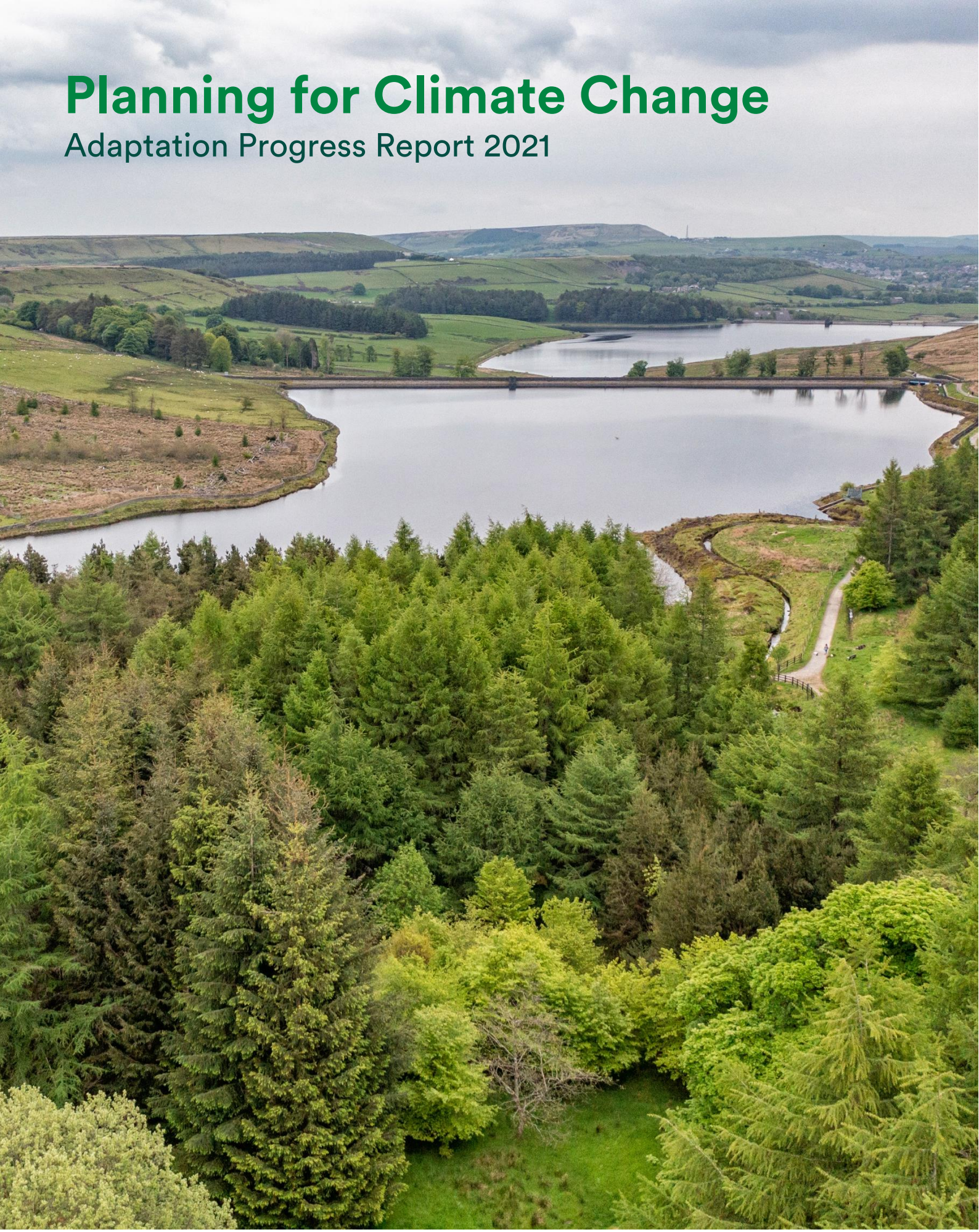
Planning for Climate Change

Adaptation Progress Report 2021



United Utilities

Water for the North West

Foreword

Weather is fundamental to how we deliver water and wastewater services, and so climate change will always be of strategic and operational importance to us.

Already, we are seeing the effects of climate change on the region's weather, with increasing summer temperatures, wetter winters and more extreme rainfall events.

With these trends set to continue, unless we take action there will be increasing impact on the services we provide to the communities we serve.

The climate crisis threatens the ecosystems on which we rely in order to provide reliable, affordable, essential services to customers. Recognising this challenge, we are committed to mitigating our contribution to further climate change and to adapting iteratively to the changes we experience.

In this report, our third on climate change adaptation, we have evolved our understanding of climate risk by incorporating the latest climate science into our risk assessment processes and embedding it within our long-term planning.

Through our company-wide assessment of climate-related risks, we recognise how climate change will test the resilience of our services to both the acute impacts of more frequent and severe weather extremes and more chronic stresses over time. This report describes the steps we are taking to adapt and the importance of being resilient. At the heart of our response is Systems Thinking, which recognises that efficiency and resilience can be secured by planning for the whole environmental system from source to sea and critical interdependencies across other systems.

"The climate crisis threatens the ecosystems on which we rely in order to provide reliable, affordable, essential services to customers "

Steve Mogford, Chief Executive Officer

Steve Mogford
Chief Executive Officer

We will continue to work in partnership to deliver the necessary adaptation measures. We are committed to co-developing and co-delivering adaptation strategies with partners across the region so we can prepare together for a changing climate.

In developing and delivering our long-term strategic plans, we are adopting an adaptive pathway approach, building potential future scenarios into our planning. This allows us to remain agile as the climate changes and as the science provides us with greater understanding, while acting on changing customer and stakeholder expectations and changes in legislation.

As we develop our plans, we will take into account the cost of mitigating and adapting to the effects of climate change. We account for the effects of climate change to ensure the resilient supply of essential water and wastewater services within our long-term planning. We will always consider what is affordable today, as well as tomorrow, and how this impacts the people of the North West.

We continue to make progress with our climate change mitigation plans, reducing operational emissions by over 70 per cent since 2005 and delivering against our six carbon pledges. We are delighted to have received accreditation for our scope 3 science-based targets from the Science Based Targets Initiative (SBTi), the recognised benchmark in this space. We are the first UK water company to do so.

Climate change represents one of the most significant challenges to our future. In responding to this, we see substantial opportunity to deliver lasting benefits for customers and the North West.

Our key messages

Climate change is here, now

- We are experiencing wetter winters, hotter drier summers and rising sea levels.
- There is clear evidence of more change to come, with the exact scale determined by global levels of carbon emissions.
- The latest climate projections show the range of global temperature change is forecast to be between 2°C and 4°C by 2100.
- If each of the latest global climate pledges agreed at the 2021 United Nations Climate Change Conference (COP26) are implemented, the most optimistic projection is for around 2°C.
- The North West already experiences the most rainfall of any region across the country, and this is set to increase under the latest climate projections.
- Society can already see and feel the impacts of extreme weather events in travel disruption, power cuts, and flooding.

We are playing our part in a global climate challenge

- We will continue to embed the latest climate research in our decision-making.
- The climate crisis threatens the ecosystems on which we rely in order to provide reliable, affordable, essential services to customers.
- This will impact every part of society, and every part of society has a role to play in the response. We can only be truly resilient by acting together.
- We are the first UK water company to have accreditation for our scope 3 science-based carbon reduction targets from the SBTi.

We will make a difference

- We will mitigate our contribution to climate change by delivering our net zero ambition, leading a dramatic reduction in carbon emissions across our business, supply chain, region and sector.
- We will remain resilient to climate change, embedding a detailed understanding of risks and opportunities as outlined in this report, ensuring we are acting in the right areas, using best available techniques, at the right time.
- We will establish long-term adaptive pathways, always responding to the latest evidence and innovations to secure best value, reliable services for customers.

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Executive summary

Inside our report

This report demonstrates our maturity in adapting to climate change, and our ambition to continue to provide a great service while protecting and enhancing the environment in the North West.

By applying the latest climate research to our climate-related risk assessment and strategies, we highlight the importance of being resilient to changing weather conditions and demonstrate the steps we are taking to adapt to that change.

Using Systems Thinking, we highlight the importance of considering how climate change interacts with each part of a wider system, and how partnership working provides multiple benefits in the journey to a climate-resilient future.

We demonstrate the work we do to protect and improve the natural environment of the North West and continue to improve our resilience to shocks and stresses.

Through our climate-related risk assessment, we identify how climate change poses a major threat to the services that we provide and the areas we must focus on to remain resilient. Our assessment highlights shocks from the acute impacts of more frequent and severe weather extremes, as well as chronic stresses over time.

We identify the need to adapt efficiently and effectively, always evolving our response by employing Systems Thinking and place-based adaptive planning approaches. We consider nature-based and traditional solutions to manage changing supply and demand requirements.

We recognise the climate challenge we're already experiencing and how projections evidence the need for increasing levels of intervention into the future to maintain current service standards.

Adaptation reporting

We have produced this report for Defra in line with requirements of the 2008 Climate Change Act. This report sets out:

- the current and future predicted impacts of climate change on the organisation; and
- our proposals for adapting to climate change.

Our purpose, vision and values

Our purpose is to provide great water and more for the North West. It drives us to deliver our services in an environmentally sustainable, economically beneficial and socially responsible manner.

Providing 'more' means creating value for our stakeholders by understanding what matters to them through strong, constructive relationships. We do this by:

- supporting communities to be stronger;
- caring for customers through trusted relationships;
- creating a great place to work for all our employees;
- protecting and enhancing the environment;
- delivering a sustainable return to investors; and
- innovating in partnership with suppliers.

To deliver that purpose and work towards our vision we follow three strategic themes:

The best service to customers

At the lowest sustainable cost

In a responsible manner

Our core values

Our core values provide the cultural framework within which we operate.

Customer focused
Customers are at the heart of everything we do, and we aim to provide a great and resilient service at the most efficient cost.

Innovative
We continually look for new ways to make our services better, safer, faster and cheaper.

Trustworthy
We make promises knowingly and keep them, behaving responsibly towards all of our stakeholders.

Physical risks

The key risks in this report, identified as being sensitive to climate change, are physical risks, meaning they are disruptive or destructive to our operations or assets.

Predicting the effects of climate change is complex, with a large amount of uncertainty involved. Focusing on the predominant downsides, we assessed the potential implications for our key risks in 2050 and 2100 compared to today, using the latest climate research, the Met Office UK Climate Projections 2018 (UKCP18). This has four pathways to 2100 depending on concentrations of greenhouse gases in the atmosphere. For our climate change risk assessment we have used a pathway, RCP6, which is consistent with peak emissions occurring in 2080 and an expected 2.0-3.7°C increase in global average temperatures from pre-industrial levels. To inform our adaptive planning, we are considering multiple pathways and future scenarios.

The outcomes of our climate change risk assessment were the subject of a special report prepared for a board-level risk review which took place in April 2021, and were summarised within the Taskforce for Climate-related Financial Disclosures (TCFD) section of our annual report. Further details of these outcomes are presented within this report, together with a description of assumptions, climate sensitivity and existing controls.

Transition risks

We are exposed to risks associated with the necessary transition to a low-carbon economy. Changing policies, regulation and legislation to address mitigation and adaptation requirements can increase operating costs and call for agility and adaptability in the way we operate.

We recognise the need for further environmental improvements to support our resilience and the need to be actively collaborative and innovative in our approach to embed sustainable long-term improvements. Our new values framework enables us to assess the latest best value approach, considering social affordability, carbon impact, and environmental need using our our Systems Thinking and place-based adaptive planning approaches.

Opportunities

As stewards of over 56,000 hectares of land, we are exploring how this will play a critical role in adapting to the impacts of climate change, such as slowing the flow of water to reduce flood risk.

We are expanding our Catchment Systems Thinking approach, using more natural solutions to create more value for the environment, and we are reviewing our approach to land management to enable multiple benefits from a targeted approach.

We are a relatively energy-intensive business, using 951GWh of energy in 2020/21. As well as the risks associated with our dependency on importing energy we see opportunities in the way we manage energy. We have developed an approach to use less, generate more and use our assets and resources smartly to maintain security of supply.

We have invested in innovation and research to reduce the total amount of energy we consume, for instance in pioneering UV LED water treatment. We have increased renewable generation through bioresources, solar and wind, increasing the amount of self-generated energy from 108GWh in 2012/13 to 205GWh in 2020/21, with the remainder being purchased from certified renewable sources.

By meeting more of our own energy demands we can rely less on imports from the grid and reduce carbon emissions. This helps us to mitigate the risks of future energy price fluctuations and uncertainty, as well as bolstering our own security of supply.

Resilience of our organisation to a changing climate

Resilience requires an integrated approach, factoring asset health and population growth alongside climate change in our planning and decision-making.

Our Water Resources Management Plan (WRMP) and Drainage and Wastewater Management Plan (DWMP) are examples of our adaptive planning. These enable us to achieve long-term, best value and sustainable plans for the services we provide in the North West, ensuring our long-term ambitions are met by aligning our short-term actions.

The plans ensure our system is resilient to drought, flooding and other hazards arising from climate change, and resilient to demand through population growth, economic trends and patterns of water use.

Recent extreme events

Managing the extremes

While most climate change concern focuses on moving climate averages, the science also predicts an increase in the likelihood of extreme events.

Extreme events are becoming ever more common and increasing in severity. Our resilience to these events is paramount to ensuring our ability to provide the best service to customers.

Variation of extreme weather events increases the risk of cascade impacts. Since multiple different extreme weather events can occur in a single short time frame, our ability to recognise the impact to our system and recover is what enables effective climate change adaptation.

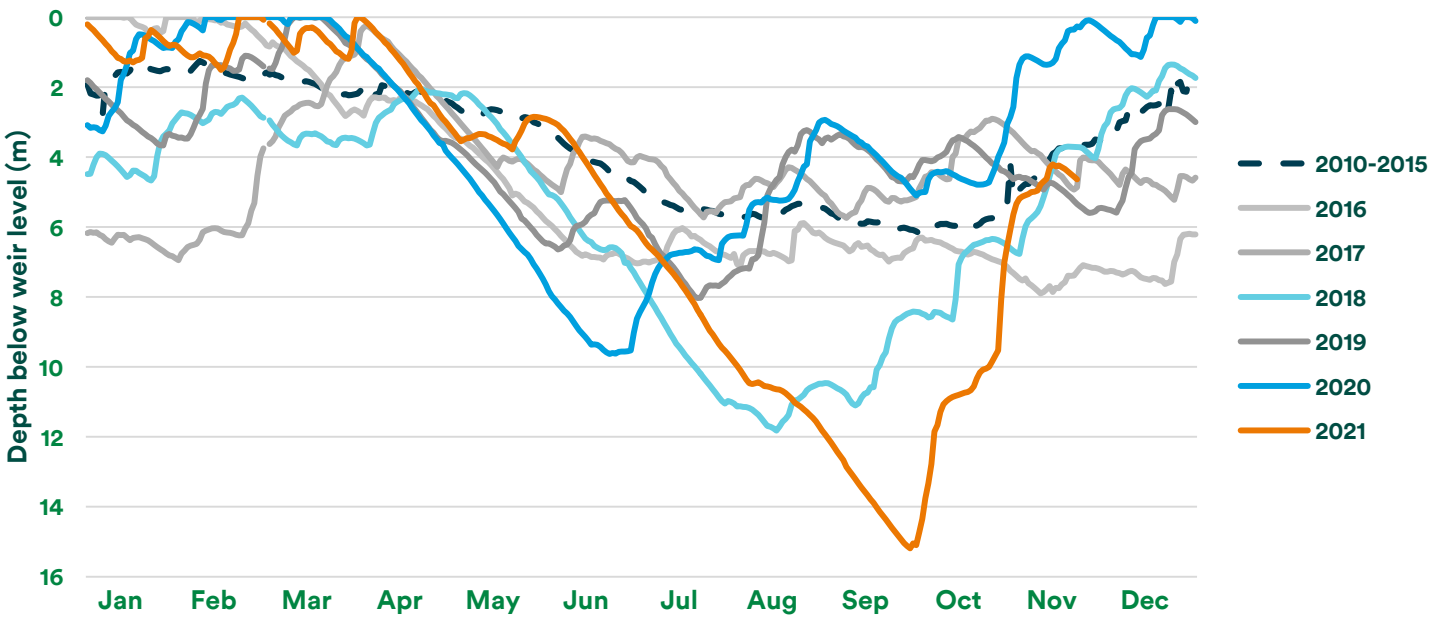
We are already experiencing the effects of climate change on the region's weather. From recent experiences we are collecting insight into the impacts we will face from the climate crisis with more frequency and severity into the future.

Hot and dry

Dry weather events occur when below average rainfall is paired with hotter weather. Recently we have experienced three notable periods of dry summer weather; the summers of 2018, 2020 and 2021. Intense dry weather periods are classified as a drought, and the first major drought in approximately 20 years affecting the North of England occurred during 2018. This event stressed our water resources, water production capacity and biological processes at some wastewater treatment works.

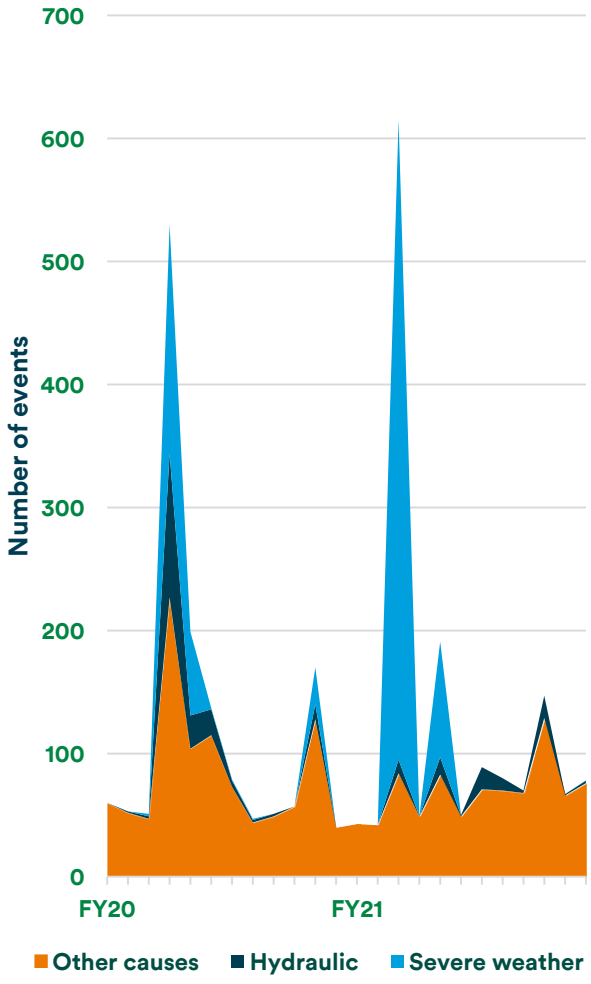
Improving our response to droughts for customers is a priority, and we have reviewed our Drought Plan communications strategy making it more flexible and responsive. One example is our approach to customer communication, which has been improved to ensure that it is more targeted, agile and regionally focused. Our drought triggers have been updated, lowering the likelihood of temporary use bans, such as restricting the use of hosepipes, minimising the impact on customers and improving our resilience. The introduction of new treatment works contingency plans help to further minimise the impact of dry weather on treatment processes.

