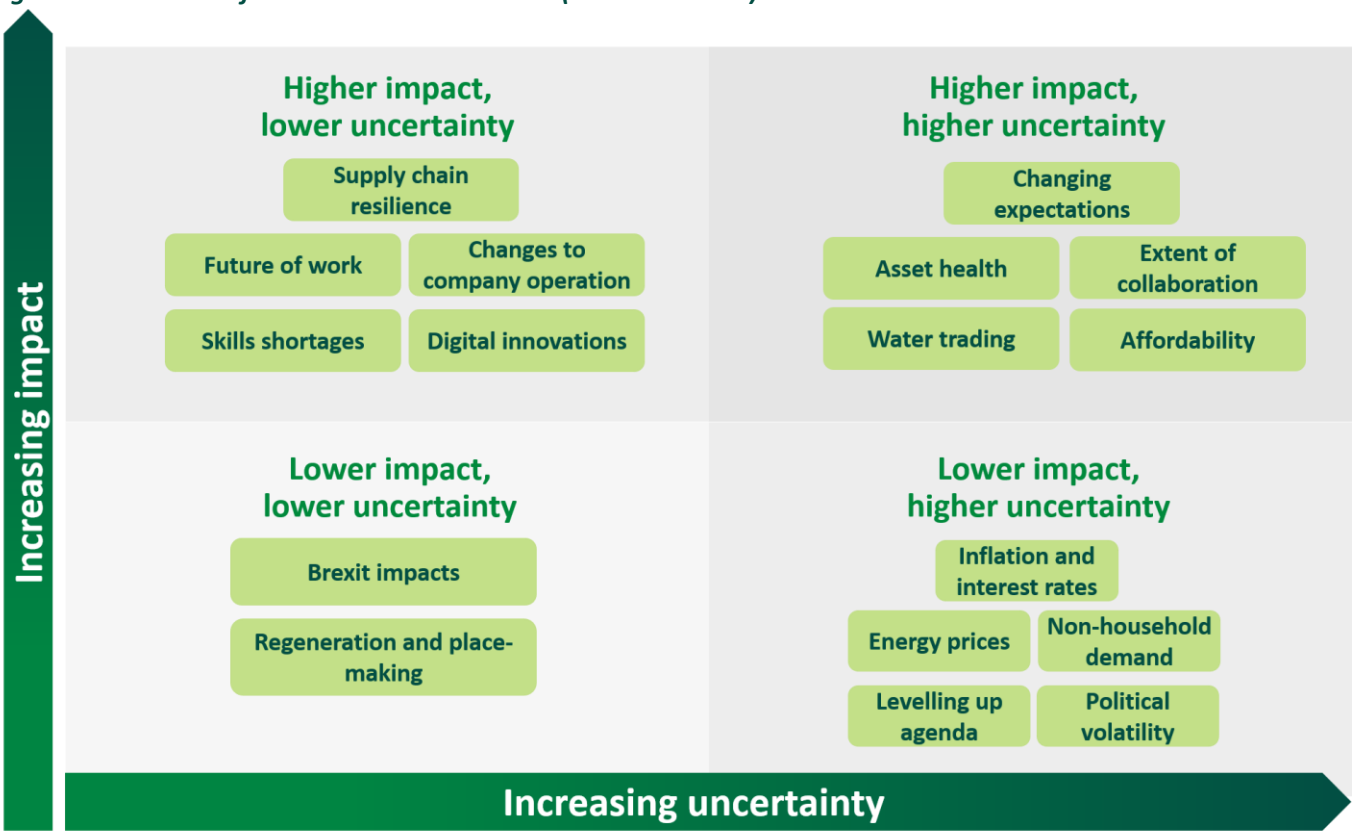


Figure 46 presents these two groups of uncertainty and how each uncertainty has been addressed in the LTDS.

Table 26 Other sources of uncertainty

Driver of change/source of uncertainty	How it has been addressed in the LTDS
Higher potential impact but less uncertain	
Changes to water company operation	We assume that water companies have the same general role and structure and there are no material changes to the regulation of the sector.
Skills shortages	We assume that skills are developed at the same pace as technological change and there are no significant skill gaps.
Supply chain resilience	Considered in programme development.
Lower potential impact (with either higher or lower uncertainty)	
Non-household demand	We want to support economic growth and work with planners to understand significant new non-household demand. For example, we are working to understand additional water needs from hydrogen energy generation and the impact on the overarching North West water resource balance.
Political instability/unexpected events	We assume political stability during the next 25 years. UUW has a range of processes in place to deal with and respond to unexpected events through incident management processes, corporate risk management procedures underpin and monitor these.