Haweswater reservoir levels

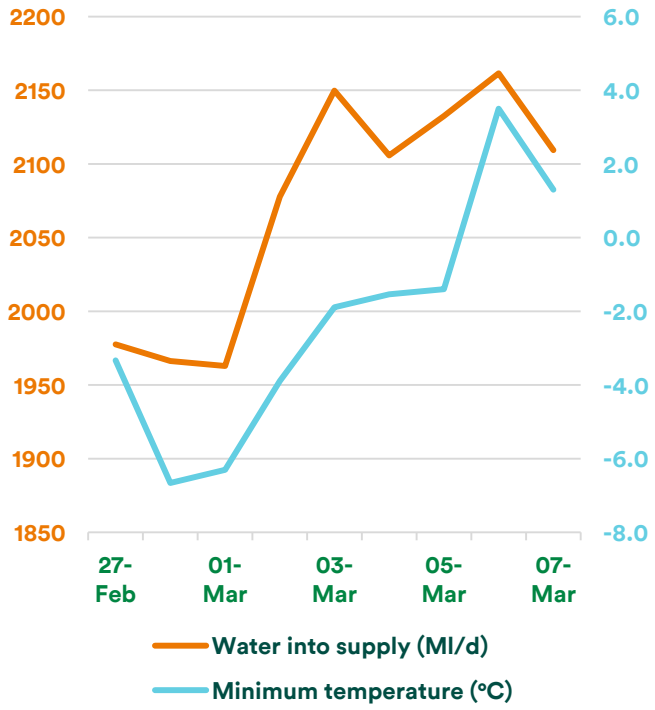


Haweswater reservoir is the single largest water source for the North West, and is critical to supplying communities around Manchester.

Internal sewer flooding frequency by cause



Water supplied during Beast of the East freeze-thaw



Heavy rain

Storm Desmond and Storm Eva hit the North West particularly hard in 2015. A national review of infrastructure flood resilience was undertaken and led to the National Flood Risk Review.

This in turn led to a broad review of our company flood risk and the realisation that there was no agreed standard of flood resilience, nor an easy, routine or reliable approach to assessing organisational flood risk. Through these major storm events and flood risk review we learned many lessons and have developed collaborative interventions accordingly.

The implementation of contingency and operational readiness plans will aid us in our resilience efforts during periods of heightened risk. Where flood vulnerability has been identified new design standards can be implemented, as part of asset lifecycle maintenance activities.

Storms and prolonged wet weather can cause potential flooding of our sewer network. In 2020 and 2021, three specific storm events have contributed to a notable increase in the overall number of sewer flooding incidents, with 40 per cent of our incidents relating to extreme rain occurring on just six days in 2020.

We continue to develop and implement a wide variety of schemes and initiatives to improve our sewer flooding performance. These include increased customer engagement, increased monitoring of the sewer network and dedicated blockage teams to respond to incidents faster.

Cold snaps

In the last decade we have experienced three notable cold snaps; in 2010, 2011 and the ‘Beast from the East’ in 2018. The Beast from the East resulted in consumers across the UK losing drinking water supplies for an extended period of time, and triggered an Ofwat review into the industry’s response to the event.

Customers in the North West had no widescale disruptions to supply, with our planning, response and recovery being commended in Ofwat’s report.

Our winter readiness plans embrace all our lessons learnt from previous cold snaps. With cold weather having an observed significant impact on many of our operations, there are many aspects that need to be considered when preparing for extremes in winter weather.

We consider it prudent to continually monitor, review and update practices and procedures for all our assets and equipment before, during and after cold snaps to prevent any unnecessary damage to our sites, assets and people.

1 Introduction

1.1 Our region and us

Background

The North West is home to 7.3 million customers who rely on our services 24 hours a day. The region includes major cities, like Manchester and Liverpool, through to small villages in Cumbria and coastal towns of Lancashire. There are diverse socio-economic factors that influence the region and its communities.

We own and manage over 56,000 hectares of land, making us the largest corporate landowner in England. Much of this is catchment land (the areas immediately surrounding our reservoirs), which plays an important role in the services we provide to customers.

The landscape of our region is predominantly woodland and grassland, with a significant covering of peat, bog and moorlands. We are committed to protecting and enhancing the environment, to the benefit of biodiversity, recreation, flood resilience and much more.

We recognise the importance of the symbiotic relationship we have with the environment, and hold passionately our duty of care, which is outlined in our Environmental Policy.

The environment is changing, however, and as a result of decades of increasing global greenhouse gas emissions the sensitive balance of our climate is being tilted.

As our region becomes hotter and wetter, and unpredictable extreme weather conditions become more common, we expect our adaptability and resilience to be tested more frequently and more fiercely.

In this report we will discuss how we are adapting to the effects of climate change, and demonstrate our approach to resilience alongside a dynamic climate.

The past 150 years in the North West

100% of the top 10 hottest years have occurred since 2002

50% of the top 10 wettest years for the have occurred since 2000

0% of the top 10 coldest years have been recorded since 1963

Environmental factors

The region has a large coastline, protected rural areas and dense urban areas, all of which create different demands and have different susceptibility to climate change.

- **30%** of land is National Park or Area of Outstanding Natural Beauty or Sites of Special Scientific Interest
- **29** designated bathing waters
- **830mm** higher than average UK rainfall each year

Social factors

We are leading the sector on affordability and vulnerability. Our Priority Services offering is now being used by over 140,000 customers who are likely to be the most vulnerable to change in a less stable climate.

- **41%** of the 100 most deprived areas in the country
- **47%** of households have less than £100 savings to cope with unexpected bills
- **18%** of households are affected by water poverty, 20 per cent above the national average

Economic factors

We are building resilience to continue serving the growing population and support jobs and the tourism industry.

- **7.3m** population expected to grow significantly in the next 25 years
- **22,700** jobs actively supported by our work, with over 5,000 direct employees
- **Tourism** relied on by Lake District, Liverpool and coastal areas

1.2 Engaging with our stakeholders

Engaging on climate change

We serve domestic and business customers from Cumbria in the North, to Cheshire in the South, through the regions of Lancashire, Merseyside and Greater Manchester.

The impact of the environment on our activities, and the impact of our activities on the environment, influence how we deliver water and wastewater services to customers. We strive to maintain a resilient and sustainable level of service to customers and the environment, taking climate change and both customers' and stakeholders' views into account.

Understanding what matters to stakeholders will only be achieved by building strong, constructive relationships and engaging regularly. This is important to building and maintaining trust, and remaining resilient to interdependent risks resulting from climate change.

These relationships are subject to robust governance to ensure the insights generated are taken into account in decision-making at executive and board level. The board's corporate responsibility committee meets four times a year, with stakeholder engagement as one of its standing agenda items, and the chair of the independent customer challenge group (YourVoice) regularly attends board meetings to provide its perspective.

There are nine key stakeholder groups that influence our planning and activities:

Customers

Why we engage

Serving over seven million people and 200,000 businesses in the North West means it's important we get our services right. But to deliver a great service in a way that customers value, we need to listen and engage with them in ways that are relevant. We know customer expectations are ever changing, and increasingly more demanding, so we constantly look for ways to engage with, and understand, evolving customer expectations of us as their water company.

How we engage

We recognise the vital importance of engaging with customers and are committed to asking for, receiving and analysing customer feedback. We develop insight through everyday interactions, regular online customer panels and a focused research programme.

To strengthen our engagement in this area we commissioned a bespoke research project into customers' views on climate change. Views expressed by customers have had an important input into the development of this climate change adaptation report.

We have changed how we communicate and deliver services based on customer feedback, such as the introduction of Priority Services and our work in building a strong partnership with the local debt advice sector.

Throughout this report the outcomes of this, and previous, customer research is considered, and has been integrated into our company-wide climate risk assessment. Our research focuses on:

- customer awareness of climate change challenges in the sector;
- how United Utilities' takes climate change and sustainability into account in the work we do and pledges we make;
- customer priorities when it comes to climate challenges in the water and wastewater industry (uninformed and informed view);
- what customers expect from us in terms of resilience and climate change and what role we are expected to play; and
- expectation of customers' role in tackling climate change as it pertains to water and wastewater.

"A global issue that we all need to be held accountable for"
Future bill payer

We asked customers...

To inform this report, we have engaged with customers on their views on the risks posed by climate change to the provision of water and sewerage services, engagement and awareness of climate change initiatives run by us and the role that customers might play in mitigating the risks from climate change.

We have engaged with over 1,000 customers specifically on climate change. Our research – a mix of focus groups, domestic and business customers and future bill payers – has provided insight into where climate change is positioned in customers' priorities.

Within this, we presented customers with some of our most sensitive, and most significant climate-related risks, as presented throughout **Risk and Opportunities – 3**.

We learned that...

When asked to rate their level of concern for climate change out of 10, customers' scores were rarely below seven. This research took place during a COVID-19 lockdown, and for household and future bill payers, the level of concern with climate change in the UK was second only to the ongoing pandemic.

It is clear that climate change is a key concern for customers and that it is regarded as "a global issue that we all need to be held accountable for". This research found that customers are satisfied with the steps we are taking to tackle climate change, and that climate change is an issue which is present in the here and now. There is also a clear recognition that the impacts are only going to get worse.

Around 80 per cent of customers and future bill payers agree that we should be responsible for taking a proactive approach to the potential impacts of climate change.

Communities

Why we engage

A changing climate will have an impact on every community in our region, across rural farms and hamlets to bustling cities. Our work puts us at the heart of local communities: places where customers and employees live and work.

We seek to develop strong relationships based on mutual trust, respect and an understanding of the impact our work has on everyday lives. We play a constructive role in tackling issues and by identifying what matters most to communities we can develop and deliver resilient solutions to the climate challenge in partnership.

How we engage

When communities come together, whether that is around a particular issue or location, they can often make powerful representations to the company.

Much of our engagement is face to face, although over the past year we have adapted to using more digital means of engagement, such as our online consultation as part of the Haweswater Aqueduct Resilience Programme, alongside traditional methods, such as attending parish council meetings.

Suppliers

Why we engage

Good relationships with suppliers help ensure that we get projects delivered on time, to good quality, at efficient costs and can identify and realise innovative approaches and solutions.

Awareness of issues throughout the supply chain means we can address them together and become more resilient to shocks and stresses. We rely on suppliers to deliver our services and create value for all. With our suppliers, we identify an area of interdependent climate-related risks, included in this report.

How we engage

Through our United Supply Chain (USC) approach we engage suppliers on sustainable and ethical issues and performance. Suppliers can join USC by committing to our responsible sourcing principles.

Through memberships of organisations such as the Supply Chain Sustainability School and the Chartered Institute of Procurement and Supply, we keep abreast of best practice.

Environment

Why we engage

We rely on the environment and play a key role in protecting and enhancing it across the region. This supports ecosystem resilience, which is key to the sustainable delivery of essential water and wastewater services.

Given the environment has no voice of its own, we engage with interested groups such as environmental regulators, non-governmental organisations, campaigners and local communities to find the best ways to tackle environmental issues, such as climate change and land management.

How we engage

We conduct facilitated workshops with environmental stakeholders to understand their priorities and undertake a large number of customer research projects.

We work with environmental partners across the North West to identify new ways to deliver improvements, and engage with several groups to explore opportunities to deliver shared outcomes. This enables us to ensure the environment is at the heart of our approach to providing a resilient future in the face of a changing climate.

Investors

Why we engage

It is important that shareholders have confidence in the company and how it is managed, given their investment in our business. We have over 70,000 shareholders, from large institutions who manage the pensions of millions of people to private individuals who are looking for a return on their hard-earned money.

We maintain relationships with a diverse range of banks, in order to finance improvements to our assets and services to return sustainable and resilient growth.

How we engage

Engagement with shareholders gives us a broad insight into their priorities, which is taken into account in our decision-making and our strategic direction. By providing updates on strategy and performance, we can assist their understanding and decision-making.

Through our investor relations programme, we actively engage with shareholders and analysts who research our company and industry. We supply information to several investor-led indices on environmental, social and governance matters.

Employees

Why we engage

Our employees are the face of the company and we could not deliver our services without them. It is essential we build productive relationships with our employees based on trust.

Employees know our business better than anyone, with a diverse range of views and experience, making them well placed to identify opportunities for improvement. That is why our assessment of climate-related risks involves us engaging with teams from across each of our business areas, to identify and address any threats and opportunities resulting from changes in the climate.

How we engage

Our Employee Voice panel consists of 24 members from across the company, providing a means by which employee perspectives are heard by the board. We have several employee-led networks, including gender equality, multicultural and LGBT+ groups, and we encourage employees to share innovative ideas via many forums.

We explore the risks we identified with our employees in **Climate-related risks – 3.2**.

Media

Why we engage

It is through both traditional and social media platforms that many of our stakeholders receive their information about us and our activities. The media is influenced by the issues that matter to those stakeholders as well as influencing them through what it reports.

As our climate research has demonstrated, climate change is of significant interest to customers in the North West, and the media drives further influence in this space as it continues to grow, highlighting the importance of the challenge we are facing.

How we engage

Given the essential nature of our services, it is important that coverage is fair, balanced and accurate, and this requires effective two-way dialogue between the company and the media. This is achieved through proactive engagement by our media team, which is available 24/7, providing content to media outlets, as well as dedicated resources to drive proactive messaging on social media channels.

This helps us to provide our knowledge and experience of our region, and the impact that climate change will have on it, to further educate through a variety of channels.

Politicians

Why we engage

Politicians influence the long-term national water strategy and environmental priorities, and champion issues raised by their constituents. These matters that affect how all businesses operate, and how they can remain resilient to climate change.

Local government, elected representatives and devolved administrations provide insight into shared social, environmental, economic and governance issues.

How we engage

We engage with regional and national politicians across the different political parties.

Open dialogue with regional MPs is maintained on specific issues and we regularly attend meetings at constituency offices. We have provided each MP in our region with a fact sheet with contact details and information about our activities in their constituency.

We take part in joint working groups with devolved administrations and local authorities on topics which support climate change, such as natural capital.

Regulators

Why we engage

Through proactive, constructive engagement with economic, quality and environmental regulators, we agree commitments over specified time periods and finalise the expectations they have of our business planning and performance.

We actively engage to shape the policy and regulatory framework within which we operate, covering customer, economic, environmental, social and governance matters.

How we engage

We hold regular meetings with all of our regulators to discuss priorities and objectives which can change over time.

When they seek views through specific consultations we provide considered responses where we think there is value and we have something to contribute.

We work together with regulators to find new solutions through projects such as Natural Course, which aims to build capacity to protect and improve the water environment of the North West.

2
Understanding climate change

2 Understanding climate change

Our approach to climate change

Climate change has been a subject of strategic and operational focus for us for decades. The impact of the environment on our activities, and the impact of our activities on the environment influences how we deliver water and wastewater services to customers. Our response to climate change focuses on its two component parts:

Mitigation

We minimise our contribution to climate change by reducing greenhouse gas emissions through, for example, our energy and land management strategies.

Adaptation

We use scenario analysis in our business planning and risk management to ensure we adapt and improve our resilience to effects of climate change.

Adapting our services

Climate change and the resulting shifts in weather patterns have the potential to significantly impact our operations and the broader environment. This fundamentally impacts our long-term approach to reliably providing our services. Hazards such as droughts, floods, storms or heatwaves will continue to become more frequent and more intense.

Our first climate change adaptation report in 2011, and our second in 2015, supported our strategic planning for adapting to climate change. In this, our third adaptation report, we include an increased focus on transition risks, and a robust and refreshed climate change risk review.

We have adopted a Systems Thinking approach which enables us to forecast how changes in weather conditions will impact us. It allows us to understand how areas of our service are vulnerable to climate change and adapt our plans to improve performance and resilience across key topic areas, such as water supply, leakage, sewer flooding and pollution.

A baseline risk and vulnerability assessment has been undertaken as part of our DWMP to understand future performance compared to a baseline. This has identified where climate change accelerates our risk of failing to meet strategic planning objectives such as internal flooding or wastewater treatment works compliance. We are also adopting advanced modelling approaches to assess the impacts of the latest Met Office climate projections in our WRMP, to ensure water resource resilience through worsening dry weather conditions.

As part of our mitigation strategy we have outperformed our target, reducing emissions by over 70 per cent since 2005/06. We have also signed up to the ambitious industry-wide Water UK Public Interest Commitment to achieve net zero emissions by 2030.

The landscape of climate change is ever changing, with dynamic drivers, policy changes, and outputs from advancing climate science. The importance of resilience across our business is paramount, and our ability to be flexible and adaptive is a key focus in our future business strategy.

2.1 Climate change research

Progress in climate science

Climate science has advanced considerably over the last decade, including a much greater understanding of the links between climate change and extreme weather events and potential tipping points in the climate system. This strong evidence contributed to the signing of the Paris Climate Agreement in 2015 to limit global average temperature rises to well below 2°C above pre-industrial levels, and the COP26 ambition to secure global net zero by 2050 and keep 1.5°C within reach.

We have worked with the engineering consultancy Atkins to produce a holistic assessment of climate change impacts in the North West. This allows us to use the latest, best available research on climate change in the UK.

According to the World Meteorological Organisation, greenhouse gas concentrations reached a record high in 2020 (a record projected to by broken in 2021), and average global temperatures have risen more than 1°C above pre-industrial levels, rises which are mirrored in the climate of the UK. Overall the most impactful changes for the UK are the increasing frequency of extreme events, including heatwaves, floods and droughts. Nationally, the likelihood of hot summers has doubled, however long-term trends and their impacts vary across the UK, and so we have carried out a detailed assessment of these impacts for the North West.

In 2019, the UK Government set its target to bring greenhouse gas emissions to net zero by 2050. However, the UK's Climate Change Committee (CCC) has stated that up to at least 2050, temperatures in the UK are expected to increase regardless of how strongly emissions are reduced globally, and sea level will continue to increase for centuries even on a low emissions pathway.

The CCC's view is that it is prudent for the UK to plan adaptation strategies for a scenario of 4°C warming by 2100.

What to expect

Research developed with Atkins has shown that the North West is projected to warm by between 3°C and 6°C above pre-industrial levels by the year 2100, and that globally we are not on track to keep warming well below 2°C, as outlined by the Paris Climate Agreement.

Climate change in the North West

Rainfall
Annual **average rainfall** has not changed significantly, however **year-to-year variability has increased**, with more dry and wet years.

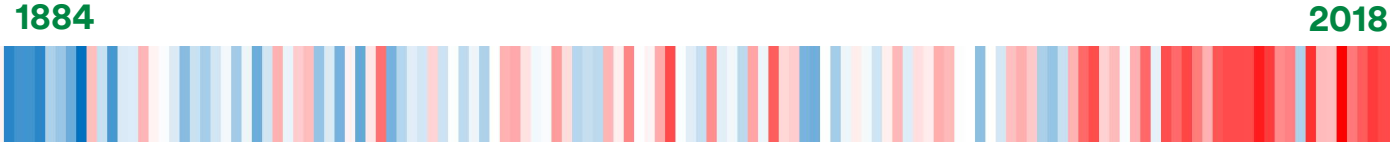
Extreme events
Evidence demonstrates that climate change has exacerbated and will continue to **exacerbate extreme rainfall and storm events**, as well as **increase the likelihood of heatwaves**.

Seasonal variation
Seasonal changes in the North West are projected to be greater than those for England and Wales, with **much wetter winters** and, under some scenarios, much **hotter and drier summers**.

Evaporation
The amount **of water lost to evaporation** is likely to have **increased**, putting increasing pressure on water resources during spring and summer and potentially increasing the demand for outdoor water use.

River flows
Winter river flows have increased in almost all catchments, with significant upward trends in 10 of the 14 river basins, and a reduction in flows during spring in most catchments.

Sea level
By 2100, under the likely warming scenarios (3°C–5°C), **sea level** at Liverpool is projected to rise between **0.3–1.0m**.



HadUK North West annual climate stripes coloured based on temperature difference from the long-term average.

2.2 Climate change mitigation

Our responsibility

While we focus on our adaptation to the impacts of climate change in this report, it is important to recognise how we contribute to rising greenhouse gas concentrations, and the significant steps we take to minimise that.

We have developed our climate change mitigation strategy to call out the significance and value of this work. While our environmental policy has been in place to set out the principles around our responsibility for protecting and enhancing the environment, our carbon policy is a bespoke policy to help us achieve a low carbon future.

We have structured our approach around four themes, covering:

Vision and visibility

Demonstrating integrity and leadership in carbon reporting and disclosure

Ambition and commitment

Delivering our obligation to mitigate climate change and lower our greenhouse gas (GHG) emissions in line with the expectations for a leading UK water and wastewater company

Demonstrating action

Demonstrating consistent and prolonged reduction of our operational GHG emissions and other environmental impacts through delivery of transformative strategies and culture change

Beyond here and now

Innovating in respect to carbon management across our processes, technology and culture

Our commitment

We already have a strong track record of sustainability reporting and disclosure, having reported our GHG emissions for nearly 20 years. We have set and achieved multiple emissions reduction targets and in July 2021 we had four targets approved by the Science Based Target Initiative.

Our approved science-based targets are to:

- reduce absolute scope 1 and scope 2 GHG emissions by 42 per cent by 2030 from a 2020 base year;
- increase annual sourcing of renewable electricity from 95 per cent in 2020 to 100 per cent by 2023;
- have 66% of suppliers (by emissions, within scope 3 capital goods) having science-based targets by 2025; and
- reduce absolute scope 3 GHG emissions covering all other scope 3 categories by 25% by 2030 from a 2020 base year.

Our progress

We are already making good progress on delivering these targets and our footprint pledges.

From October 2021 all the electricity we purchase will be Renewable Energy Guarantees of Origin (REGO) backed green electricity.

We are progressing our journey to a 100 per cent green fleet by purchasing electric vehicles to replace smaller vans and cars, and by completing trials of biogas powered heavy goods vehicles.

We have established two tree nurseries and identified hundreds of potential sites for new and ‘replanted’ woodlands to support our pledge to create 550 hectares of new woodland by 2030.

We are confidently progressing on our pledge to restore 1000 hectares of peatland by 2030 with our ongoing partnership programmes to secure water quality and to ‘slow the flow’.

Climate change mitigation

VISION AND VISIBILITY

Demonstrating integrity and leadership in carbon reporting and disclosure.

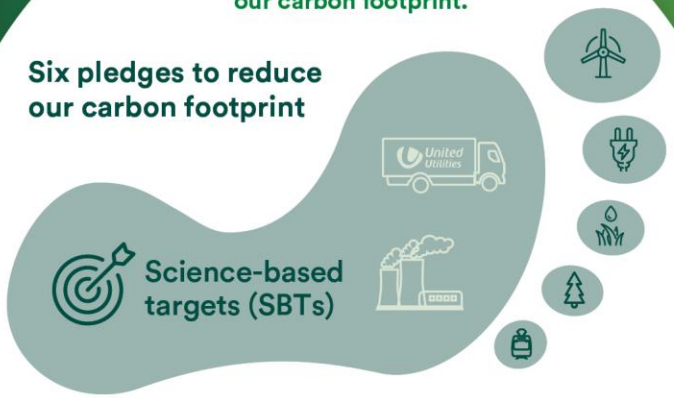
Carbon management is integrated into decision-making and driving decisions and behaviours.

Enhanced disclosure aligned to TCFD recommendations.

AMBITION AND COMMITMENT

Delivering ambitious commitments to mitigate climate change and lower our carbon footprint.

Six pledges to reduce our carbon footprint

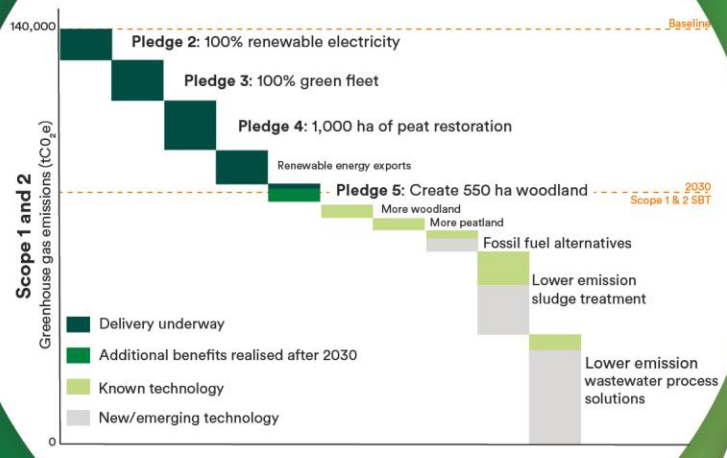


Pledge 1 Meeting SBTs for scope 1 and 2
2 100% renewable electricity by 2021
3 100% green fleet by 2028
4 1,000 ha peatland restoration by 2030
5 550 ha woodland creation by 2030
6 Set SBT for scope 3 in 2021

Net Zero 2030 Routemap: Unlocking a net zero future
(UK water industry)

DEMONSTRATING ACTION

Delivering consistent and prolonged reduction of our greenhouse gas emissions and other environmental impacts.



Delivery approach in our strategy to meet our climate change mitigation commitments

Science-based target to reduce scope 1 and 2 emissions by 42% by 2030
(from the 2019/20 baseline)

BEYOND HERE AND NOW

Innovation across our processes, technology and culture and beyond.

Beyond here: influencing others, collaboration with value chain.

Beyond now: innovative solutions for multi-capital benefits, questioning legacy standards and specifications.

3
Risks and opportunities

3.1 Managing risk

Successful management of risks and uncertainties enables us to deliver on our purpose to provide great water and more for the North West, and be more resilient across our corporate, financial and operational structures.

By recognising the causes and consequences of risks through the identification, analysis and evaluation of the individual and compounded risk, and the capacity and capability of the company to manage these, we are able to be proactive, prepared and prioritised.

In periods of adversity, such as during the recent weather extremes, risks become more likely to materialise. Thorough assessment of climate-related risks with respect to projected changes in the climate enable us to ensure our services will remain resilient through such adverse conditions as they worsen and increase in frequency.

Risk management is not just about adverse events happening, however, but also about realising opportunities. Looking ahead and considering the longer term is therefore fundamental. We combine this with an ongoing review of our processes and practices to ensure their effectiveness in an ever changing business environment.

Proactive and early action in the face of a changing climate enables us to maintain customer and stakeholder confidence; and ensure the company is resilient to change. In this sub-chapter we explore our risk management framework, and subsequently its integration with climate change considerations.

Our approach to risk management

Our risk management framework provides the foundation for the business to anticipate threats to delivering an effective service through a changing climate, 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.

Continuous improvement is a key feature of the framework which incorporates a maturity assessment model to identify areas to enhance. Based on risk management capabilities relative to five levels of maturity, a recent assessment has supported the development of a road map of improvements. These include an update to risk appetite statements, greater focus and analysis of cross-cutting themes and improved escalation of data from operational risk management systems.

How we identify and assess risk

We have a number of mechanisms in place to identify risk. These include a risk universe, cross-business horizon scanning forums, consultation with third parties and comparison with National Risk Registers.

Each risk is event based and is sponsored by a senior manager who is responsible for the analysis of the corresponding causal factors, consequences and the control effectiveness, taking account of both the internal and external business environment. This process determines the likelihood of the event occurring and the full range of potential impacts from a minimum (best case) to a maximum (worst case). Comparing this position against the desired target state, in combination with the strengths, weaknesses and gaps of the control environment, supports the decisions for further mitigation as appropriate.

This ongoing analysis culminates in the biannual business unit risk assessment (BURA) which forms part of the governance and reporting process to ensure consistency of approach and a true reflection of the risk facing the company. It also serves to calibrate the most significant risks from a financial and reputational context and to assess how these relate to our risk appetite.

Managing risk

Risk and asset planning framework

Risk and Asset Planning (RAP) is our business framework to identify operational risks and issues, identify and monitor strategic performance requirements, and prioritise these for investment or operational management. It aligns with the International Standard for Asset Management (ISO55000) embodying the principles of the Asset Management System.

RAP provides the framework within which we undertake options appraisal. Through this we identify, capture, quantify, validate, assess, prioritise and cost our risks in a systematic way. At each stage we review and filter out those risks for which there is insufficient evidence or materiality to warrant further resources. We have a tiered escalation process to review risks captured in the field.

The RAP framework brings together the elements of risk management and asset planning to help make informed decisions, manage and maintain accurate asset plans, and to provide the governance for our operational risk management processes.

RAP facilitates the identification of risks from operational teams and through our strategies and methodologies. Strategies address and balance customer priorities, statutory requirements and stakeholder expectations.

In a tier process, risks identified by operational teams are aligned with top strategic risks, prioritised and mitigated. This allows us to assess our systems in a structured way to identify asset resilience risks through a range of hazards.

This framework provides a foundation from which we manage our resilience through change, such as climate change, by applying mitigation plans to our risk assessments.

myRisk

The myRisk tool provides a common approach to the capture and assessment of operational risks across a wide range of financial and non-financial drivers. The system is an integral part of our Risk and Asset Planning (RAP) process, allowing risks to be identified and managed locally or escalated to the appropriate level. It is built around our latest value framework, our Risk Breakdown Structure (RBS), and is aligned to our KPI delivery to ensure consistency of approach.

A series of models utilise the data captured using myRisk. The model inputs are governed through the RAP framework and assured through peer review. This approach enables informed decision making underpinned by over 18,000 risks, identified and quantified using the myRisk tool. The models are flexible enough to cover investment requirements from across the business.

18,000 risks have been captured in the tool over the last three years, which ensures we have the most robust awareness of our business risks. Identifying and actioning risks with our approach enables us to propose suitable and informed adaptations to mitigate the risks sensitive to climate change.

Control and mitigation

Embedded in our business process is an objective, best practice assessment of the full range of mitigation options. Our process categorises control and mitigation options into four different types: directive, preventative, detective and responsive.

This categorisation lets us understand the focus of existing controls, both individually and in combination, and objectively target risk improvement.

These four control/mitigation types incorporate the four R's (Resistance, Reliability, Redundancy and Response and recovery) from Cabinet Office's 'Keeping the Country Running 2011' guidance, which sets out how resilience can be delivered.

Each control is assessed for its design and operational effectiveness to target specific improvement actions that represent best-value for money over the long term. In respect of our climate-related risks, our adaptation and resilience depends on our effective control of such risks.

Our approach to control and mitigation of risk is key to our long-term resilience, and so is thematic in our strategic approach and methodologies.

Systems Thinking

A system is a set of components that are connected and work together to serve a common purpose.

Systems Thinking involves learning about those individual components, whether human or digital, to understand how they interact, so that we can identify patterns and predict performance.

For a water and wastewater company, this means rather than operating an asset or treatment works in isolation, we use data from telemetry on our assets, along with knowledge about the wider environment in which we work, and digital advances such as artificial intelligence, to understand the bigger picture, predict where there may be issues, and make the best decisions.

This long-term commitment to understanding the bigger picture will enable us to better manage the impact of climate change on our end-to-end system, whether those impacts are as a result of components of the system that are managed by us or not.

Understanding how our end-to-end system performs in specific scenarios or environments will enable us to understand those areas of our service that are vulnerable to climate change in both the short and long term. Taking a proactive approach will ensure that we optimise resilience and are on the front foot when it comes to addressing challenges such as water supply, leakage, sewer flooding and pollution.

We know that flooding and droughts have become more prevalent across the North West and that they are the forerunners to longer-term climate change impacts. Taking a Systems Thinking approach to the management of our system, and using a variety of data sets, such as weather forecasts, has already allowed us to predict how our system will perform and therefore be more resilient to extreme weather impacts, and more proactively manage the impact on our customers.

Anticipate, React, Recover

The National Infrastructure Commission (NIC), through its publication **Anticipate, React, Recover, 2020**, highlights the need for a proactive approach to ensure the resilience of the UK's infrastructure to future challenges, including those resulting from climate change, disruption to energy and telecoms, and disrupted transport networks.

We support this approach and are integrating this into future strategy development.

Resilience in the round

There are three categories of resilience, financial, corporate and operational, each with their own sub-categories. Resilience in the round means being resilient across all of the component parts of these, understanding the connections and interdependencies between them.

This concept was presented by Ofwat as part of its Price Review 2019 (PR19) consultation document, and is something we have been aligning our strategy and programmes of work with as part of our continuous improvement.

We commissioned an independent assessment of our **resilience in the round by Arup**. Arup benchmarked us based on its experience of working across the sector, and its assessment of our plans shows that we are focused on proactive actions to prevent issues before they arise.

In conclusion Arup said that "in many areas, United Utilities is leading the industry in their approach to risk and resilience".

"...in many areas, United Utilities is leading the industry in their approach to risk and resilience"
Arup

3.2 Climate-related risks

Our risk assessment

For our first adaptation report a comprehensive risk assessment was undertaken, utilising industry best practice to assess our strategic risks. This was based on UKCP09, the most up-to-date climate projections available at that time.

Since then UKCP18 has been published, and we have made significant progress across a range of climate-related planning activities, including drought planning, improving resilience to flooding and freeze-thaw events. We have improved strategic planning for wastewater and drainage, incorporating UKCP18 into some of these plans, and this will continue to evolve in future planning cycles.

We recognise that climate change impacts all areas of our business, and that the extent of this impact is ever increasing. In order to address this, we have continued to advance our climate risk assessment.

With comprehensive discovery at its centre, promoting climate change discussions across the business and with interdependent third parties, we have established a comprehensive insight into the risks we must continue to address.

Our risks have been scored based on their likelihood, based on a 2050 horizon and impact, across our values framework.

Climate change in risk

Climate-related risks are managed through our embedded risk management framework and across our governance and reporting processes. Our approach helps to ensure the identification, assessment and management of climate change risks, to reduce impact and likelihood while maximising opportunities.

Our mitigation metrics are aligned to limiting global temperature rises to 1.5°C. Adaptation metrics account for the risks and uncertainties associated with this, the global climate goal, and with higher temperature rises (including 2°C and 4°C), as well as how the many potential variations in climate change impact the delivery of service improvements. Targets are set with risk and uncertainty included.

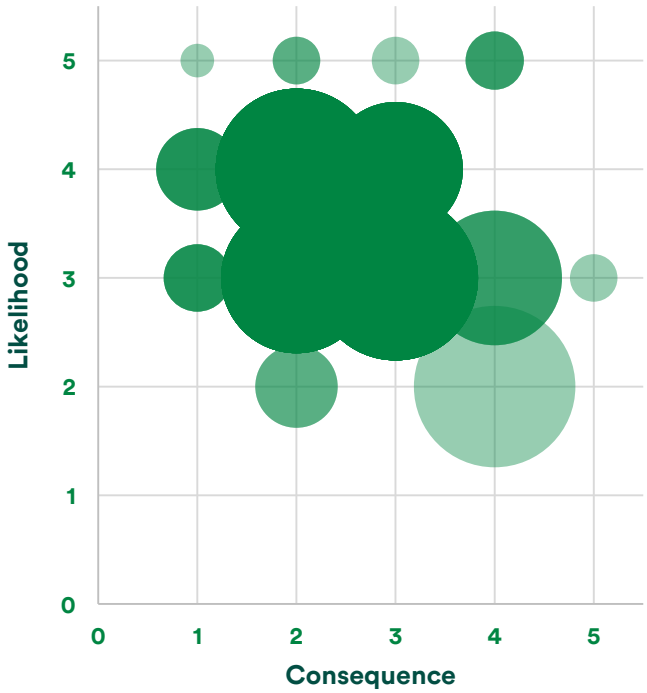
While the most significant climate-related risks are physical risks, transition risks are also managed through our risk management framework.

Our risk assessment has been applied to over 100 climate-related risks, and has identified a set of key risks to undergo further investigation considering current controls under scenarios to 2050 and 2100.

By embedding this assessment within our corporate risk framework, we further raise the profile of climate change adaptation and provide the board with enhanced insight into climate risks from within existing risk management processes. It highlights where climate risks are not well understood or where existing controls are deemed inadequate to manage the risk in the long term to allow corrective action to be taken.

Of the identified key risks, those found to be most impactful to the service we provide to customers have been presented as part of our customer research, and each of our most significant climate-related risks are explored in this chapter.

Climate-related risk score distribution from Appendix – A.1



Climate-related risks

Modelling for climate change

Many of our climate-related risks are subject to complex modelling which incorporates the impact of climate change and the associated adaptation options in our long-term plans.

Our 25-year Water Resources Management Plan is a sophisticated example of a climate change risk assessment. We've worked with the Met Office for many years to understand how weather metrics, like temperature and rainfall, affect the consumption of water by customers. We understand the likely fluctuations in how our supply system responds in different circumstances, defining the headroom required to take into consideration climate change uncertainty using the latest UK climate projections and drought indicators.

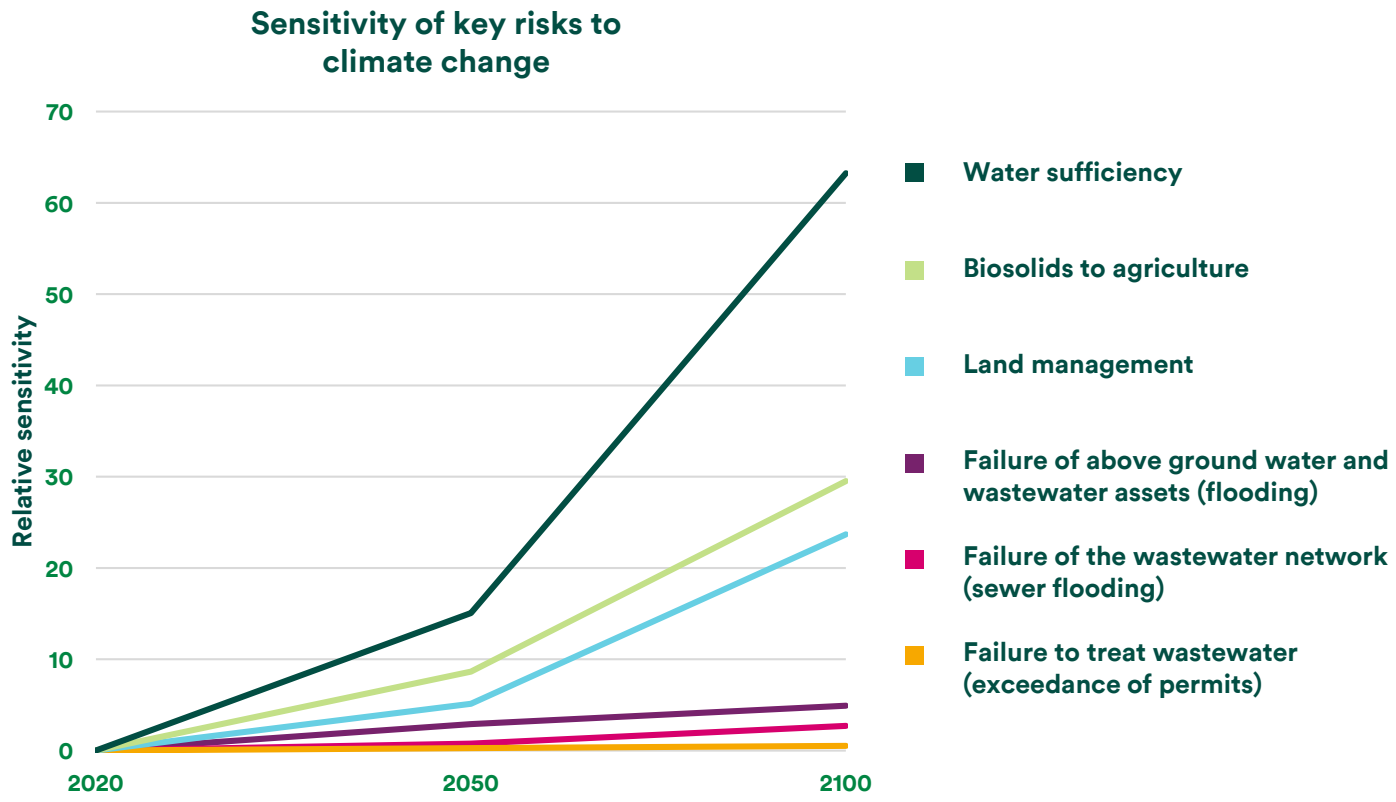
Our plan considers how resilient our water supply system is to a host of non-drought hazards related to climate change, including flooding, freeze-thaw, contamination, asset failure and power failure. We are planning a programme of work to improve resilience across the next 25 years.