Driver of change/source of uncertainty	How it has been addressed in the LTDS
Financial changes	For the purpose of calculating bill impacts we assume that corporation tax remains at 25% for all years and that the Wholesale CPIH-stripped WACC is 3.23% for AMP8 and 3.84% for AMP9 and beyond. We maintain the 1% Retail margin for all years.
Brexit impacts	We assume that environmental legislation is maintained or strengthened following exit from the European Union.
Levelling up agenda	We consider the impact of levelling up on growth in the North West, whilst we have not measured this directly we have considered indirect effects of population growth and non-household customer growth.
Energy prices	We assume energy price stability, we have a range of measures in place to reduce the impact of price changes including self-generation of energy.

10. Board assurance of the LTDS

10.1.1 The UUW Board has been closely involved in reviewing, challenging and shaping the AMP8 plan and our long-term strategy. Throughout the development of our strategic planning frameworks and LTDS, the Board has been progressively engaged, providing input and feedback to shape our overall vision and ambitions. Long-term and strategic items feature regularly and as ongoing discussions with the Board, enabling iterative input throughout the development of our LTDS. A summary of highlights from board activity covering long-term strategies is outlined in Figure 47.

10.1.2 We have engaged external experts to provide independent assurance and challenge that our approach is robust. This has involved a third party review of our processes to develop the LTDS, systems, and controls on the data and systems used. This helps us to identify areas for improvement and make sure that we are developing an LTDS which represents industry best practice. The third party assurance process provides valuable feedback to our Board, helping them to evaluate and challenge our approach and make informed decisions that are in the best interests of all our stakeholders.

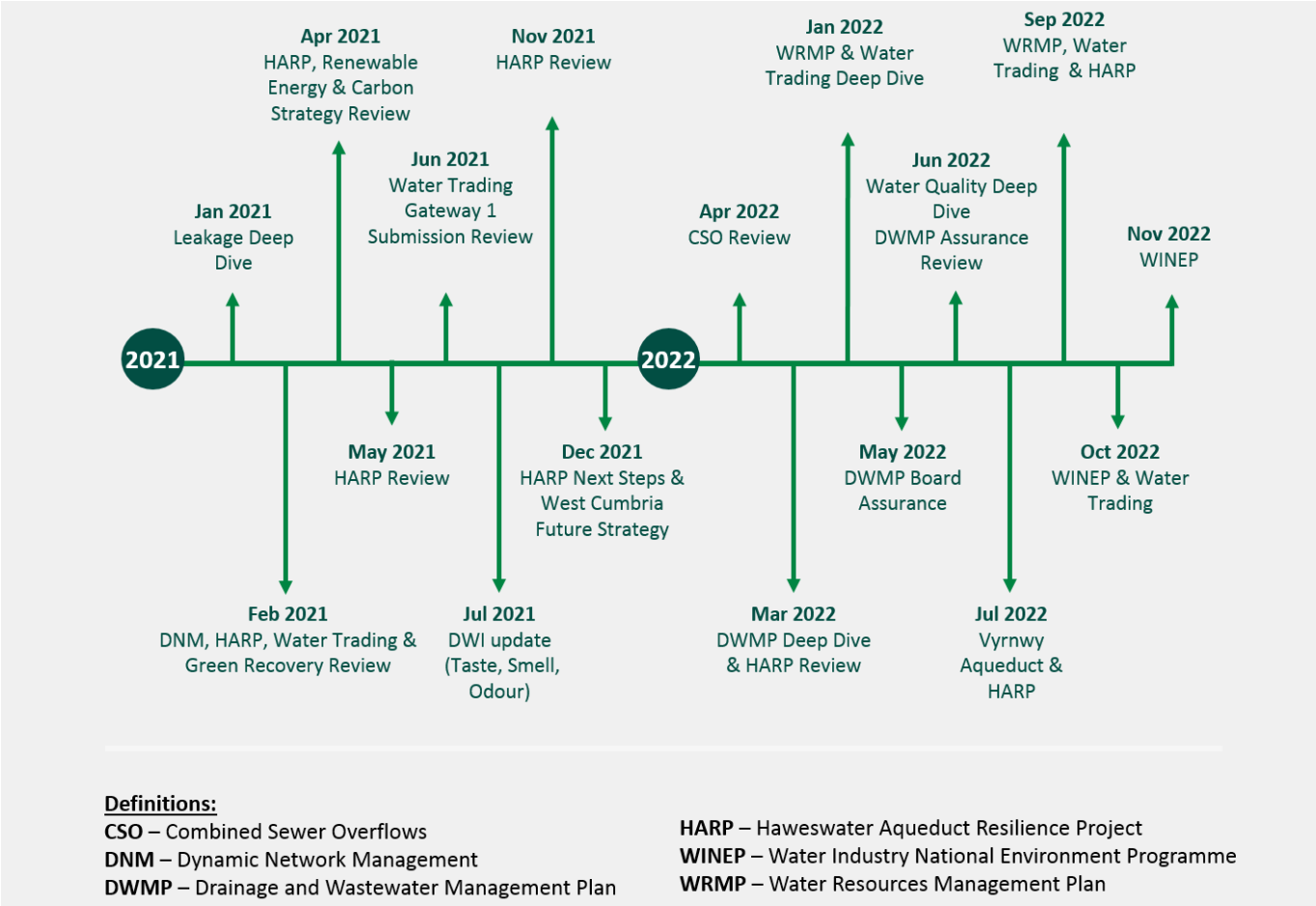
10.1.3 We have also engaged with 'YourVoice', our independent challenge group, to shape our engagement with customers on long-term issues. This group provides a forum for independent experts and representatives from customer groups to provide feedback and input. By engaging with customers and stakeholders and by taking their feedback into account, we are able to outline long-term ambitions which are supported by customers and stakeholders and align with their interests.