Our Drainage and Wastewater Management Plan is being developed to assess climate change scenarios for sewerage planning as part of our adaptive planning.

Incorporating longer-term impacts into our corporate risk assessment process has been completed for our most significant climate risks.

The graph below illustrates the outcomes of that risk assessment, in terms of those identified as having the highest sensitivity to climate change.

Each of our highest scoring risks, in terms of impact and likelihood, are visited in this report, detailing the risk, the impact to customers, and our action to address them.



The water supply system in the North West is dominated by surface waters (lakes, reservoirs, and rivers) and is reliant upon seasonal rainfall patterns to ensure supply resilience. We have key reservoir sources in the Lake District, Pennines and North Wales. Water quantity and quality is protected by the careful management of over 56,000 hectares of owned catchment land and many thousands of hectares of non-owned land. Ecosystem resilience in these catchments is fundamental to securing plentiful water supplies and excellent water quality.

Our water treatment and distribution system is extensively integrated, meaning that water can be moved around our region to provide resilience to water sources, asset outages (planned and unplanned) and higher than usual demand for water.

All water companies are highly susceptible to climate change. It effects not only the reliability of our raw product but also modifies customers' use patterns, with droughts impacting source replenishment and increasing demand. This susceptibility is more acute where companies have a high dependency on surface waters which are more quickly impacted by prolonged dry weather periods compared to ground water sources.

We recognise and are adapting to the challenge of a changing climate. To provide a reliable supply of water now and in the future, we must address the threat of increasing temperatures, evaporation, and demand for water (population and consumption) contrasted by decreasing summer rainfall, and stresses on our assets.

Water sufficiency

Water sufficiency

Extended periods of lower than average rainfall reduces the amount of water we have available to use. Since such dry weather periods usually occur during the summer months, the impact can be compounded by the demand for water, soil moisture level, and the loss of water to evaporation being higher.

Due to the effects of climate change, we expect the frequency and severity of summer dry weather to increase, in contrast to the wetter winter periods we will also be facing.

Impact on customers

With the increase in frequency of water sufficiency events and drought, customers are at risk of experiencing:

- poor pressure;
- loss of supply;
- increased frequency of temporary use bans;
- water quality issues; and
- taste/odour/discolouration issues.

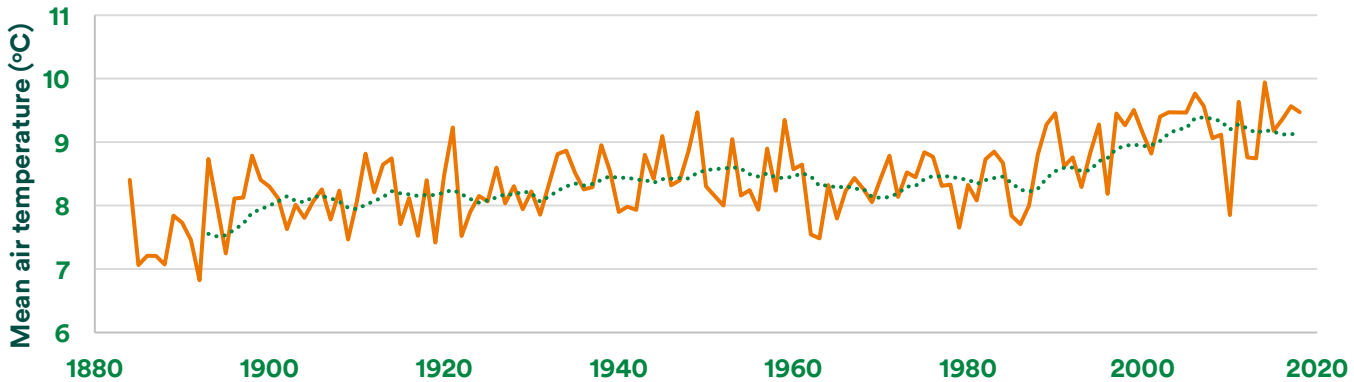
Impact from climate change

The UK has warmed by more than 1°C since pre-industrial times and the likelihood of hot summers has doubled. We are experiencing this in the North West where average annual temperatures are around 1.3°C higher in the 21st century compared with the last decade of the 19th century, with some monthly averages demonstrating an increase in temperature by as much as 2.4°C. These increasing temperatures lead to more frequent drought conditions and an increase in water use across the region.

While these changes are already taking place, and the frequency of heatwaves has been increasing, the rate at which temperatures are increasing has also been found to be accelerating.

The rate of temperature increases is higher, with increases over the past 30 years being higher on average than for those over the past 50 years. These in turn are higher than those over the past 150 years. This is a pattern of acceleration that is predicted to continue without significant reduction of global greenhouse gas emissions.

HadUK - Annual average temperature in the North West



Our Drought Plan

Our Drought Plan outlines our approach to managing water supplies to make sure there's always enough water available for customers across the North West during drought conditions.

We are currently developing our Drought Plan 2022, which considers the impacts of climate change as a key influence on future raw water supply. The draft Drought Plan was published in April 2021, and revised in July 2021, ahead of finalisation in 2022.

Our Drought Plan is now more operationally focused, shorter and easier to use for customers, stakeholders and regulators. Supporting this, customer and stakeholder communications have been completely revamped to ensure we have an industry-leading approach to communicating with customers in the event of drought, to reduce demand.

We have stress-tested our plan under many different future scenarios to ensure we are resilient over the coming years. We have invested in our supply side drought options to have them always available, minimising the time it takes to bring them online during dry weather conditions. This has enabled us to react quicker and made us more resilient during dry weather.

We are investing in further supply side options and reducing demand through leakage and water efficiency; this has reduced the likelihood of requiring drought permits and temporary use bans.

In agreement with the Environment Agency we have realigned our drought levels, ensuring:

- consistency with the rest of the water industry allowing easy comparison during dry weather;
- reduced frequency of passing drought levels; and
- removed drought permits with high environmental impact

There is further information on **our Drought Plan** on our website.

Water Resources Management Plan (WRMP)

The Environment Agency Water Resources Planning Guidelines Supplementary Guidance on Climate Change provides high-level guidance on incorporating UKCP18 in to the WRMP24 plans. The guidance indicates that UKCP09 are still valid but in water resources zones with significant risks, updated assessments are required using a number of UKCP18 data products. We are adopting advanced modelling approaches to assess the impacts of the new projections.

Managing water sufficiency

WRMP climate change assessments: The three factors that influence supply-demand balance – water availability, dry weather demand and headroom – are impacted by climate change.

Supply: With hotter and drier summers more common under a changing climate, the amount of water available to abstract for water supply decreases. Climate change is also a major component of headroom, which accounts for uncertainties in the water resources plan. Hotter, drier climate change scenarios will generally trigger earlier investments in supply and demand side schemes and will influence the feasibility of strategic regional and national transfers.

Demand: Under a warming climate and growing population, overall water demand is anticipated to increase, even when accounting for potential improvements to water efficiency. Impacts on demand in other sectors, like energy and manufacturing, could have knock-on effects for water availability and allocation at a catchment scale.

WRMP19/24 Drought resilience: In WRMP19, we based our water resources planning on the objective to be resilient to a 1 in 200 year drought. A significant step change is required in WRMP24, where we will be planning for resilience to more extreme droughts, with a return period of 1 in 500 years by 2039.

Water sharing

We created and lead the regional water resources group Water Resources West, which covers four of the eight largest city regions in the UK, including several iconic National Parks.

We look more broadly than just our own company boundaries to understand the pressures on water resources from a changing climate in conjunction with environmental and economic needs. By working with other water companies and other sectors which abstract water, we are exploring the risks and opportunities for shared catchments and shared water resources. We are also sharing best practice for climate assessment and other aspects of water resource planning.

Our new understanding of the spatial coherence of future climatic events allows us to explore opportunities to improve resilience across different parts of the UK by developing new shared water resources. A key feature of ongoing WRMP plans are Strategic Resource Options (SROs) that include options to move water from the North West to parts of England with greater water scarcity.

Managing water sufficiency

West Cumbria link to Thirlmere

As part of our WRMP15 we identified a future supply-demand deficit in the West Cumbria Resource Zone and so we are delivering a major pipeline transfer scheme to address it.

We recognised that in developing a solution to this problem we needed to look more broadly at the risks and emerging trends impacting West Cumbria and ensure that we came up with a solution that enhanced the resilience to other threats too. The chosen solution is a transfer scheme that involves using Thirlmere reservoir as the new source to supply drinking water for homes and businesses in West Cumbria, via a new pipeline and water treatment works. This means that as well as the provision of a more resilient water resource for West Cumbria we are providing:

- support for the Britain's Energy Coast economic strategy, allowing for more water to be available than is currently forecast; and
- opportunity for abstraction from other existing sources in West Cumbria to cease, and return those habitats to more natural conditions.

Community involvement and stakeholder engagement has been central to the development of our water supply strategy for West Cumbria. This is the single biggest project to go through the Lake District National Park in recent times and every area the pipeline passes through has a multitude of designations and uses. We needed to be innovative in our approach and take the communities of Cumbria with us on the journey.

We recognised that co-design with the stakeholders in Cumbria was key to the success of the project and the role that the company has in Cumbria as a major landowner and supplier of essential services was critical. The use of our local team helped develop and build on existing relationships and fully understand what was really important to local communities and stakeholders. These relationships have continued into the implementation of the scheme and the reinstatement and monitoring phases.

The project is a great example of 'co-imagining' with customers and stakeholders. We were clear from the outset that local communities and stakeholders would be encouraged to have their say on any plans – a key aspect in partnership working and the universal key to understanding and controlling climate change.

Haweswater Aqueduct Resilience Programme

The Haweswater Aqueduct was built between 1933 and 1955, and is a major feat of engineering – stretching 109 kilometres from Haweswater reservoir in the Lake District to Bury in Greater Manchester and serving 2.5 million people for over 80 years.

In 2005 we began preparations to carry out inspections of the single line potable sections of the aqueduct (52 kilometres of the total length). In 2013 engineers found areas of concern that posed a potential future risk to both water quality and supply resilience. Action was taken straight away to carry out essential maintenance work to the worst affected areas but it was clear that more work was needed. In 2016 we conducted a second inspection, with the aim of carrying out additional necessary repairs, and to complete a more detailed analysis of the condition of the assets to determine the remaining asset life.

Following the inspection in 2016 it was determined that a long-term solution was required to secure the resilience of the potable water services and a programme of work, the Haweswater Aqueduct Resilience Programme (HARP), was initiated to explore and develop solutions.

Research determined that the preferred solution for customers and stakeholders was replacement of all six single line potable water tunnel sections of the aqueduct (52 kilometres). This will ensure a resilient and enduring water supply for years to come.

In November 2020 the first major milestone was reached in HARP. We bypassed the single highest risk section of aqueduct near Kendal despite storms and the COVID-19 pandemic. The next major milestone is the tendering of the project of work to replace the remaining sections, which is due to begin in early 2022.

We deliver an effective wastewater service by collecting over 3708 million litres of used water every day, from flushed loos to emptied sinks, showers to dishwashers. We transport the used water along 78,000 kilometres of pipes and sewers to one of our 568 wastewater treatment works, where it is cleaned up and safely returned to the sea and rivers.

Climate change will result in an increasing frequency and severity of rainfall events. This will increase the amount of flow entering our sewage network, creating a higher risk of the drainage systems being overwhelmed.

Increased rainfall (storm) events can result in severe sewer flooding. The frequency of such events is predicted to increase significantly under most climate change scenarios by 2100. For a storm of such intensity that it is estimated to occur only once in 50 years (a return period of 50 years), 15 per cent of our region is currently at risk of internal flooding. By 2050, 20 per cent of our region is expected to be impacted, rising to 29 per cent by 2100.

Sewer flooding

Sewer flooding

The majority of sewers in the North West carry storm water as well as sewage. This means that when there are intense storm events, or incidents of prolonged severe weather, the sewers may become completely full of water creating a risk of sewage flooding out onto the ground or even inside homes and businesses.

Sewer flooding is often caused by blockages from sewer misuse, where unflushable items (such as wet wipes), fat, oil and grease clog up the network. Blockages are more likely to occur in dry weather periods due to the lower flows in the sewers. The combination of blockages and the more frequent, intense rainfall as climate change increases seasonal variation is therefore amplifying the risk of sewer flooding.

We recognise that flooding of sewage into homes and gardens is absolutely unacceptable, and so we work hard to prevent sewer flooding. It currently occurs for around 4.47 homes per 10,000 sewer connections.

Impact on customers

Increases in average winter rainfall levels and severe rainfall events due to climate change will make this an ever more unpredictable and complex challenge, and could lead to increased frequency of sewer flooding, including:

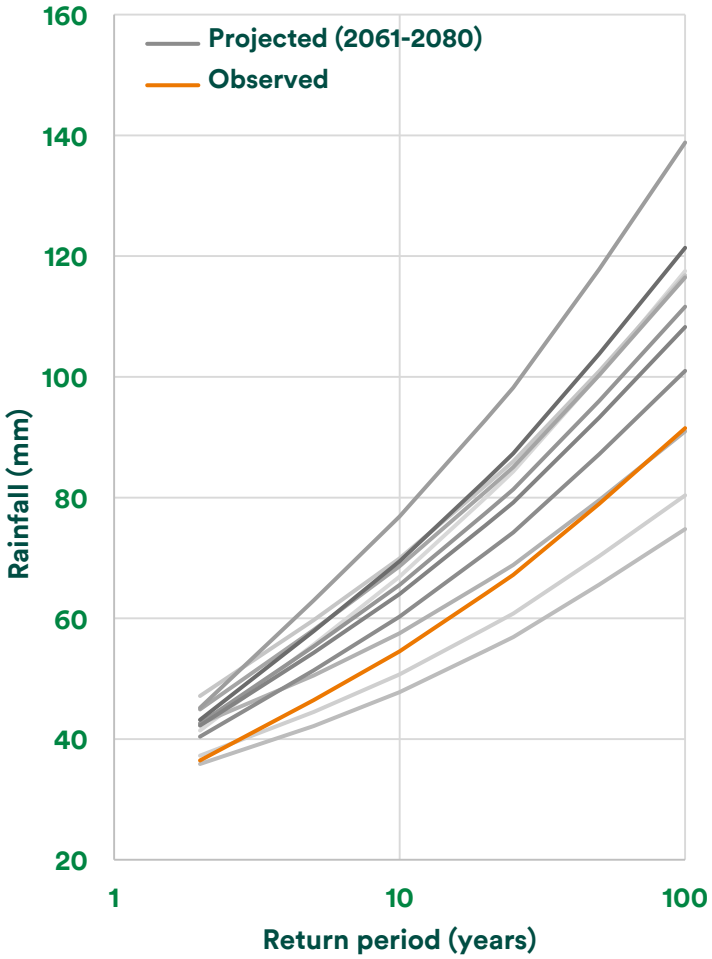
- sewage flooding in the home or in gardens;
- sewage flooding into driveways, roads, footpaths, rail services; and
- customer service phone line disruptions.

Impact from climate change

UKCP18 trends are showing an increase in extreme rainfall, predicting the risk of sewer flooding to become ever more present. We have recently experienced this impact, as five of the 10 wettest years for the North West since 1884 have occurred between 2000 and 2018.

Seasonal changes in the North West are projected to be greater than for other regions across England and Wales, with much wetter winters. A 1 in 100 year rainfall event in the period 1981–2000 is projected to become a 1 in 50 year event in the period 2061–2080.

Extreme daily rainfall return periods



Observed 24-hour heavy rainfall event return periods (1981–2000 period) in amber. Grey lines show possible return periods accounting for climate change using factors from UKCP18 (2061-2080 period).

Managing sewer flooding

Drainage and Wastewater Management Plan

As part of our strategic planning for the future we have developed a comprehensive long-term drainage and wastewater planning approach.

Following the UK government's draft Strategic Policy Statement to Ofwat in 2017 and subsequent Ofwat PR19 methodology, the Drainage and Wastewater Management Plan (DWMP) framework was published in late 2018.

This sets out a high level approach for producing a long-term plan which sets out how we will maintain a robust and resilient drainage and wastewater system in light of pressures such as climate change.

To develop the plan we have modelled the impact that changes have on our system to understand future risk and performance through baseline risk and vulnerability assessments (BRAVA). We have stretched beyond the framework to provide us with our best ever understanding of sewer flooding risks, and the potential implications for managing sewage sludge.

We are now developing options to mitigate the impact and address issues. Key to the development of this plan is our engagement and partnerships, covering local flood authorities, customers, local planning authorities, catchment hosts and the Environment Agency. Our first draft DWMP will be published in June 2022, followed by the final DWMP in March 2023.

Dynamic Network Management

We have developed an enhanced approach to the drainage strategy framework, which builds on understanding developed though our active involvement in the WaterUK 21st Century Drainage Programme. This enables us to understand more comprehensively the operation of our drainage networks and address key issues to support the development resilient drainage.

By gathering information on all the areas which drain to a treatment works, we apply a comprehensive risk assessment and then use a collaborative approach to define the plan. As we get information on local development, this can be fed into our models to understand the impact the development has on our sewer flooding risk.

Our recently improved asset modelling tool, Pioneer, allow us to understand where we are likely to see deterioration in service from our network, using over 30 factors, such as sewer age, material and gradient.

This predicts where we have higher risk levels of incidents such as a blockage, the main cause of sewer flooding. By following this approach we build up an in-depth understanding of a drainage catchment and collate a detailed list of risks.

This approach involves input from across the company, including our strategy, engineering and operational functions, working cohesively to develop a collaborative plan to mitigate risks.