10.1.4 The activities undertaken by the Board to challenge the LTDS and satisfy themselves that the strategy is the best it can be, are outlined below.

10.1.5 Our board assurance statement is signed by the full UUW Board. It describes how the board has assured itself that the plan demonstrates substance and ambition across all key areas of the PR24 submission, including long-term delivery strategy, affordability, cost and outcomes, risk and return and customer engagement. The board assurance statement is provided as supplementary document *UUW11 – Board assurance statement.*

10.1.6 Other supplementary documents supporting board assurance are *UUW76 - Confidence and assurance of the submission* which describes key assurance processes and outputs, *UUW77 - Board leadership of the business plan* which describes how the board has engaged with and provided strategic direction throughout creation of the plan, and *UUW79 - Statutory obligations summary* which sets out how we have met commitments in AMP7 and our approach to doing so in AMP8. *UUW80* provides the assurance aggregation report from external assurance providers Deloitte LLP.

Figure 47 An overview of UUW board engagement on long-term issues, ambitions and plans.



Requirement – The Board has challenged and satisfied itself that the long-term delivery strategy reflects a long-term vision and ambition that is shared by the Board and company management

10.1.7 The UUW Board is responsible for setting the strategy of the company, ensuring the long-term success of the company for customers, investors and wider stakeholders. The board is responsible for challenging and encouraging the executive team in its interpretation and implementation of how it manages the business, and that it is doing so in accordance with the strategic goals the board has set.

Requirement – The LTDS is high quality, and represents the best possible strategy to efficiently deliver its stated long-term objectives, given future uncertainties

10.1.8 Our plan is high quality and represents the best possible strategy to efficiently deliver the stated long-term objectives, given future uncertainties. The plan sets out both our numeric targets and provides a narrative to describe how we will achieve and go beyond our statutory requirements. Comprehensive assurance of the plan has been undertaken which gives us confidence in its quality.

Requirement – The LTDS will enable the company to meet its statutory and licence obligations, now and in the future

10.1.9 The board is fully committed to ensuring UUW meets its statutory and licence obligations, now and in the future. The LTDS has followed the statutory guidance provided by regulators. External assurance confirmed that we have met the requirements of this guidance for WRMP (which has been signed off by DEFRA), DWI Water Quality, DWMP and WINEP programmes of work. New obligations identified – for example those arising from the Environment Act 2021 – have been considered and the long-term plan has been constructed so that we can deliver against these. In addition to this, the long-term preferred plan has been developed so as to be able to address future statutory and licence obligations based on today's knowledge and understanding.

Requirement – The LTDS is based on adaptive planning principles

10.1.10 The board has required that the LTDS be constructed based upon adaptive planning principles. Through the use of scenario testing in line with the Ofwat common reference scenarios and wider UUW scenarios plans have been developed based on adaptive planning principles of:

- Testing against a range of plausible circumstances;
- Identifying short-term expenditure which keeps options open under a range of scenarios along with the appropriate decision and trigger points to inform future planning cycles;
- Ensuring our AMP8 plan is low regrets and our long-term strategies are flexible to cope with changes over time;
- Optimising plans to ensure decisions are made at the right time; and
- Aligning plans to our long-term ambitions.

Requirement – The LTDS has been informed by customer engagement

10.1.11 The company has regularly engaged with customers to research and test their views (including intergenerational testing). Our high quality research programme tests customers changing views as well as testing specific topics such as smart metering. Outputs from our research have fed back in to our plans to ensure that the views of customers are considered and our approach has been challenged by the independent challenge group for the North West, the YourVoice panel.

Requirement – The company has taken steps to secure long-term affordability and fairness between current and future customers

10.1.12 In order to secure long-term affordability and fairness between current and future customers the company commissioned affordability and acceptability testing research. This research and testing sought the views of household, non-household customers and future bill payers to understand their preferences and outline to them the implications of our long-term plan and understand views on intergenerational equity. This research helped inform the development of our plan embedding the preferences of customers where possible.

Requirement – The Board has challenged and satisfied itself that the 2025-30 business plan implements the first five years of the long-term delivery strategy

10.1.13 The board is satisfied that the 2025-30 business plan has been challenged and implements the first five years of our long-term delivery strategy. Our business plan contains a number of enhancement cases, with each linked to the long-term delivery strategy. These cases set out why now is the right time for this investment. All discretionary enhancement has had customer research in order to demonstrate support for the programmes. Each enhancement business case has an executive sponsor appointed accordingly and has been assured in line with our published assurance framework. Further details can be found in *UUW10 – Assurance and track record*.