We have validated the approach through a series of investigations and trials. This has enabled us to prevent sewer flooding in people's homes, year on year, and reduce pollution incidents. This methodology has been key to the development of our Dynamic Network Management (DNM) approach. This involves the latest sensing technology and machine learning neural networks, which has unlocked a pre-emptive approach to wastewater network problems.

Dynamic Network Management delivers a Systems Thinking capability to our operational teams. It involves:

- collecting data from our assets, third party assets and the environment;
- real-time transfer of that data to a central location; and
- applying descriptive, diagnostic and predictive analytics.

The DNM approach involves applying machine learning to vast amounts of data from over 20,000 locations across the region, covering sewers, outfalls and pumping stations. The new platform identifies any deviation in performance and correlates this to the location and rainfall conditions to generate alerts for review and action by our performance teams.

Climate change is one of the principal reasons that DNM has been developed. The ultimate goal is to use the DNM capability to understand the connected network, and how it responds to changing demands from the environment. The objective is to use DNM capability to drive continuous improvement in customer services and environmental performance.

This will enable us to become proactive in our approach by identifying problems and addressing issues, such as those that arise from ever increasing storm conditions, before they affect customers.

Managing sewer flooding

Street trees

In 2015, in partnership with City of Trees (CoT), The University of Manchester and other associated partners including EU LIFE Natural Course, we undertook a project to explore ultra-urban green infrastructure that involved:

- trees being planted on streets across Salford, Eccles and Bury;
- run off collected through slot kerbs;
- trees installed in a three-layer pit system; and
- monitoring flow for volume and quality at the inlet and outlet of downstream treatment works.

The University of Manchester is undertaking a long-term academic study on the impacts of these solutions to inform us on the performance over an extended period of time. This will enable us to learn about how effective the solutions are and how they can be applied to other areas, not just within Greater Manchester but across the region.

We identified an average flow rate reduction of 70 per cent through summer 2016, and a 98 per cent reduction in outflow during a storm on 25 June 2016. Such successes feed into our understanding of how natural flood management can reduce the amount of storm water running into our sewers, helping us to adapt to the effects of increasing winter rainfall and reduce flooding incidents.

Ongoing engagement shows that customers have a preference for us using green infrastructure interventions where possible, which benefit the wider community and the local environment. We have embraced working in partnership with a range of stakeholders, including local authorities, developers and the Environment Agency. We are assessing the natural capital benefits of our interventions.

Award-winning sustainable garden at the 2021 RHS Tatton Flower Show

Sustainable drainage systems

One way we take care of rainfall is through Sustainable Drainage Systems (SuDS). These are planted and constructed features that slow down rainwater runoff, mimicking natural drainage. By utilising SuDS, we can help mitigate flooding risk, improve water quality, and protect the environment.

When it rains, the water soaks into the ground, or moves through the soil as groundwater. Once the ground is wet, the water will run off and be collected by ditches, streams, ponds or rivers. When it stops raining, water evaporates from the soil's surface and is absorbed into the ground.

Case Study: SuDS

Work has been completed on the installation of a ground-breaking climate and water resilience research roof in the heart of Manchester.

Sited on Bloc – a city centre workspace that has been transformed by Bruntwood Works as part of its £50m Pioneer redevelopment programme – the blue-green roof from Polypipe Civils & Green Urbanisation will help to develop a greater understanding of how new construction and technology can help cities and urban developments to mitigate the impact of climate, while enhancing biodiversity.

Over the next two years, the 'smart' blue-green roof, designed by environment management consultants EPG, part of the STRI Group, will allow us, as co-funding partners, to assess how storing and re-using rainwater at roof level can reduce the volume of surface run-off entering its sewer network.

We promote the installation of SuDS through demonstrations such as our award-winning Garden of Resilience at the 2021 RHS Tatton Flower Show. We are leading the way in demonstrating how customers can make changes to play their own part in improving resilience through sustainable drainage.

SuDS is just a small part of the wider Catchment Systems Thinking (CaST) approach – managing catchments in a holistic and integrated manner in partnership, looking at the wider environment to create mutual benefit for the environment, customers, and communities.

We are already observing these benefits by being a key partner in projects such as Natural Course and IGNITION, where we find new ways to improve the environment and communities that we live in.

Each of our 568 wastewater treatment works play a crucial role in protecting the water environment from pollution. These works vary significantly in size, process type and age. The effectiveness of the wastewater treatment process can be influenced by many factors, including population growth, increased summer tourism, asset health, tightening of consents and extreme weather events, exacerbated by climate change.

The increased frequency and severity of intense rainfall events can inundate the sewer network and treatment works, or cause outfalls to block and river banks to erode.

Increasingly common dry periods, however, can lead to stronger concentrations of crude sewage in the network with less dilution from surface water. Since this would be expected to occur while river levels are low, the impact of pollution is compounded. Warmer temperatures in rivers and lakes will also lead to lower oxygen levels impacting the aquatic ecosystems and making them more sensitive to discharges from our systems.

Failure to treat wastewater

Treatment capacity

If an area experiences particularly heavy rainfall, the kind we have seen more often in recent years, our wastewater treatment works may have insufficient capacity to treat the higher flow volumes.

Average annual water run off in the North West is 28 per cent higher than the average for England and Wales, which means more water requires treatment. We also have a significantly higher proportion of combined sewers than any other water company, and so more of the storm water makes its way to our treatment works, putting pressure on treatment capacity.

Under strict regulatory conditions, which includes flows being in excess of treatment capacity, we utilise combined sewer overflows (CSOs) to enable excessive flow of storm water mixed with sewage to be discharged into the environment. This is to prevent flooding of assets, streets and homes due to finite treatment capacity.

A collaborative multi-agency approach is essential to the effective management of this climate risk, working with key stakeholders such as the Environment Agency, planning authorities and the highways authorities. The new approach to DWMPs provides a cyclical framework to ensure continual improvement through short and long-term plans, supported by the Water Industry National Environment Programme (WINEP).

To inform our DWMP and better understand the impact of failure to treat excessive flows, we have committed to conduct 195 investigations by 2025. Through the sector's Green Recovery programme, we will investigate a further 300 overflows, helping us to understand their environmental impact and identify solutions to inform future business plans.

Impact on customers

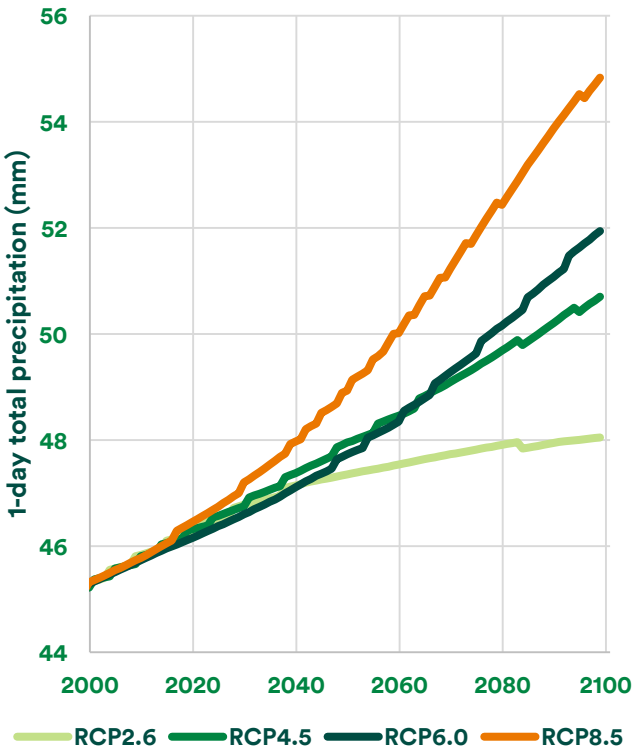
Climate change could lead to an increased frequency of failure to adequately treat wastewater, causing an increased risk of pollution to rivers and coastal bathing waters. This can have a negative impact on:

- customer experiences of blue spaces, impacted by the sight and smell of sewage discharge; and
- local ecology and water quality.

Impact from climate change

Projections from UKCP18 across the range of regional climate models show a clear increase in rainfall during weather extremes. For the RCP8.5 scenario, extreme daily winter rainfall at the 1 in 100 year return period is expected increase by 10 mm from the baseline (1981-2000) by 2100.

Single day rainfall projections



Failure to treat wastewater

Davyhulme modernisation

Our largest wastewater treatment works is Davyhulme, which serves the city of Manchester, and throughout its 100 year history has pioneered the innovative and resilient treatment of wastewater.

Innovation has been at the heart of resilience for Davyhulme. In 2013, the world's largest thermal hydrolysis plant was commissioned, using a new process to break down sludge. This in turn releases more methane as a by-product, which is captured and used for renewable energy generation. This enabled the site to become self-sufficient for gas and electricity, vastly improving its resilience to any power outages that may be caused by storms as a result of climate change.

In 2018, one of the activated sludge plants was replaced with a fully nitrifying activated sludge plant. This modernisation resulted in the effluent performance improving, and gives the site greater resilience to variations in flow that are often associated with heavy rainfall.

These robust and resilient innovations are designed to meet the needs of today and prepare for the demands the future may bring. With Manchester being one of the fastest growing cities in Europe, we will need to continue to adapt to the changing community that Davyhulme serves.

Ribble and Wyre catchment investigations

We have contributed £1.5 million to an initiative working with the Ribble and Wyre Rivers Trust, Natural England and the National Farmers' Union to investigate sources of pollution that could be impacting bathing water quality across the Fylde peninsula area.

By reviewing the impact on the Ribble and Wyre estuaries from 30 priority farm properties with the assistance of the Rivers Trust, we are able to identify opportunities for multiple benefit solutions and catchment wide interventions to the benefit of water quality.

The scheme has attracted a lot of interest from farming communities to support in the project. Farmers have used matched funding grants to, for example, fence off the watercourse from livestock, build a wetland to treat a discharge from slurry store and install wash down facilities on farmyards.

These changes will all contribute to the long-term improvement of the bathing waters, and provide a sustainable, systems approach to ecosystem resilience.

Blackpool South Surface Water Strategy

We have invested over £30 million to address the combined challenges of climate change, an aging Victorian sewer network, increasing urbanisation and a responsive catchment in Blackpool.

The aim of the project was to reduce the frequency of which excess flows from storms result in untreated storm water mixed with sewage discharging into the environment.

The primary objective of the project was to separate surface water from the combined sewer system. New infrastructure was constructed, including a storm water interception tank, pumping stations, and a new sea outfall to provide a sustainable discharge point for surface waters. This removed over 800,000m^3 of surface water from the combined sewer system that otherwise would need to have been treated at our wastewater treatment works in Fleetwood.

By diverting the surface water away from treatment the effects of storms and the resulting excess volume of surface water have been significantly reduced.

This reduces the chances of storm water making its way to our treatment works, putting pressure on treatment capacity, and ultimately resulting in reduced frequency of failure to treat occurrences.

Failure to treat wastewater

Morecambe catchment strategy

Over the last 25 years we have spent £1 billion improving the region's bathing waters. A part of this investment has been our £72 million project in the Morecambe area of Lancashire to improve bathing waters and the resilience of our wastewater assets.

The Morecambe system collects at Schola Green Wastewater Pumping Station located in the west end of the town. From there, flows for treatment are pumped across a 6km long pipeline to Morecambe Wastewater Treatment Works. Both locations have outfall pipelines running into the sea at Morecambe Bay. The Schola Green outfall is a storm overflow, and so is operated infrequently during adverse weather conditions, while treated final effluent is discharged from the Morecambe outfall.

This project has been designed to improve the quality of the bathing waters around Morecambe Bay, by limiting the numbers of spills from Schola Green to no more than two per bathing season, which runs from 15 May to 30 September, and ten per year.

To further ensure that discharges of storm water and sewage are diluted to protect the local environment, a tidal pumping system has been introduced at the treatment works, ensuring discharges only occur when the outfall is fully submerged at high tide.

This project has improved bathing water quality in Morecambe Bay, the UK's largest expanse of intertidal mudflats and sand, and provided resilience to climate change, and to meeting future demands associated with population growth.

Sewage sludge is a renewable resource produced as a by-product from wastewater treatment. The safe treatment and recycling of sludge is a critical part of our service to customers and the environment. Typically, sludge is treated using anaerobic digestion, resulting in biosolids which are used for renewable energy, and are mostly recycled to agricultural land.

The recycling of biosolids to land is an inherently vulnerable activity as it relies on access to third-party land. This vulnerability may be exacerbated by the impacts of climate change. There are several key risks from climate change that we have identified, which must be addressed to support a resilient and affordable bioresource service into the future. In support of this we are continually working to improve the quality of the biosolids product we produce and recycle, and engage with the farming community to ensure sufficient land is available for recycling.

The bioresources sector is undergoing a period of significant regulatory reform. This may result in changes to bioresource operations, influencing how climate change impacts our activities. We will assess and plan for climate change adaptation within our bioresource strategy to ensure that we continue to deliver a resilient service. We will further use competitive markets for biosolids treatment and disposal to support our adaptation to the impacts of climate change, and other drivers such as population growth and enhanced environmental quality standards.

Biosolids to agriculture

Recycling biosolids

Our wastewater treatment process currently produces around 200,000 tonnes of dry solids of sludge annually. There is a growing recognition of this sludge as a commodity from which valuable energy and nutrients can be recovered. As such, we increasingly treat sludge using advanced anaerobic digestion to recover greater quantities of renewable energy, while producing a higher quality biosolids product to recycle to agriculture and ensure that the value recovered is maximised.

As the lowest cost and most sustainable option for biosolids disposal, our current company strategy is to recycle 100 per cent of biosolids to land. Recycling of biosolids to land supports circular economy principles, avoiding waste and keeping the valuable nutrients in biosolids in use. Organic inputs to agricultural soils provide multiple benefits, such as increased water retention, increased microbial activity and increased soil nutrients, and supports the agricultural sector's net zero carbon ambitions.

Sludge to land activities rely on access to third-party land, the weather, and customer demand from land managers to use our biosolids in agriculture. We can only influence these factors to a limited extent.

Furthermore, other drivers such as population growth and enhanced environmental quality standards are increasing the volume of sludge produced by our business.

Impact from climate change

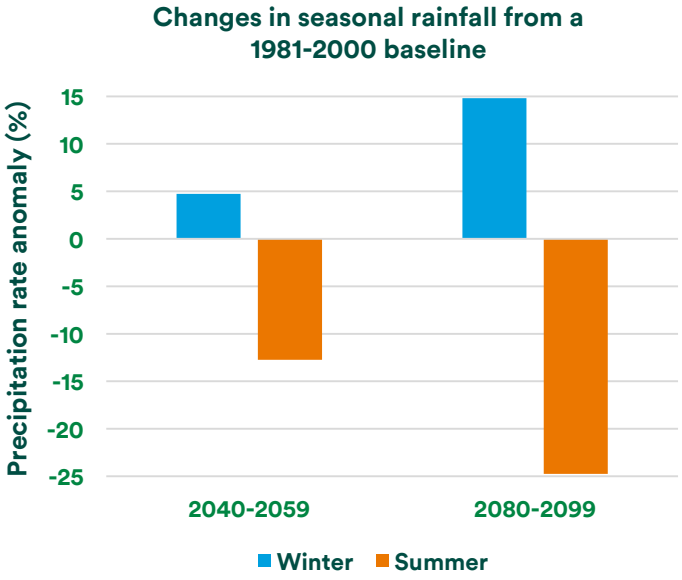
Climate change is bringing wetter weather in the winter. This poses a risk to recycling biosolids to agriculture, as waterlogged fields, which will increase in likelihood in the future, cannot be used for biosolids recycling.

This waterlogging of fields has several impacts on biosolids recycling to land:

- Reduced reliability for biosolids recycling;
- Increased risk of pollution events from prolonged use of stockpiles; and
- Increased use of alternative, higher cost and less sustainable outlets for biosolids disposal.

Biosolids use is also impacted by prolonged dry periods and shifting weather patterns, as this impacts the agricultural calendar. This may influence demand due to changing land use, or types of agriculture predominant in the North West.

We are developing our contingency plans to deal with these adverse weather events to ensure that we maintain a reliable biosolids outlet and can safely and effectively stockpile biosolids. Contingency measures include seeking alternative recycling outlets or increasing our storage facilities to manage short-term weather impacts.



Precipitation rate anomaly from UKCP18 RCP6 projections.

Managing biosolids

Retaining a resilient outlet for biosolids disposal and recycling

Farming in the North West is characterised predominantly by livestock and mixed crop farming. Over 82 per cent of the agricultural land in the North West is grassland. In practice, grassland needs an enhanced standard of biosolids to satisfy best practice nutrient management needs. We continue to increase the amount of enhanced standard biosolids (opposed to conventional standard) that we produce to access a greater proportion of grassland to recycle biosolids, and avoid the need to increase transport distances to find suitable agricultural land.

Sustainable land management is vital to making sure we have sufficient land for recycling biosolids in the future. Our Agricultural Services team have Fertiliser Advisers Certification and Training Scheme (FACTS) qualifications and are able to provide agronomical knowledge and data records around nutrient content of soils to farmers. This free service helps to strengthen partnerships and confidence in the biosolids products we provide.

We have implemented the Biosolids Assurance Scheme (BAS). The purpose of this is to provide food chain and consumer reassurance that BAS Certified Biosolids can be safely and sustainably recycled to agricultural land.

BAS certification enables us to increase our access to agricultural land bank and, alongside our improved nutrient advice service to land managers, it helps ensure a resilient outlet for biosolids recycling.

Low carbon energy supply

Bioresources has a key role to play to enable us to meet our ambition to achieve net zero carbon by 2030. Sludge from wastewater is treated through digestion processes to produce biogas, which can be used to generate renewable energy in combined heat and power engines or supply green gas to the National Grid.

Energy generated can be used on site to power wastewater treatment works and any surplus is exported to the National Grid. Managing bioresources in this manner ensures a secure and resilient power supply at many of our largest wastewater sites, reduces our carbon emissions, and provides financial value through electricity and gas markets.

Managing biosolids

Regional Sludge Operational Management

Our Regional Sludge Operational Management (RSOM) has delivered a step change in operational performance. We manage sewage sludge as a regionally integrated system, moving sludge between wastewater treatment works and sludge treatment centres to treat and dispose of it in the most efficient way.

We have established a regional operational management plan, co-ordinated by a regional sewage sludge production planning team in our Integrated Control Centre which drives decision making and Systems Thinking to optimise service. This has allowed us to become an intelligent and efficient bioresource business with clear relationships across the wastewater production line and with third-party service providers.

We are now able to use data from our treatment facilities and the environment to better understand the end-to-end system and use this insight to effectively plan both operationally and strategically.

During the current business plan period we have been working to improve the resilience of our asset base through a Throughput, Reliability, Availability and Maintainability (T-RAM) initiative. This will provide greater sludge treatment resilience and unlock sludge treatment capacity at our facilities.

Innovation and the future asset base

We recognise that there is a need to continue to improve our performance, and we support regulatory change to protect and enhance the environment.

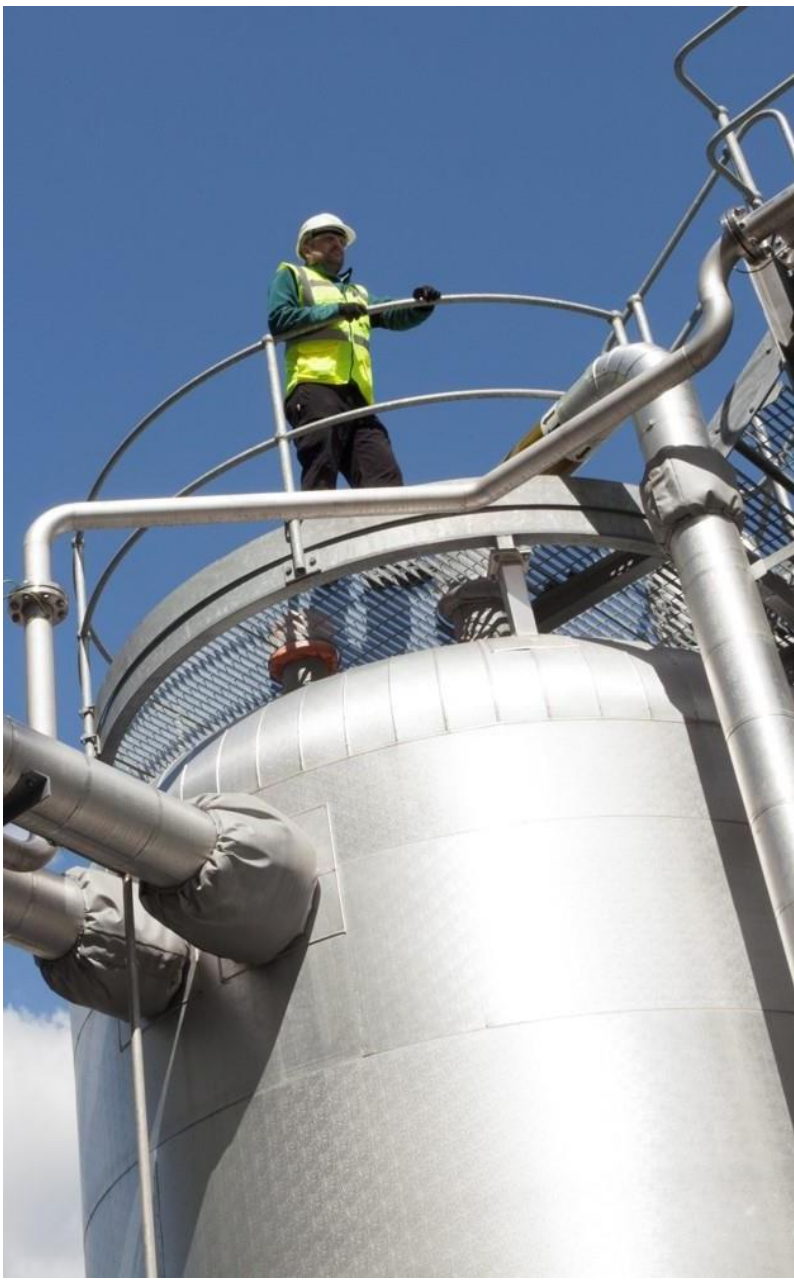
Successful bioresources management has the potential to support the delivery of priority environmental outcomes, including sustainable agriculture and soil health, a circular economy, roadmap to net zero carbon, and energy resilience.

It is currently uncertain how regulatory reform will evolve over time and the implications this might have on bioresources management in the future. The technology choice to treat and recycle sludge has a significant impact on the environmental outcomes which can be achieved. At present, the only practicable alternative outlet for sludge at scale is incineration.

We have developed a discussion paper on unlocking greater value through a national bioresources strategy, where we set out our proposal for the development of a holistic bioresources strategy.

Technology will improve with time, particularly low carbon or sludge destruction technologies, so we need to ensure that we are making the right investment, at the right time to meet the long-term requirements, including providing resilience to climate change.

By adopting a Systems Thinking approach we can find solutions that deliver balanced and holistic environmental outcomes, at an affordable cost to society. We will use the market to help provide solutions where it benefits customers. That may include sludge trading with other water companies or other organic waste companies, or through joint planning, financing and development of new treatment capacity.



We rely on the natural ecosystems of the North West to provide resilient services. The healthier the natural ecosystems are the more resilient they are climate change, and so it is important for the sustainability of our business that we protect and enhance the value it provides.

The natural environment and the services provided by ecosystems are under increasing pressure from climate change and a range of other factors, which is driving the need for a strategic and collaborative approach to protect and enhance value of the natural environment, the natural capital, of the North West.

We meet increasingly stringent environmental consent levels, which help to improve the quality of rivers and bathing waters, woodland and moorland, and so support tourism in the region. We plan far ahead to enhance the long-term resilience of the environment, innovating and investing in new technologies and nature-based solutions to solve environmental challenges, ensuring resilience and growth in a changing climate.

Protecting land quality

Land management

As one of the country's largest private land owners, with over 56,000 hectares of land, it is our duty to be custodians of the environment in the North West. Two-thirds of our land holding is under a landscape designation (National Park or Area of Outstanding Natural Beauty (AONB)), and 41 per cent is designated as a Site of Special Scientific Interest (SSSI). These designations demonstrate the potential for the land to deliver huge public value across ecosystem services including for recreation, carbon storage and biodiversity.

Changing requirements of land may lead to health, safety and environmental issues, while flooding can pose a risk to accessibility and treatability. With much of our land holding currently in a degraded condition due to historic drainage and agricultural impacts, there is a sensitivity to climate change impacting our land risk. We rely on land for effective flood management and the capture and storage of water, and so for us land quality is key to providing resilient and sustainable services.

Much of our land contains protected habitats of global significance, such as blanket bog. These habitats are extremely vulnerable to the impact of climate change as they need to retain water in order to ecologically function and provide the ecosystem services on which we rely. It is important that land management practices are conducive to the habitats holding water in order to mitigate the impact of climate change as well as to prevent any further deterioration of their condition.

Impact on customers

Decreasing land quality can have various implications to customers through interactions with the environment. These can include:

- loss of recreational space;
- loss of valued wildlife and habitats (e.g. SSSIs);
- damage to local scenic areas (e.g. AONBs); and
- can result in water quality issues (discolouration, taste, odour).

Impact from climate change

Climate change will impact the environment in many ways, such as hotter drier summers – which may increase sensitivity to the spread of fires across moorlands. With increasing visitor numbers, such devastating events are becoming more common. This can lead to poor air quality with direct health impacts, as well as the indirect impacts associated with higher levels of carbon released into the atmosphere, and discolouration of water, requiring further treatment to secure clean water at the tap.

The removal of carbon released to water through the water treatment process, prior to distributing to customers, requires power and chemicals and generates a waste product that must be disposed of.

Protecting land quality

Catchment Systems Thinking

Our innovative Catchment Systems Thinking (CaST) approach progresses further our pioneering partnership approach which we began in 2005. By applying Systems Thinking to the broader water environment, we aim to deliver multiple benefits to the environment and society.

CaST looks at both owned and non-owned catchments as an entire system rather than a series of isolated risks and opportunities, and so is able to deliver benefits across multiple areas. Already the CaST approach has reduced pollutants and advanced flood risk management along watercourses in Cumbria and Lancashire.

Case Study: River Petteril

The Petteril is a tributary of the River Eden, located in Cumbria. We have 11 very small wastewater treatment works along the river, four of which were included in the National Environment Programme (NEP5) as requiring a permit for phosphorus removal as part of our contribution to achieving good ecological status by 2027. When the ecosystem resilience is viewed more broadly, further risks to the catchment are identified, including flood risk, and pollution from agriculture and transport, and septic tanks.

The River Petteril in Cumbria's Eden Valley formed a pilot project which brought together a wide range of stakeholders, including farmers, regulators and big businesses. We delivered enhanced monitoring for the whole catchment to identify the sources of phosphate pollution and collaborated with a steering group to identify the most cost effective interventions.

The result was a greater improvement in water quality beyond our own assets at a lower cost to customers. Furthermore, the collaboration allowed additional natural capital benefits to be incorporated at a catchment-wide scale, such as enhanced biodiversity, soil conservation and tree planting.

This allowed us to address phosphorus that would not have been cost beneficial otherwise, by addressing these multiple benefits through nutrient trading, catchment permitting, agricultural interventions, educational campaigns and much more.

Irwell and Manchester Ship Canal

The Manchester Ship Canal (MSC) opened in 1894, providing a navigable channel between Manchester and the Mersey Estuary. The section between Salford Quays and Bollin Point replaced the natural river system - with the rivers Irwell, Irk, Medlock and Mersey entering the canal upstream of Bollin Point.

The majority of Greater Manchester drains into the canal. This contributes to the water body being sensitive to low flow during dry summers, with legacy sediment oxygen demand, that results in low concentrations of dissolved oxygen. The MSC is also a barrier to migratory fish returning to Greater Manchester, due to both the physical obstruction caused by locks and the water quality.

As we feel the impacts of climate change, and hotter, drier summers become more frequent, we identify the need to apply our Systems Thinking approach to deliver multiple benefits. By considering the wide range of ecosystem services the MSC provides, and using cutting-edge monitoring, predictive algorithms, and system optimisation tools, we are able to determine and uphold the most effective strategic approach to resilience.

Future success for climate resilience relies on effective partnerships, and in the MSC we are uniquely positioned to act as the Catchment System Operator; overseeing the catchment by leading a collaboration of coordinating organisations.

By working alongside the Mersey Rivers Trust, and a diverse network from across the public and private sector, we can enable decision making which balances business needs with the needs of customers and the environment, through a partnership approach based on principles of co-design and co-delivery.

Protecting land quality

Thirlmere catchment resilience

During Storm Desmond in December 2015, the Thirlmere catchment experienced unprecedented rainfall which, compounded by other factors, led to erosion of the land and several significant landslides. This resulted in damage to local infrastructure, including the closure of one of the main arterial roads through the Lake District, the A591, for six months.

These landslides led to debris slides from the slopes surrounding Thirlmere Impounding Reservoir, raising the turbidity of the water within the reservoir.

As this water source supplies 12 per cent of the region we serve, this led to the need to employ significant mitigation measures to ensure customers continued to receive safe, clean drinking water.

To improve resilience of the Thirlmere catchment from storm events, further protecting raw water quality and securing potable supplies to the Manchester area, we are proposing to reinforce our long-term strategy for the catchment by improving its resilience to what appears to be an increasing trend in the frequency of very high, but short-lived, intense rainfall events.

The actions we are taking on the catchment include:

- restoration of natural processes (geomorphology and vegetation) to improve resilience;
- green infrastructure enhancements to increase the capacity of the catchment to hold water;
- woodland and forestry management to create self-sustaining and climate resilient woodlands; and
- working with partners to create landscape-scale changes to land management to benefit water quality and resilience.

Habitat creation at Martin Mere

Burscough Wastewater Treatment Works in Lancashire serves over 30,000 people and discharges upstream of Martin Mere which is a Wildfowl and Wetlands Trust (WWT) nature reserve.

A conventional treatment solution to meet the phosphorus standards required by the Water Framework Directive is not cost beneficial, so without innovation the phosphorus load upstream of this important habitat would not be improved.

Through our seventh Asset Management Plan period (AMP7) we are working in partnership with the WWT to develop and deliver a partnership solution, which includes:

- developing both treatment and conservation reed beds in agricultural land adjacent to the existing Martin Mere reserve, thereby expanding the area of habitat;
- diverting the effluent from Burscough Wastewater Treatment Works to the treatment reed bed for polishing;
- optimising the existing phosphorus removal at Burscough Wastewater Treatment Works to reduce the load discharged to the reed bed; and
- enhancing the amenity value and public access to deliver further natural capital benefits.

Each of the risks and opportunities presented in this report have cross functional impacts, however some are better considered at a systemic level. By adopting a Systems Thinking approach, we are able to consider risks which impact our business more widely. Business wide risks are those which may impact our system from multiple sources interdependently, which we may be in full, partial, or no direct control of.

Business wide risks include flooding from storms, rivers, and sea level rise but also the potential uncontrolled release of water from owned and non-owned reservoirs. In their own right these are significant risks to our assets, but we also consider the risks to our people and wider supply chain to ensure resilient water services.

It is important to understand the resilience of others with regard to cascade failure. A storm, for example, may cause power supply failure resulting from damage to assets outside of our asset base, but this may still impact our core services.

Core to our ability to provide a climate resilient service to customers is the maintenance of asset health. A well-managed asset base means they are more likely to withstand the shocks and stresses that climate change will bring.

Asset flooding

What is asset flooding?

Heavy or prolonged rainfall can result in the flooding of our water, wastewater and bioresource treatment works and pumping stations. When one of our sites floods, it can impact the services we provide, whether that's the supply of clean drinking water, or our ability to take away and process wastewater.

Many of our assets, particularly our wastewater sites, are built near to bodies of water, therefore flood risk can never be completely eliminated. Flooding can lead to interruptions to water supplies, property flooding or environmental pollution. This can be through damage to our assets or through damage to other company's assets upon which we rely, e.g. electricity supplies, roads and bridges, or failures to telecommunications.

Due to the wide-reaching potential impacts of asset flooding we have created a robust programme of site-specific controls to manage and mitigate these impacts. Our plans help to ensure that our operational teams are prepared and are able to recover more quickly.

We continually review our design standards to ensure appropriate flood resistance is built into new assets and we actively seek out new ways to help us better manage the risk through our innovation strategy.

We work with partner organisations, particularly the Environment Agency, to ensure we receive timely and focused flood warnings and we continue to develop partnership solutions to cost effectively reduce flood risk through both natural and traditional flood management.

We are improving our resilience to flooding, however we recognise that we must continue to increase our efforts to maintain resilience as the climate deteriorates further.

Impact on customers

Increases in sea level and the intensity and frequency of storm events can directly impact customer property. The same events are also likely to put our services at risk resulting in potential further compounding issues of;

- Localised lack of water supply
- River pollution
- Discolouration and water quality
- Further flooding of customers

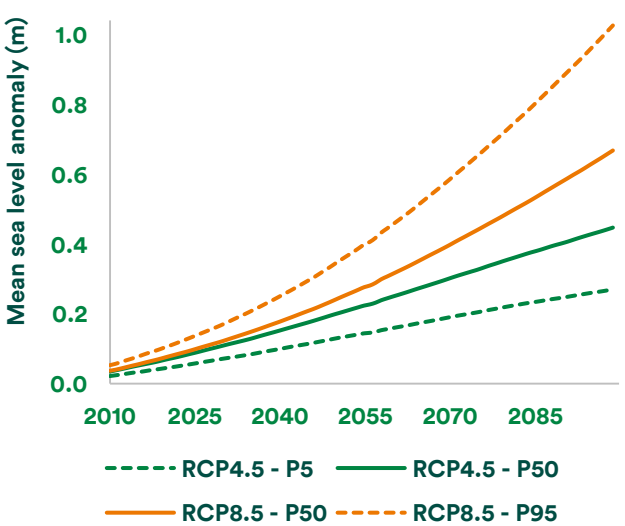
Impact from climate change

With predictions of more frequent, intense storms, and increased winter rainfall, we expect the frequency and severity of asset flooding to increase.

We expect that flooding of assets from which we receive essential services, but do not own, is also likely to increase as a result of increasing severity of rainfall resulting in increased cascade failure risk

As sea levels continue to rise our coastal assets, and those on tidal waters, are likely to be at increased risk of flooding and outfall blocking.

Liverpool projected sea level rise



Managing flooding

Wyre Natural Flood Management

Natural flood-risk management (NFM) is widely recognised as a worthwhile approach to reducing flood risk, although it is often challenging to progress projects with partnership and collaboration, since the benefits of such an approach are distributed widely.

The purpose of the Wyre pilot is to develop a market-based approach by bringing together all the organisations that have a role in unlocking the benefits.

The Wyre catchment was chosen for the pilot because:

- it suffered from significant storm flooding in 2015;
- the Churchtown area has suffered four 1 in 50 year storm events in the last 20 years;
- through Natural Course the Environment Agency commissioned a report into potential NFM opportunities in the Wyre, which identified opportunities but did not quantify the benefits or prioritise the interventions;
- the catchment offered the opportunity to deliver multiple benefits across water quality, carbon sequestration as well as flood risk reduction; and
- we had assets in the catchment at risk from flooding with the potential to impact on service to customers.

In order to realise the benefit of a systems approach, a partnership was formed between us and some of the potential beneficiaries, including the Environment Agency, The Rivers Trust, FloodRE and Coop Insurance. This collaboration allowed us to explore how a business case could be developed to attract investment from multiple sources. This is a key learning point for future multi-benefit approaches, which are vital in adapting to climate change.

Partnership working is key to future flood resilience, and in this case identified further opportunities and benefits available from the project as a result of knowledge sharing. In this specific project alone we identified opportunities to have:

- 600m^3 of water retained;
- 25,600 tonnes of carbon sequestered;
- 283 biodiversity units created; and
- 56 properties protected from 1 in 50 year storm flooding events.

Thornton flood risk resilience

Thornton, is a town near Blackpool, within the River Wyre catchment. The natural catchment area is low lying, flat and saturated, which results in elevated flood risk. Historically, there has been flooding from multiple sources, most notably in 2017. There are also water quality issues from misconnections, and it has been the partnership's ambition for these to be rectified for many years. The scale of capital investment required to install a traditional solution to attenuate storm flows is not cost beneficial per customer, nor environmentally sustainable to deliver.

The existing system, through its connection to sewers, creates inefficiencies through decreased sewer capacity, increased pumping and unnecessary treatment at Fleetwood Wastewater Treatment Works.

In 2019 we identified the need to work together to deliver solutions within Lancashire's strategic partnership. We collaborated with other risk management authorities, catchment partners such as The Rivers Trust and the communities' part of the Wyre Flood Forum. We set out a plan of action to solve our joint issues in the catchment, through natural solutions:

- Collaborate through effective catchment partnership to identify needs;
- £220k contributed to Wyre Rivers Trust through bespoke legal agreements across Lancashire;
- 3.3 hectares of wetlands and 1,000m^3 of flood storage at Hillylaid Pool;
- 1,300m^3 of storage and wetlands habitat constructed collaboratively with McDermott Homes; and
- Support EU LIFE and Natural Course as project partners.

Our partnerships have allowed us to deliver this quickly and efficiently through The Rivers Trust and McDermott Homes. This provides an opportunity for the community to help plant up the wetland areas that have been created so that the ecological benefits of this scheme can be realised.

We are learning from our collaborations here and want to apply them across wider strategic partnerships in the North West.

People

Working conditions

Detail

It takes more than 5,000 of us to keep our network flowing, making us one of the largest employers in the North West. In total, 22,700 people are actively supported by our work, meaning that we generate – either directly or indirectly – one in every 100 jobs in the region.

While we all do an important job, nothing we do is worth getting hurt for. Health, safety and wellbeing take precedence because our people deserve to go home safely every day. Climate change poses a risk to working conditions, whether that's the longer, hotter heatwaves for teams working outdoors, or storms and site access increasing remote working.

Action

We continue to review and develop our health and safety management system, which is accredited to ISO 45001, and in March 2021 achieved our ninth consecutive Royal Society for the Prevention of Accidents Gold Award. We are also assessed against the Workplace Wellbeing Charter.

We have established communities of over 100 wellbeing champions, 200 mental health supporters and 350 organisational and front line coaches, and actively participate in local and national campaigns to keep our employees safe and well through any changing working conditions.