11. What next? How we will maintain and update our strategy in the future

11.1 Overview

11.1.1 This section captures our action plan for continual improvement in adaptive and long-term planning.

11.1.2 Adaptive and long-term planning is a continuous process that is agile and responsive to emerging developments. In this section, we describe how we will maintain and evolve our LTDS as a valuable part of our integrated planning and decision making. We also explain how we will monitor and govern the delivery and ongoing effectiveness of our LTDS. Appendix B provides further detail on our monitoring plan for the LTDS, aligning with and further strengthening our corporate risk management process.

11.2 Maintaining and further improving our Long-Term Delivery Strategy

11.2.1 Each of the areas below are priorities for continual improvement of our LTDS.

Horizon scanning and planning assumptions

11.2.2 Horizon scanning and planning assumptions are managed as a continuous 'business as usual' activity at UUW, in which we work to capture and actively consider any and all materially relevant developments. We use an actively managed and coordinated process to cyclically inform our risk management and asset planning with latest planning assumptions and a horizon scanning process structured using the widely recognised Political, Environment, Social, Technology, Legal and Economic (PESTLE) model.

11.2.3 We used our existing maturity in horizon scanning to inform our first LTDS, and our adaptive plans reflect the critical importance of monitoring and responding to evolving developments in numerous areas, such as national water policy and technology for example. We will extend and embed our horizon scanning process to regularly inform and update our LTDS. We will continue to use latest planning assumptions in each iteration of our LTDS, in alignment with those we use in our regulatory and statutory business planning.

Monitoring and research

11.2.4 Monitoring and research has been included as an essential part of our adaptive plans where more insight will support effective future decisions. We will manage a wide ranging programme of monitoring and research over the coming years to inform the next LTDS, and we see this as an ongoing, evolving activity to continually mature understanding and evidence in emerging areas. This will include, for example, site, scheme and catchment monitoring along with strategic research on emerging drivers like micro plastics and forever chemicals. This is done in collaboration with others where that enables efficiency and effectiveness.

Innovation and technology

11.2.5 Innovation and technology is another essential component of our adaptive plans to support continual improvement in the short, medium and long-term. Our scenario planning demonstrated the importance of the rate of innovation in determining the ability, pace and cost (both financially and environmentally) of achieving desired outcomes.

11.2.6 Our adaptive plans prioritise substantial deployment of latest technologies, for example to further mature our Dynamic Network Management (DNM) to optimise the capacity and operation of our water and wastewater systems for service outcomes. Our plan also embraces the need for transformational change in our ability to deploy behavioural, catchment and natural solutions to minimise the need for traditional hard engineering solutions which are often financially and environmentally expensive, and have fixed levels of resilience to the future climate.

Data, systems, tools and capabilities

11.2.7 Data, systems, tools and capabilities for adaptive and long planning, including scenario analysis, have helped us develop a robust LTDS and AMP8 business plan. There is continued development in these systems and tools that we will monitor closely to test and embed latest functionality. For example, emerging systems offer the ability for rapid consideration of large numbers of scenarios that could help a richer and more regular analysis in the future. By deploying external best practice and our own internal developments, we will further advance our adaptive planning capabilities for the next LTDS. We will also cyclically revisit all our assumptions to understand whether new scenarios need to be considered.

11.2.8 Alongside other technological developments, Section 9.4 (technology) explains how we think advances in data and digital solutions can influence our long-term strategies in all areas of our business.

Collaboration

11.2.9 Collaboration and partnerships, are critical in determining the ability, pace and cost of achieving the desired outcomes presented in our LTDS. Our adaptive plan includes ambitious programmes to grow the benefits of collaboration, including partnership programmes, behavioural and engagement programmes, and policy development activity. Our plan will be responsive to latest regional and national policy, and the effectiveness of us and others in changing behaviours to either reduce or compound our need to act.

11.2.10 Working on our LTDS has reinforced our appreciation for the importance of our role in contributing to national debate and evidence-based policy for well-considered approaches to systemic challenges. For example, we will continue to provide evidence and make suggestions about national water policy such as modernising discharge permits to support the most effective results, better labelling of white goods and wet wipes, and the removal of the right to connect surface water to the sewers.

Periodic updates

11.2.11 Periodic update of the LTDS will be undertaken at least every five years. This will factor in all the above developments to ensure the LTDS remains efficient and effective. From our experience in long-term planning, there can be highly material external developments over a five year period that drive substantial changes to our long-term plans. For example, with emerging climate science, national policy and technological developments. We will start the next iteration of the LTDS early in the planning cycle to maximise its value in shaping from the outset our strategic thinking, statutory and other long-term plans, and the five year detailed delivery plan that will start in 2030.