Site access

Detail

Access to our sites can be affected by a number of means. Both our infrastructure and the region's transport routes can be the cause. Roads and other transport routes can be impacted by events such as floods and land slips, and with such events expected to increase, the frequency of our access being impeded increases. We could also be limited by our sites themselves being flooded or damaged by weather events. The gates and immediate access points could get damaged by storms, either directly from the high winds and rain, or indirectly through falling debris or other refuse. This could physically block the access points, or interrupt the automated nature of the gates.

While access to site due to winter weather can be a prevailing issue, this is expected to decrease in frequency in the latest climate projections.

Ultimately, without access to our sites we cannot properly maintain our assets. This can have issues in the short and long term. If our access is impeded to a site, it is likely that the site itself will need attention. If not, the lack of access could interrupt our long-term maintenance strategy, causing scheduling difficulties and possible compliance issues.

Action

Despite the variety of consequences that could come from this risk, there are many controls available to us. The possibility of having multiple access points to sites and assets could greatly reduce the risk of not being able to access sites. This could range from alternate access points on the opposite side of the site, or additional manual entrances and exits.

Further risks

Power outages

Detail

Our treatment processes rely on a resilient, continuous supply of power. Overhead power lines are susceptible to interference from damaged vegetation, which can cause a variety of power supply disruptions, whether that is short interruptions or severe damage.

With the increase of extreme weather conditions, the likelihood of severe damage leading to large scale power outages is also increasing. This creates an interdependent risk with energy suppliers.

This risk is present throughout our business, as we experienced during Storm Desmond and Storm Eva in 2015, when severe adverse weather resulted in poor pressure and no water issues. This was exacerbated by power outages preventing effective communications with customers and employees. Over 85 per cent of future bill payers are satisfied by our approach to adapting to the increasing risk of power outages.

Action

Centralised operational planning, monitoring and control through Systems Thinking provides us with a high level of preparedness for informing our operational teams of potential power outages.

Accelerated asset deterioration

Detail

With weather patterns in the North West predicted to change, with more frequent, heavier downpours in the winter and hotter, drier summers, our assets are expected to experience accelerated deterioration from climate change. This deterioration is expected to be further exacerbated through forecast population increase, placing increased demand on our assets.

The effects of climate change are rarely expected to cause catastrophic failures of our assets, but more generally be associated with deterioration due to increased day-to-day operations. The following examples demonstrate how climate change could be expected to increase the rate of asset deterioration:

- The increased incidence of flooding and asset inundation are expected to put additional strain on assets and shorten their operational lives;
- Aging sewer systems designed in the early twentieth century, or before, can be routinely overfilled with heavy rainwater;
- Pumps will run harder, longer and more often to deal with the increased flow;
- Additional pumping of water to support availability in hotter, drier summers will not just increase power costs, it will also add further wear and tear onto pumps and other assets;
- The longer, drier summers will put additional pressures on our water network as the ground dries and hardens.

All of these risks exist in our current operation but are expected to increase significantly as the full effects of climate change are felt in the coming years.

Action

We can reduce these risks by adding additional headroom in our designs; providing extra redundancy across our asset base. We will also work to identify, minimise and protect single points of failure in our process, thus ensuring our systems are resilient enough to handle the increased workload.

“I bet with a lot of people the last thing they will think when there is a power cut is ‘oh this is going to affect the water as well now’.”

Future bill payer

Transitioning with a changing climate

Adapting to climate change is an international objective, and carries many interdependencies. The Task Force on Climate-Related Financial Disclosures (TCFD) relates climate-related assessments to the following:

- **Physical risks** such as the disruption of operations or destruction of property
- **Transition risks** such as policy constraints on emissions, imposition of carbon tax, water restrictions, land use restrictions or incentives, and market demand and supply shifts
- **Opportunities** such as access to new markets and new technology

We have been an early adopter of TCFD reporting, and publish a TCFD report within our annual report. This section looks at some of our most significant transition risks and opportunities associated with climate change.

Energy and carbon

Detail

As a relatively energy-intensive business, we are susceptible to risks arising in the way energy is managed, including those resulting from decarbonisation and exposure to additional taxation.

The cost of energy is expected to rise, and more accountability to be put on businesses for the greenhouse gas emissions they produce. We are taking actions to ensure we are resilient to changes in energy prices.

Actions

Our energy strategy is focused on using less, generating more and intelligently using our assets to get best value while maintaining security of supply. In 2020/21, we generated 205GWh of renewable energy, equivalent to almost a quarter of the electricity we consumed.

We generate renewable energy from the sun, wind, and water, and extract bioresources from wastewater that we break down into biomethane (which is used to generate renewable energy) and biosolids (which are treated to provide a high-quality fertiliser for farmers). Since the cost of energy continues to rise, investment in renewables provides us with financial resilience and also contributes to our efforts to reduce our climate change impact by reducing our carbon footprint.

In 2017, we were awarded the Institute of Chemical Engineering Global Energy Award for our work on renewable energy at our Davyhulme Biomethane plant, just one year after completing one of Europe's largest floating solar array at our Godley reservoir in Hyde, producing three megawatts of clean energy.

Since our last climate change adaptation report, we have switched to buying only green energy, and we are continuing to address our roles and responsibility in this space.

Novel technology

Detail

New technology and innovations create opportunities for improvements in service and efficiency, and keeping at the forefront on innovation is vital to delivering a sustainable service through a changing climate. Adopting new technology can create risks however, through cyber security and changes to our ways of working.

Actions

Our proven approach to innovation is externally recognised as being the most embedded in the sector. Our innovation efforts are focused on sector-wide climate crisis problems and will deliver financial and other multi-capital benefits. In our AMP7 business plan we reported that the application of our established innovation model is expected to deliver £445 million of savings from 2010 to 2025. We are actively working with global innovators, from small start-ups to large, established corporations, reaching far beyond the water sector.

Innovation Lab

This sector-first, twelve-week programme provides successful applicants with the opportunity to test their solutions in a live environment, while gaining access to, and building relationships with, senior United Utilities executives. The Lab comes with the potential to lead to longer-term commercial partnerships. Challenges are set to the marketplace to enable innovative smaller companies with solutions to come forward. Our results show that we are bringing world-first technologies to the market, adopting them and then sharing with the sector.

Our floating solar array on Godley Reservoir

CEO Challenge

We run an annual competition, sponsored by our Chief Executive Officer (CEO) and directors across the organisation, where our early career graduates are engaged in solving real business challenges to improve service and efficiency. Giving graduates the opportunity to work on real business challenges, with freedom to make decisions, learn from inevitable mistakes in a safe space, and change the way we do things, assists in their personal development and helps embed an innovation mind-set at all levels of our business.

Climate change is priority theme in our CEO Challenge. In our most recent competition, a group of graduates focused on helping us to further mature our plans to achieve our commitment to Net Zero by 2030, delivering company-wide engagement and embedding climate change mitigation actions.

By driving a culture of innovation within the business, ensuring we have effective physical and technological security measures and awareness training and strong governance and inspection, we aim to protect infrastructure, assets and operational capability while being adaptable to a changing climate.

Financing

Detail

In 2019 the government published its Green Finance Strategy, a crucial aspect of helping the UK achieve its own target of carbon neutrality by 2050. This sets out how the government aims to accelerate the growth of green finance and enable the UK to seize the commercial potential arising from the transition to a sustainable economy. Sustainable financing and ESG (environmental, social, governance) are driving positive change across the financial landscape, and how we manage ESG matters is essential to how we deliver our purpose and operate in a responsible manner, and remain resilient to future financial shocks and stresses stemming from climate change.

Actions

Long-term financial resilience starts with a robust balance sheet and prudent approach to financial risk management, and this enables us take action and remain resilient to climate change.

Our financial resilience is one of our competitive advantages and we believe we are at the frontier in this respect. We have maintained a responsible level of gearing and a well-controlled pension position for many years, which provides us with the ability to be proactive in our approach to resilience, and respond quickly and efficiently to events.

Sustainable bond

We attracted huge demand for our first ever sustainable bond issue, which was more than three times over-subscribed. The £300 million bond, which matures in October 2029, will be issued under the our Sustainable Finance Framework and at had the lowest ever GBP corporate coupon at that maturity at issuance.

Funds raised under the framework will go towards projects that improve the resilience of water and wastewater infrastructure, reduce carbon emissions, enhance catchments and support customers who are struggling to pay their bills. All of these projects will contribute to achieving the United Nations Sustainable Development Goals for the region.

Accounting policies

Climate change accounting policy disclosures within our 2020/21 annual report were recognised by the Financial Reporting Lab as best practice: “United Utilities addresses climate change in its accounting policies in the financial statements and explains how it is considered in the valuation of property, plant and equipment. United Utilities highlights where it has recognised depreciation acceleration and where it did not need to recognise write-downs”.

Interdependencies

We recognise that there are many interdependencies associated with delivering our adaptation activities and the actions of others are likely to impact on our ability to manage climate change risks. Primarily this is due to the nature of cascade failures as a result of climate-sensitive risks.

Area	Approach
Energy	
This year we generated 205GWh, equivalent to almost a quarter of the electricity we consumed, however as a relatively energy-intensive business we will remain reliant on a continuous energy supply. The energy industry is facing climate change challenges across generation and networks. Increased risk of flooding to substations, storms and severe weather causing loss of supply, and increased vegetation growth along the network, all threaten the continuous service they provide.	We are diversifying our portfolio of supplies by investing in generation of more renewable energy (e.g. wind, solar, maximising CHP outputs). This will reduce our reliance on the grid in order to build resilience to power outages. Our energy management plans aim to reduce power consumption by site specific initiatives, and ensure that critical assets have energy resilience measures in place, such as dual supplies and back-up generators.
Telecoms	
The drive to adapt to climate change relies on advances in technology, connected networks, and reliable communications. Increased severe weather events and higher temperatures can put pressure on telecommunication assets and result in service disruptions.	We recognise that collaboration with other utilities regarding climate change, and sharing assessed vulnerabilities can support mutual resilience. With an increasing uptake of smart systems to support our Systems Thinking capability, we are ensuring that the solutions we develop are sustainable, working with suppliers to ensure new technology and IT systems which support our business are resilient.
Transport	
While we advance our Systems Thinking approach and enhance our centralised operational monitoring and control capabilities to drive efficiencies, many of our services require reliable logistics and supply. Increasing risk of flooding can cause damage and blockages to transport routes, inhibiting access to sites and delivery of material.	Despite the variety of consequences that could come from this risk, there are many controls available to us. The possibility of having multiple access points to sites and assets greatly reduces the risk of not being able to access sites. This can range from alternate access points on the opposite side of the site, or additional manual entrances and exits. This risk is particularly sensitive to severe weather, where disruptions to our supply chain can result in a cascade failure even if the disrupted transport route is not local. We work with our suppliers to ensure that transport resilience is accounted for, and ensure we have suitable reserves to mitigate this risk.

Area	Approach
Co-sited infrastructure	
There is often a close proximity of multi-infrastructure conduits to our network, which may run in parallel to roads and railways, pipes and cables, and various other infrastructure. This increases the sensitivity to cascade failure in the event of severe weather, due to flooding or land slips. This is more critical in our densely populated regions such as Manchester and Liverpool, where key infrastructure supports a large population in a relatively small geographical area.	We work closely across infrastructure sectors to ensure that all of our streetworks consider co-sited infrastructure, and take steps to ensure that our work causes minimal disruption to any services provided in proximity to the work being carried out. We recognise the need to further mature proactive management in partnership in response to the increasing risk to this from climate change. Our pipes are often located below the network infrastructure of other service providers, where leaks and bursts may cause cascade failure and disruption. We aim to minimise reactive work in favour of proactive maintenance, and with the support of such projects as our acoustic logger deployment, the largest for leakage detection in the world, we can minimise our contribution to this risk.
Agriculture	
One of the most sensitive sectors to the impact of climate change is agriculture, where crops and livestock depend and benefit from favourable weather conditions. The availability of water resources is crucial to crop yields, and as heatwaves become ever more common, water demand from agriculture is predicted to increase by 26 per cent by 2050. The bioresource sector also depends strongly on agriculture, details of which are outlined in **3.2.3 - Bioresources**.	The farming community is an important group for us to engage with. We currently work with over 1,200 farmers across 120,000 hectares of land. Much of our land is managed on our behalf by tenant farmers, who do a great job of handling it in a way that supports our water quality and environmental goals. Through our Sustainable Catchment Management Programme (SCaMP) and Catchment Systems Thinking (CaST) approach we have a long history of protecting and enhancing the water environment, with wildlife and biodiversity enhancement as key drivers with their help. Non-household demand for water, which includes agriculture, is included in our future supply and demand forecasting. We ensure that future needs are addressed in our WRMP, and within the regional WRMP.
Supply Chain	
Having an integrated culture throughout our supply chain is fundamental to the successful delivery of our strategic aims. Future pressures to transport methods, access and resource availability as a result of climate change have the potential test the resilience of our supply chain.	Recent disruption has shown the importance of our relationship with our supply chain partners, and highlighted the impact that climate-related supply chain interruption may have. During these disruptions, we acted swiftly to accelerate payments from 14 days down to seven days to help with cash flow and offered a range of payment options. Through our USC approach we engage suppliers on sustainable and ethical issues and performance, to ensure our supply chain is resilient to shocks and stresses. To support this into the longer term, through our partnership with the Supply Chain Sustainability School we have been able to offer both our commercial colleagues and supply chain partners free resources to learn more about the responsible sourcing principles.

Achieving our ambition

We have identified a number of challenges to our adaptation ambition which are common to many organisations, leaving opportunities for further progress in our mutual climate change readiness.

The majority of our stakeholders feel that responding to climate change is important and gain reassurance that our investment will help to provide greater resilience.

Area	Approach
Cost Adaptation measures for infrastructure enhancement, particularly if based on 'hard' engineering solutions, may have a high cost. Therefore, adequate funding may not be available to implement these solutions. This may be particularly relevant to adaptation measures proposed for the sewerage network as this has been subject to largely maintenance-only expenditure since privatisation and hence resilience is lower compared with other key expenditure areas.	We keep bills down and target the best long-term value by continually striving for efficiency and innovation. Acting early, ahead of the shocks and stresses caused by climate change, is more cost effective than managing the response to impacts once they have already happened. Each measure will be subject to cost benefit analysis, with the most cost effective measures being prioritised. By making the assessment of climate change risk in a business as usual processes, the impact is now built into every project we undertake. The key to adaptation is ensuring that we resolve the 'bigger' problem in the most efficient and sustainable manner. In the future, we believe that partnership working will assist us in delivering more efficient and sustainable solutions for customers, while understanding the fact that funding will always be limited and therefore it is not possible to mitigate all risks.
Affordability In periods of economic constraints, customers may be unable or unwilling to see bills increase to pay for climate change adaptation. This may be reinforced by a limited understanding of climate risks and vulnerabilities and/or a belief that the uncertainty is currently too great to warrant taking immediate action. Affordability may also be a constraint for the country as a whole, as work on adaptation to climate change may divert expenditure from other areas of the economy.	We conduct willingness to pay surveys with customers to determine the amount (if any) extra they are willing to pay for our service. An up-front explanation and briefing on climate risk is given to customer focus groups as part of the willingness to pay survey. Customers place a high value on maintaining current service levels and reducing sewer flooding. To achieve this in the long term we need to ensure our climate change adaptation actions are embedded throughout our business planning. In the future, we might consider that we need to build customer engagement and the value they place on low frequency, high consequence events (i.e. resilience), which is a wider consideration than just climate change. There is strong stakeholder and government support for adaptation activities. Defra in its Statement of Obligations state that it expects water companies to take a long-term approach to meeting the challenges of a changing climate. Where we are able to make a sound business case, Defra would expect support for investment in line with our adaptation report.

Area	Approach
Uncertainty Uncertainties associated with UKCP18 forecasts and the associated impact on sewerage and water networks may make the definition of effective adaptation measures problematic. In making the case for future investment there needs to be a sound evidence base to justify the benefit of potential investment.	We continue research and development projects, for ourselves and in collaboration with industry bodies and government departments, to agree the evidence base necessary to justify investment in adaptation. An effective adaptive approach means taking action where there is sufficient certainty or risk, but investigating and understanding the requirements for potential future interventions. By taking a phased approach to future scenarios we can remain agile to change. Uncertainty associated with climate change can cause difficulties in justification of works. While it is still an area that requires further work, we have customers' support to protect existing performance levels. For the longer term this necessitates the inclusion of allowances for climate change.
Timing Future updates to UKCP scenarios need to be released in time to inform any price review process, to provide clarity for water companies and their regulators.	We are always using the latest and best available evidence for climate change as relevant to the area of planning.
Skilled Resources Availability of adequate resources, for example technical, engineering and scientific, across the country to deliver climate change adaptation measures.	We work with government departments, educational establishments, industry bodies, and others to increase capacity in these areas. We have a huge skills programme, delivering over 25,000 days of training a year as well as supporting over 400 employees in further education. We are particularly proud of our graduate and apprenticeship schemes. We currently employ 138 apprentices and our scheme is part of the government's Energy and Efficiency Industrial Partnership (EEIP) in which we lead a group of 14 utility firms, including Scottish Power, Amey, E.ON UK and Siemens, on five pilot projects in Cheshire, Cumbria, Lancashire, Liverpool and Manchester. We have invested over £2.5 million and continue to improve our Technical Training Centre at Bolton to ensure we are able to equip our existing and new employees with the skills they need to develop, maintain and improve our assets now and in line with any future technological advancements.
Visibility of other utility plans More timely visibility of the adaptation plans of other key infrastructure and utility owners may support the development of optimal adaptation plans by all utility providers. Infrastructure systems are only as strong as the 'weakest link'. For example, dependent utility or service providers that are designed to 1 in 30 year events could impact on the efficacy of the operation of other key infrastructure built to withstand 1 in a 100 year events.	We believe that the requirement for preparing statutory adaptation plans will enable closer working and co-operation on climate change adaptation plans across key infrastructure and utility owners. We look to Defra to help facilitate this as part of its overall assessment of statutory adaptation plans. Having visibility of plans is useful but it is now becoming apparent that what is required is a more granular and geographically specific understanding of how each utility approaches climate change, how it assesses risk and then how it manages that risk within its business processes. We believe that the government accepting the National Infrastructure Commissions (NIC) recommendation for Secretaries of State to publish clear, realistic standards of resilience across water, energy, and digital will contribute to improved visibility of other utility plans. While there is a certain amount of work that we can undertake as an individual utility we will continue to work with government to facilitate this on a regional and national scale.

Area	Approach
Regulations and legislation Lack of supportive legislation, guidance, regulations, policies etc., by government or regulators, may present impediments to the delivery of cost effective adaptation programmes.	We are currently working with these bodies and plan to continue this work to support the development of effective and timely legislation and guidance. We would welcome the opportunity to take an active role in the development of sector resilience standards, following the acceptance by the government of the NIC's recommendations that Secretaries of State to publish clear, proportionate and realistic standards every five years for the resilience of water services. We continue to work with government and regulators to ensure legislation and guidance is driving the right behaviours and supportive of our ambition. The Environment Act provides clear strategic direction with regard to the reduction in per capita water consumption, which we will embed within our strategy development and long-term planning processes.
Carbon impact Adaptation measures may themselves contribute to carbon emissions and therefore accelerate climate change. This will be particularly relevant to interventions based on 'hard' engineering solutions.	We will work with our regulators and other water companies to agree a balance between adaptation activities and the increase in carbon that these traditionally bring about. It is important the carbon is effectively valued throughout the planning lifecycle, including in legislation and regulation through to detailed solution design. We continue to work with our regulators and stakeholders on alternative adaptation approaches that do not involve high-energy solutions, such as sustainable drainage schemes.
Partnerships Climate change will impact every part of society, and every part of society has a role to play in the response. Working together with others, including NGOs, charities, and local action groups, we can share knowledge and pool resources to deliver greater value for all, exceeding that achievable individually.	We will develop our partnership framework to identify areas of common objectives and alignment of strategic ambitions – promoting joint working to co-create and co-deliver adaptation interventions that provide benefits to all parties. Working with partners we can deliver maximum value through collaborative solutions.