11.3 Monitoring and governing delivery of our LTDS

11.3.1 External monitoring and governance will include the following:

(a) **YourVoice** is an independent panel of customer and stakeholder representatives that help to hold us to account and shape our approach and direction in line with customer priorities. We have agreed with the YourVoice panel that they are able and keen to provide an ongoing role in our LTDS through an annual review of our latest progress and developments. The panel will also be especially focused on our delivery of priorities for behavioural and engagement programmes, nature-based approaches, and partnership working.

(b) **Annual reporting to Ofwat and customers** will be undertaken through the Annual Performance Report (APR).

11.3.2 Internal monitoring and governance will include the following from the start of AMP8:

(a) **The Board** will retain their overall leadership of the LTDS and all our strategic and long-term planning. In addition to focus on strategic matters most board meetings, a specific review of the LTDS will be undertaken approximately mid-AMP, and sooner if deemed appropriate in response to a strategically material development. This frequency provides a formal sign off for the latest LTDS every five years, and a mid AMP progress review.

(b) **The Executive Strategy Meeting (ESM)** The agenda for the ESM is fed by our planning and strategy work, and shaped by insight from the horizon scanning process mentioned above. Through the ESM, the Executive will continue to have a leading role in monitoring, shaping and delivering the LTDS through an annual review, and sooner if deemed appropriate in response to a strategically material development.

(c) **A monitoring plan** has been developed to underpin the above reporting and governance measures. This plan has been designed to integrate with our existing corporate risk management process, to track how our adaptive plan is performing and if and when an alternative pathway may be required. The corporate risk process already provides a cyclical, holistic and integrated approach to monitoring and managing risk across the business, underpinned with formal governance

arrangements that conclude with the Board, assurance and public disclosure in the annual report. Our continual improvement to long-term planning will itself strengthen our corporate risk system by further maturing its inclusion of long-term risks. The monitoring plan is found in Appendix B and includes the metrics that will be measured, the frequency of review, and thresholds for subsequent action.

Appendix A Foundations – the detail underlying our strategy and adaptive plans

11.3.3 Our LTDS acknowledges the wide range of drivers of change that have the potential to influence our operations and takes proactive steps to manage them, investing in low regret solutions and taking an adaptive approach that evolves as we learn more.

11.3.4 Section 9.4 explained how we assessed a wide range of drivers of change to understand their potential impact and how uncertain they are. Drivers of change that are highly uncertain and have a high potential impact have been addressed in our plan through scenario testing and the development of our core pathway and alternative pathways. This has included Ofwat's CRSs and our own wider scenarios.

11.3.5 Drivers for change that are more certain and have a high potential impact have been addressed through assumptions built into all our pathways. This also applies to more uncertain drivers that did not meet Ofwat's requirements for wider scenarios. Table 27 summarises how we have dealt with a full range of drivers of change in our LTDS.

11.3.6 Drivers for change with lower uncertainty and lower impact are recorded for regular reassessment. These drivers may fall within management control such as operational decisions and therefore the uncertainty around these drivers can be minimised.

11.3.7 All assumptions made in our PR24 Business Plan align with the assumptions adopted in the LTDS and outlined in this section of the report.

11.3.8 All drivers of change will be revisited every time we update our LTDS. At this point, it may be appropriate to generate additional scenarios to test our planned expenditure against and/or to modify the nature of the assumption we have made. This is captured in our monitoring and continual improvement plan, found in section 11.

Table 27: How we have addressed drivers of change in our LTDS

PESTLE	Driver of change	Influence on strategy	Assessment in the LTDS	Description
Political / Legal	Government and regulatory policy	High	Wider scenario and assumptions	Government policy and the way the water sector is regulated have a significant influence on the investment we need to make. Ofwat has advised that it does not consider it appropriate for companies to develop a wider scenario to reflect policy change. Policy change often (but not always) follows customer and public expectation. As such, we have developed a wider scenario that reflects changing expectations. Other than those factors included on our changing expectations wider scenario and Ofwat's Common Reference Scenarios, we have assumed no change to regulation or Government policy influencing the water sector (directly or indirectly).
Environmental	Climate Change	High	Common Reference Scenario	Ofwat's Common Reference Scenario for Climate Change.

PESTLE	Driver of change	Influence on strategy	Assessment in the LTDS	Description
	Abstraction reductions	Low	Common Reference Scenario	Ofwat's Common Reference Scenario for Abstraction Reductions.
Social	Household income	Low	Assumptions	We assume stable real terms household income over the period of the LTDS.
	Consumer behaviour and attitudes	Med	Assumptions	We assume no step change in the behaviour and attitude of customers, such as in relation to water and sewer use, water sources and water quality.
	Customer affordability and vulnerability	Low	Assumptions	Our priority is always to deliver the best outcomes to customers at the lowest cost and we will continue to do this. We assume no step change in the willingness to pay of customers nor in the needs of vulnerable customers.
Technological / Operational	Development of technology	High	Common Reference Scenario, and wider components	We have tested the development of technology in line with Ofwat's Common Reference Scenario and also considered wider technological developments (see Section 9.4).
	Water transfers	Med	Wider scenario	We assume water transfers occur in line with our Water Transfer wider scenario.
	The activities of other water companies in England and Wales	Med	Assumptions	We collaborate with other water companies in a number of areas (water resources management and through a broad range of research programmes for example) and we will continue to do so to maximise outcomes for customers and the environment. We assume reciprocal collaboration from other water companies such that joint strategies and plans are delivered efficiently and effectively.
	The activities of stakeholders in the North West	Med	Assumptions	We collaborate with many stakeholders in the North West and will continue to do so. We assume that stakeholders will continue to collaborate with us and deliver an appropriate proportion of schemes that provide benefits towards the goals of multiple stakeholders.
	The availability and costs of inputs	Low	Assumptions	We assume the costs of inputs to our operations (consumables such as chemicals) remain the same (in real terms) as today. We assume that all inputs remain available to us, as and when we need them.
	The availability of skills	Low	Assumptions / ambitions	We continually invest in developing the skills we need to be successful as an organisation. We assume that the skills needed to deliver our operations will continue to be available, either via in-house staff or the skills of our supply chains.

PESTLE	Driver of change	Influence on strategy	Assessment in the LTDS	Description
	The capacity of the supply chain	Low	Assumptions	We utilise the expertise of our supply chain to deliver outcomes to customers and the environment. We assume our supply chain continues to have the capacity to meet or needs.
	Levels of asset health and resilience	Med	Assumptions / ambitions	We invest in the health of our assets through day-to-day maintenance activities. These maintenance activities are funded through base expenditure allowances set by Ofwat. We assume that Ofwat's base expenditure allowances are sufficient to ensure a good level of asset health which supports the delivery of resilient services.
Economic	Economic growth and financial stability	Med	Assumptions	We assume stable economic growth over the period to 2050 and that any significant impacts on economic growth will be short-lived only (not lasting more than one year). We assume financial stability and the status quo of existing financial organisations, instruments and other related financial factors.

A.1 Trends explored in scenario and sensitivity testing

11.3.9 In the below tables, the impacts and consequence are described for the adverse scenario in question (e.g. for climate change larger temperature increase causes greater impact) but the benign was also assessed (i.e. smaller temperature increase causes lesser impact).

A.1.1 Water

Test	Trend	Impact	Consequence	Materiality	Uncertainty	Approach to assessment
A	Climate change	Increasing frequency and duration of dry weather events	Supplies are reduced	High	High	Scenario testing (CRS)
B	Climate change	Accelerated raw water deterioration due to changing weather patterns	Additional treatment required	High	High	
C	Climate change	Higher temperature increases chlorine reactivity	Higher doses are needed increasing contacts for taste and smell	Medium	High	
D	Climate change	Higher temperature increases chlorine reactivity	Higher doses are needed increasing disinfection by-product formation	High	Very high	
E	Climate change	Higher temperature increases biofilm growth within the water network	Increased risk of discolouration events	Medium	Very high	

Test	Trend	Impact	Consequence	Materiality	Uncertainty	Approach to assessment
F	Climate change	Higher temperature and soil wetting – drying cycles increases the deterioration rate of mains	More frequent water quality events linked to mains failures	High	Very high	
G	Climate change	Heavier rainfall increases sediment load in raw water	Production capacities are reduced	Medium	High	
H	Technology	Enhanced treatment for deterioration raw water/risk substances	Reduced cost	Medium	High	Sensitivity testing (these technology components are outside the Ofwat CRS)
I	Technology	New approaches for replacing lead pipes	Pipes replaced for lower cost and/or faster	High	Medium	
J	Technology	Smart water networks are implemented at a quicker pace, supporting the identification of leaks	Secondary benefit of fewer bursts, which increase water quality risk	Medium	High	Scenario testing (CRS)
K	Technology	Smart water networks are implemented at a slower pace	Smart meter penetration directly impacts our ability to reduce per capita consumption to 110l/p/d	High	Medium	
L	Demand	Population growth is higher or lower than forecast	Impact on the supply-demand balance and ability to reduce per capita consumption to 110l/p/d	Medium	Medium	Scenario testing (CRS)
M	Demand/ climate change	High demand increases main/supply pipe replacement	Secondary benefits for lead and customer contacts	Medium	Very high	
N	Demand/ climate change	Climate change causes increase in demand due to warmer weather	Impact on the supply demand balance, additional pressure on supplies under increasing climate change	Medium	Very high	Sensitivity testing (CRS)
O	Demand	Economic growth in leads to increase in demand	Higher than forecast non household consumption	Medium	High	
P	Demand	Climate change and extreme variability in weather lead to more freeze thaw events	Higher levels of leakage than forecast	Medium	High	
Q	Changing expectation	Increased concern over risk substances (e.g. PFAS, pharmaceuticals)	Additional treatment required	High	Very high	Scenario testing (Wider Scenario)
R	Changing expectation	Increased concern over health impact of specific mains materials	Wholesale cohort replacement of mains is required	High	Very high	
S	Changing expectation	Focus on lead drives policy change	Supply pipes transferred to company ownership	High	High	
T	Resilience	Acute orthophosphate shortages	Plumbosolvency control cannot be maintained affecting lead risk	High	Very high	

Test	Trend	Impact	Consequence	Materiality	Uncertainty	Approach to assessment
U	Cost constraint	Unchecked asset health deterioration	Increased investment requirement to recover	High	Medium	Sensitivity testing
V	Cost constraint	Low rate of lead pipe replacement	Pace to achieve ambition is not deliverable	High	Medium	Sensitivity testing
W	Water transfer	The scale and timing of water transfer needs	Changing requirements for outgoing transfers	Very high	Very high	Scenario testing (Wider Scenario)

A.1.2 Wastewater

Table 28: Trends explored in wastewater

Test	Trend	Impact	Consequence	Materiality	Uncertainty	Approach to assessment
A	Climate change	Increased periods of intense rainfall	Increased risk of sewer flooding	High	High	Scenario testing (CRS)
B	Climate change	Increased periods of intense rainfall	Increased risk of CSO discharge	High	High	
C	Climate change	Increased periods of intense rainfall	Access to assets prevented limiting monitoring and surveys	Medium	High	
D	Climate change	Increased periods of intense rainfall	Increased erosion posing risks to assets	High	High	
E	Climate change	Increased likelihood of extreme weather	Increased risk of power supply interruptions impacting WwTWs	High	Very High	
F	Climate change	Higher temperatures	Deterioration in bathing water quality	Medium	High	
G	Climate change	Drier weather	Reduced river flows impacting river water quality	High	High	
H	Climate change	Increased impact under UKCP18	More extreme outcomes affecting the factors discussed in A-G	High	Medium	Sensitivity testing
I	Demand	Increased volumes of wastewater to treat	Higher likelihood of flooding and blockages	High	High	Scenario testing (CRS)
J	Demand	Greater pressure on assets	Assets deteriorate faster	Medium	High	
K	Demand	More connections to sewer network	Increased risk of CSO discharge	High	Medium	
L	Demand	Additional flow and load at WwTW	Increased risk of spills and compliance	Medium	Medium	Sensitivity testing
M	Technology	Smart wastewater networks are implemented faster than expected	Greater efficiency in the network	High	Medium	Scenario testing (CRS)
N	Technology	Smart wastewater networks are	Lower efficiency in the network	High	Medium	

		implemented slower than expected				
O	Changing expectations	Increased public concern over the environment	Increased applications for first time sewerage	Medium	High	Scenario testing (Wider Scenario)

A.1.3 Bioresources

Table 29: Trends explored in bioresources

Test	Trend	Impact	Consequence	Materiality	Uncertainty	Approach to assessment
A	Climate change	Increase in temperature	Limited outlets	High	High	Scenario testing (CRS)
E	Climate change	Increased likelihood of extreme weather	Increased likelihood of power outages	High	Very High	
F	Climate change	Higher temperatures	Higher odour impact	Medium	High	
I	Demand	Greater pressure on assets	Assets deteriorate faster	Medium	High	Scenario testing (CRS)
K	Technology	Faster than expected smart technology	Faster identification of areas of concern in the process	High	Medium	Scenario testing (CRS)
L	Technology	Slower than expected smart technology	Slower identification of areas of concern in the process	High	Medium	
M	Changing expectations	Increased public concern over the environment		Medium	High	Scenario testing (Wider Scenario)

A.2 Key assumptions

Most of the uncertainties which are likely to have high impact are embedded in Ofwat's common reference scenarios or our wider scenarios, and managed through our scenario testing. However there are several drivers for change, identified in Table 27, 28 and 29, which have the potential to impact our strategy but were not appropriate for including in a scenario. We have made a range of assumptions for these drivers which are detailed below, along with how we expect the uncertainties to affect our strategy moving forward.

Political and legal

Government policy and regulation plays a critical role throughout the UK water sector and therefore could fundamentally impact on how our strategy is formed and how our adaptive pathways evolve. There is continual evolution in how the sector is regulated and there are many uncertainties with ongoing national developments

that could impact our assets, operations, services and plans. For example there is ongoing national discussion around: funding and ownership models; the focus, pace and scale of legislative duties such as those in the new Environment Act; and, regulatory approaches and guidance such as those in the Farming Rules for Water.

Ofwat has advised that it is not appropriate to consider a wider scenario on policy change. Therefore, we have based our LTDS on the assumption that there will be no significant changes to government policy or the way we are regulated for the duration of the LTDS, other than those captured in our 'changing expectations' wider scenario. We assume no changes to our relationship with the regulator, and if changes were to occur we would revise our strategy appropriately.

The role of others in water priorities – Many organisations play important roles in the water environment that can help or hinder our role and plans. For example, we have assumed no change to the current national application of the 'polluter pays' principle that facilitates proportionate action from all stakeholders in an issue, such as pollution of a water course or greenhouse gas emissions. We have also assumed no change in approach to local authority planning for surface water management. We keep all these factors under review for developments in practice that can influence our role and plans.

Geopolitical stability has been shown to impact UK water services on numerous occasions, for example with recent disruption to supply chains through the pandemic, or to energy prices following the war in Ukraine. The sector has shown its resilience and general ability to absorb substantial shocks, but still with ramifications for a business to manage. We continually seek to maintain and improve resilience in our plans and operations as far as practical, and for the LTDS we have assumed stability and supply chain availability. However, it is important to recognise that events beyond our control could have a material impact on our adaptive plans.

Environmental

The state of the natural environment – Water and wastewater services fundamentally rely on nature and the climate. Climate change and elements of biodiversity and ecosystem resilience were captured in Ofwat's common scenarios.

Social

Affordability and willingness to pay – The cost of living crisis is placing significant pressure on household incomes and our plans include for strong support measures for those who most need them. Our LTDS has assumed no strategically fundamental change in customer affordability of water bills, and latest customer acceptability testing and willingness to pay research remained highly supportive of our plans. However, we are continuing to monitor this and propose to undertake further customer engagement if step changes occur to willingness to pay and investment priorities.

Changes in consumer behaviour – Would affect both water and wastewater services. Our plans include ambitious programmes to support behavioural change in water and sewer use, and others are also working in this space. We have followed regulatory guidance about the levels of water efficiency we should plan for. In practice, levels could be higher or lower dependent on the success of measures by us and others, including the approach of national policy on labelling white goods, for example. This is an area we continue to monitor and will respond to over time in our planning.

Availability of skills – We have assumed success of the collaborative efforts to avoid the risk for a shortage of skills.

Appendix B Monitoring plan

B.1.1 The monitoring that we conduct to support and guide our LTDS is integrated into our corporate risk management process.

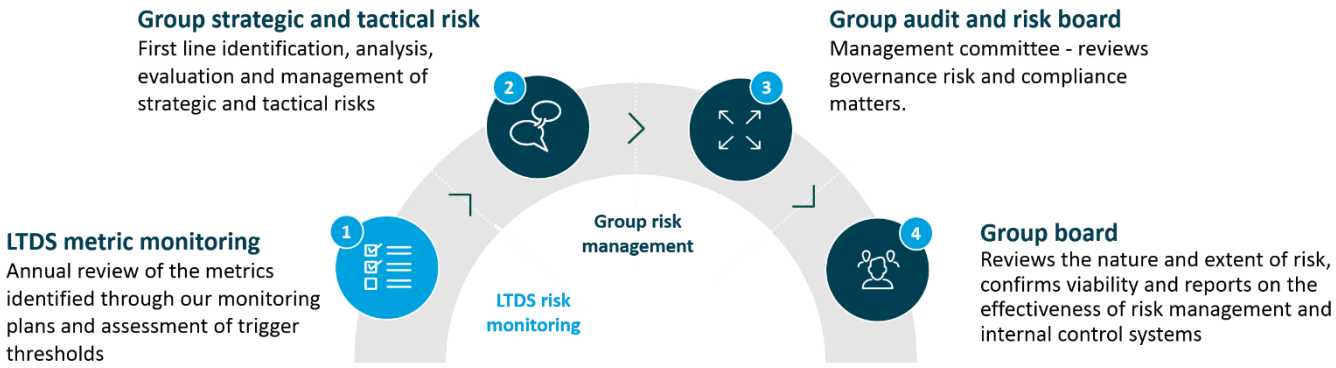
B.2 Our approach to risk and resilience

B.2.1 Our risk and resilience framework provides the foundation for the business to anticipate threats to delivering an effective service in these challenging times, and to respond and recover effectively when risks materialise. Key components of the framework include:

- An embedded group-wide risk management process, which is aligned to ISO 31000:2018 risk management guidelines;
- A board-led approach to risk appetite, based on strategic goals;
- A strong and well-established governance structure giving the board oversight of the nature and extent of risks the group faces, as well as the effectiveness of risk management processes and controls; and
- A portfolio of policies, procedures, guidance and training to enable consistent, group-wide participation by our people.

B.2.2 Our tactical risk and appetite statements support monitoring of risks identified through the LTDS. Monitoring of the LTDS metrics will occur in line with the corporate governance and reporting process, summarised in Figure 48. We will review and report on these annually.

Figure 48 Governance and reporting process, showing interface to LTDS monitoring



B.3 LTDS monitoring plan

B.3.1 For each of our alternative pathways, we have outlined:

(i) The metrics that will be monitored, how these will be calculated and the source of the data.

(ii) The frequency at which the metrics will be monitored and reviewed.

(iii) The thresholds that the metrics will be monitored against and what action will be taken when the thresholds are reached.

B.3.2 This framework forms our monitoring plan for the LTDS, which is in turn, integrated in to our corporate risk management process. Our monitoring plans for each strategy are presented in sections 4.6, 5.6 and 6.6.

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