A
Appendix
Risks and actions

A.1 Climate-related risks

This section presents a summarised extract of risks that have been identified through our climate-related risk assessment.

A set of the most significant of these risks is addressed within the body of the report.

Scores are given on a scale of 1 to 5, with the total risk score out of 25.

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Wastewater	Network	Increased rainfall	Overwhelming sewers	Sewer flooding	4	5	20
Business wide	Asset Health	Increased rainfall	Flooding assets	Failure of assets	4	5	20
Water	Environment	Lower average summer rainfall	Reducing water resources	Supply interruptions	4	5	20
Water	Environment	Hotter, drier summers	Leading to more severe and frequent moorland/forestry fires	Water demand and quality stresses, risk to catchment health	3	5	15
Bioresources	Process	Increased rainfall	Changing ability to recycle biosolids to land	Adverse effect on supply and demand of biosolids to agriculture	5	3	15
Wastewater	Environment	Increased rainfall	Increasing spills	Polluted bathing waters	3	4	12
Wastewater	Process	Increased rainfall	Increasing spills	Exceedance of permits	3	4	12

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Wastewater	Environment	Increased rainfall	Polluting water sources due to runoff	Water quality	3	4	12
Business wide	Asset Health	Increased rainfall	Increasing soil movement causing pipe systems to move leading to fractures	Accelerated asset deterioration	3	4	12
Wastewater	Process	Lower average summer rainfall	Increasing subsequent shock loads	Pollution events	3	4	12
Interdependency	Environment	Increased rainfall	Increasing run-off from agricultural land	Increased nutrient loads to water sources	3	4	12
Wastewater	Network	Lower average summer rainfall	Leading to blockages in the sewage system	Sewer flooding	3	4	12
Transition	Corporate	Lower average summer rainfall	Leading to political pressure for prioritising essential water use	Supply interruptions	3	4	12
Wastewater	Network	Increased rainfall	Increasing use of rising mains	Supply interruptions	4	3	12
Water	Abstraction	Hotter, drier summers	Promoting cyanobacteria and actinomycetes growth	Taste and odour compound formation	3	4	12
Water	Abstraction	Increased rainfall	Decreasing raw water quality	Impact to treatment and customers	3	4	12

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Water	Environment	Hotter, drier summers	Increasing tourism	Increased risk of damage to land and catchments	4	3	12
Transition	Corporate	Climate change	Progressing the need to adopt new technologies driven by a change in legislation and standard practice	Change in operational processes and capabilities	3	4	12
Transition	Power	Climate change	Driving legislation and taxation, and decarbonisation targets	Higher energy costs	4	3	12
Business wide	Corporate	Increased rainfall	Floods, accidents and landslips	Disruption to transport and supply lines	3	4	12
Interdependency	Corporate	Climate change	Driving changes in social expectations	Result in more social pressure and higher customer expectations (e.g. Extinction Rebellion)	4	3	12
Business wide	Environment	Hotter, drier summers	Causing more severe and frequent moorland/forestry fires	Damage and degradation of land	2	5	10
Water	Network	Increased rainfall	Increasing run-off	Increased risk of cryptosporidium	2	5	10
Water	Process	Increased rainfall	Causing direct flooding of service reservoirs	Contaminants entering the underground storage	3	3	9

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Water	Network	Hotter, drier summers	Increasing tourism, within the North West	Localised supply/demand issues	3	3	9
Water	Abstraction	Hotter, drier summers	Promoting algal growth in reservoirs	Treatment disruptions arising from blockages	3	3	9
Water	Environment	Lower average summer rainfall	Increasing compaction of soil surface	Reduced aquifer recharge and increased flood risk	3	3	9
Water	Network	Increased rainfall	Increasing deposition in raw water mains	Water quality reduction	3	3	9
Wastewater	Process	Lower average summer rainfall	Creating an increase in septic sludge volumes	Odour issues	3	3	9
Water	Process	Increased rainfall	Resulting in adverse raw water quality	Water quality reduction	3	3	9
Interdependency	People	Increased rainfall	Causing more emergency events	Pressure on our emergency response	3	3	9
Water	Abstraction	Lower average summer rainfall	Resulting in lower summer flows causing reduced aquifer recharge	Lower groundwater levels and reduced source yield	3	3	9

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Interdependency	Abstraction	Climate change	Changing usage requirements of water, leading to increased abstraction by other catchment users	Pressure on water resources	3	3	9
Transition	Corporate	Climate change	Influencing policy and regulation	Change in drivers and service operation	3	3	9
Water	Network	Hotter, drier summers	Causing temperature inversions in reservoirs	Water quality reduction	3	3	9
Business wide	People	Increased rainfall	Causing infrastructure damage and blocks	Issues when accessing sites (e.g. chemical deliveries, reservoir inspections)	3	3	9
Business wide	Asset Health	Rising sea levels	Causing coastal flooding	Failure of assets	3	3	9
Wastewater	Environment	Rising sea levels	Causing tidal blocking	Coastal discharges	3	3	9
Wastewater	Process	Lower average summer rainfall	Causing lower average and peak flows	Increased recirculation pumping	3	3	9
Wastewater	Process	Lower average summer rainfall	Resulting in increased septicity	Demand on the treatment process	3	3	9

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Water	Abstraction	Hotter, drier summers	Increasing evapotranspiration from reservoirs and land	Reduced raw water volumes	3	3	9
Transition	Corporate	Increased rainfall	Increasing flood frequency	Identification and installation of more flood defences	3	3	9
Water	Process	Hotter, drier summers	Promoting bacterial growth in the water treatment process	Increased treatment costs	3	3	9
Water	Process	Lower average summer rainfall	Reducing dilution with reduced raw water volumes	Increased treatment requirements	3	3	9
Transition	Corporate	Increased rainfall	Leading to change in liability risk	Higher insurance premiums	3	3	9
Business wide	Environment	Increased rainfall	Increasing river flow and velocity causing erosion from rivers and coasts undercutting assets	Failure of assets	2	4	8
Business wide	Environment	Increased rainfall	Increasing the potential for landslips	Damage to land, damage to assets below, landslips into reservoirs and of dam slopes, along with H&S concerns	2	4	8
Water	Abstraction	Hotter, drier summers	Resulting in a higher average demand due to reducing water resources	Potential supply interruptions	2	4	8

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Water	Network	Increased rainfall	Causing loss of river crossings and vulnerable mains	Increase in supply interruptions	2	4	8
Business wide	People	Hotter, drier summers	Causing more severe and frequent moorland/forestry fires	Increased pressure on the work environment	2	4	8
Water	Environment	Lower average summer rainfall	Increasing risk of breach of environmental flow requirements in water courses	Reduced reliability of sources	2	4	8
Business wide	Power	Climate change	Causing changes in energy supplies	Potential power issues for our assets	2	4	8
Interdependency	Corporate	Increased extreme weather events	Increasing frequency and duration of loss of telecommunications	Service disruption	2	4	8
Interdependency	Power	Increased extreme weather events	Increasing frequency and duration of loss of power within a treatment process	Service disruption	2	4	8
Wastewater	Network	Increased rainfall	Increasing infiltration of groundwater into sewers	Sewer flooding	2	4	8
Water	Asset Health	Increased extreme weather events	Causing waves to hit the dam	Failure of assets	2	4	8

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Business wide	Environment	Hotter, drier summers	Resulting in lower flows in rivers and warmer receiving waters	Tighter discharge permits at WwTW or increased compensation flows from reservoirs	2	4	8
Business wide	Technology	Hotter, drier summers	Causing overheating of UU IT/OT assets	Failure of communication to assets	2	4	8
Water	Asset Health	Increased rainfall	Causing dam overflow capacity to be insufficient	Failure of assets	2	4	8
Interdependency	Corporate	Increased rainfall	Causing disruptions within our supply chain	Service disruption	2	4	8
Wastewater	Process	Cold snaps	Reducing the effectiveness of biologic processes in wastewater treatment	Pollution events	2	4	8
Water	Asset Health	Hotter, drier summers	Leading to crack formation in dams and other structures	Compromised resilience	2	4	8
Water	Process	Increased extreme weather events	Resulting in discolouration and odour issues	Increased complaints and compliance risk	2	4	8
Water	Network	Increased rainfall	Causing aquifer recharge in winter, leading to infiltration into raw water pipelines and other assets post treatment	Reduction in the quality of supply for customers	2	4	8

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Transition	Environment	Climate change	Requiring increased uptake in climate change mitigation actions	Change in strategy development and acceleration of decarbonisation activity	2	4	8
Business wide	Corporate	Cold snaps	Resulting in surface ice and snow	Increase in transport and supply line interruptions	2	4	8
Business wide	People	Hotter, drier summers	Increasing insect populations on operational sites	Risk to health, safety and wellbeing	2	4	8
Bioresources	Process	Increased rainfall	Resulting in decreased renewable generation	Odour issues, and temporary plant hire	2	4	8
Business wide	People	Hotter, drier summers	Causing work environments to become intolerable	Risk to health, safety and wellbeing	2	4	8
Wastewater	Process	Increased rainfall	Resulting in high numbers of alarms	Overwhelming operational technology capability	4	2	8
Water	Environment	Increased rainfall	Causing colour issues and increased siltation in reservoirs	Increase in treatment requirements	2	3	6
Water	Water	Increased rainfall	Resulting in higher frequency of flood events	Population movement out of flood plains, impacting the supply/demand balance	2	3	6

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Water	Network	Cold snaps	Resulting in damage to water networks	Increase in leaks and supply interruptions	2	3	6
Interdependency	Network	Climate change	Cascade failure due to co-sited infrastructure	Service disruption	2	3	6
Business wide	Technology	Increased extreme weather events	Causing disruptions to telephony and IT	Impact to our ability to monitor sites and assets	2	3	6
Business wide	People	Cold snaps	Causing ice build-up on roads and paths	Risk to health, safety and wellbeing	2	3	6
Water	Process	Cold snaps	Causing dosing lines to freeze	Risk to water treatment	2	3	6
Wastewater	Network	Lower average summer rainfall	Resulting in increased H_2S and septicity	Accelerated asset deterioration	2	3	6
Business wide	Customer	Cold snaps	Causing leaks and increased volumes of calls	Pressure on our emergency response	2	3	6
Business wide	Technology	Hotter, drier summers	Causing electrical systems to fail due to sensitivity to temperature changes	Impact to our ability to remotely monitor sites and assets	2	3	6
Water	Asset Health	Increased rainfall	Causing reservoirs to overtop	Increased asset deterioration	2	3	6

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Water	Abstraction	Increased rainfall	Increasing surface water to groundwater	Increased turbidity affecting raw water quality	2	3	6
Water	Abstraction	Climate change	Leading to increased abstraction by other catchment users	Reduction in water resources	2	3	6
Transition	Corporate	Climate change	Changing operation of our assets and services	New recruitment and training requirements	2	3	6
Water	Process	Hotter, drier summers	Increasing water temperature at source	Impact to the treatment process	2	3	6
Interdependency	Corporate	Hotter, drier summers	Resulting in increased reservoir misuse	Risk to health, safety and wellbeing	1	5	5
Wastewater	Network	Hotter, drier summers	Leading to increased microbial action and increased gas production	Risk to health, safety and wellbeing	1	4	4
Water	Water	Rising sea levels	Resulting in the intrusion of salt water into the fresh water table	Saline intrusion into groundwater and river intakes	1	4	4
Business wide	Technology	Increased likelihood of thunderstorms	Interrupting monitoring and control capabilities	Service disruptions	1	4	4
Wastewater	Process	Rising sea levels	Causing saline intrusion into sewers	Detriment to sedimentation and aeration processes	1	4	4

AREA	CATEGORY	CAUSE	IMPACT	OUTCOME	LIKELIHOOD	CONSEQUENCE	RISK
Interdependency	Corporate	Climate change	Resulting in pressure on supply chain operation	Service disruptions	2	2	4
Water	Environment	Climate change	Increasing the risk of disease in livestock	Pressure on agricultural sector and catchment operation	2	2	4
Water	Environment	Hotter, drier summers	Increasing the prevalence of invasive species	Pressure on agricultural sector and catchment operation	1	3	3
Transition	Water	Climate change	Leading to population movement	Change in demand	1	3	3

A.2 Mitigating actions

New actions

The table below lists actions which have not been included in previous reports and provides an introduction to these actions, or an update on what progress has been achieved.

ID	DESCRIPTION	ACTION	TIMESCALE
N01	Development and delivery of our Rainwater Strategy and supporting analytics.	Our new rainwater strategy is being developed to support our ability to manage hydraulic issues (e.g. flooding and spills) and further risks posed by climate change. We will promote alternative drainage options, and develop our understanding of the effectiveness and cost implications of alternative solution across a values framework.	From 2022
N02	Assess the impact that climate change will have on sewer flooding risk in high priority catchments.	Catchments identified through Risk Based Catchment Screening (RBCS) were assessed as part of the Baseline Risk and Vulnerability Assessments (BRAVA). Assessments were run for 2020, 2030 and 2050. Rainfall uplifts were applied for climate change for 2030 and 2050 assessments in line with 2017 UK Water Industry Research (UKWIR) uplift report which uses findings of Met Office UK Climate Projections 2009 (UKCP09) medium emissions scenario.	Complete
N03	Inclusion of latest updated climate change projections and resilience assessments into our 2019 Water Resource Management Plan (WRMP19).	We worked with UKWIR and the Environment Agency to apply the UKCP09 projections for our WRMP19 using best-practice methods. We fully reassessed the effects of climate change on water source yields, water demand and target headroom within the revised plan. Climate change did not trigger a deficit in any of our water resource zones. Our drought plan has been reviewed and updated. It sets out actions for drought events including those significantly worse than on historic record.	Complete

ID	DESCRIPTION	ACTION	TIMESCALE
N04	Inclusion of latest updated climate change projections and resilience assessments into WRMP24.	We worked with UKWIR and the Environment Agency to apply the UKCP18 projections for our WRMP24 using best-practice methods. We fully reassessed the effects of climate change on water source yields, water demand and target headroom within the revised plan. Climate change did not trigger a deficit in any of our water resource zones.	Complete
N05	Ensure drought plan is kept up to date.	We review elements of the drought plan every year through the WRMP and drought plan annual review, and make more substantial changes in response to material change.	Ongoing
N06	Support water trading for future UK supply demand.	We are delivering the Severn Thames Transfer (STT) Strategic Resource Options (SRO) by the Ofwat timelines, and this is included in the WRMP.	Complete
N07	Investigation into algae DNA to develop insight into taste and odour compound formation.	Established collaborative project led by Dwr Cymru Welsh Water and Cardiff University to develop testing of environmental DNA with the aim of identifying species responsible for taste and odour compounds.	Ongoing

ID	DESCRIPTION	ACTION	TIMESCALE
N10	Continue to deliver catchment management activities on United Utilities owned and non-owned catchments.	During 2020-2025 our focus for catchment management will continue to be the Water Framework Directive safeguard zones which are designated areas to be carefully managed to prevent pollution and deterioration of raw water. We will build on our knowledge and experience of working in partnership on non-owned catchments to work with the variety of different stakeholders.	2020-2025
N11	Pledge to restore 1000 hectares of peatland by 2030 as part of our carbon net zero commitment.	The 1000 hectares is an expectation of the area of peatland that will be restored through AMP7 and AMP8 Water Industry National Environment Programme (WINEP) investment programmes. In addition, we have secured a green recovery allowance that will accelerate the delivery of nature based solutions by working in partnership. As part of this programme we plan to deliver 2500 hectares of peatland restoration between 2021 and 2025.	2020-2030
N12	Reduce leakage by 15% reduction from PR14 performance commitment levels by 2024/25.	We are installing 100,000 acoustic leak sensors across the North West and using machine learning to distinguish leaks from other sounds. We are also replacing 100 kilometres of ageing water pipes, and deploying hundreds of sensors to manage pressure in the network and stop pressure surges.	Until 2025
N13	Influence and deliver sustainable growth and development in Greater Manchester through a trilateral partnership with the GMCA and the Environment Agency.	Formation and development of trilateral partnership, to improve flood risk resilience, enhance the environment, drive circular economy approaches and support regeneration through a series of subgroups covering: Place Based Planning; Sustainable consumption; Sustainable production/low carbon; Enhancing Natural Capital; and Resilience to climate change.	Ongoing
N14	Ensure that the impact of climate change is considered in the development of the Drainage and Wastewater Management Plan (DWMP).	A number of assessments have been carried out as part of DWMP development to understand the potential risks posed by climate change. These include BRAVA of flooding and overflow performance and various resilience assessments. As part of the resilience BRAVA an assessment was carried out to understand the impact of climate change on future receiving water quality and the impact that might have on end of pipe permits.	Ongoing

ID	DESCRIPTION	ACTION	TIMESCALE
N15	Integrate climate change within the DWMP.	We have considered climate change within the BRAVA storm overflow performance assessment using UKCP09.	Complete
N16	Pilot our Dynamic Network Management approach to develop an intelligent wastewater network using artificial intelligence and machine learning.	Neural networks have been applied to vast amounts of data across the region, covering sewers, outfalls and pumping stations. The new platform identifies any deviation in expected flow, level and asset performance in correlation to the rainfall conditions. Generating alerts for performance teams when those changes are likely to cause any impact on our customers or the environment.	Ongoing
N17	Mature our water demand forecasting capability.	We will continue to evolve our water demand forecasting capability utilising enriched data sources and new technology. We will work collaboratively with the Met Office to refine and continually improve our short term data model and develop longer term forecasting.	Ongoing
N18	Develop our Freeze Thaw service.	In development with the Met Office we have a Freeze Thaw model that aids our decision making process around possible outbreaks in demand as a result of the Freeze Thaw Process. The model predicts out to 14 days and uses a complex scoring matrix to determine the level of risk to our business.	Embedded
N19	Delivery of Wyre Natural Flood Management (NFM) project and incorporation/dissemination of lessons learnt.	Agreements have been secured with all partners and the project is currently going through final contract sign off. This will then be delivered and represents a 9 year commitment to NFM in the Wyre catchment with the option of extending through to 2070. This is an innovative funding project with potential to change how this activity is delivered more broadly.	2021-2030
N20	Maintain, update and deliver Natural Capital strategy with focus on delivery of greater ecosystem service benefit including climate resilience.	Our first natural capital strategy was completed and signed off in 2020. This is currently being embedded and implemented within the business, this will be subject to regular review and development to ensure targets are met and advances in natural capital thinking are picked up and incorporated.	2020-2050
N21	Supporting IGNITION project to develop financing mechanisms to deliver climate adaptation.	We have supported over the past 3 years, and will continue to support the IGNITION partnership until project completion. This is a partnership with multiple non-governmental organisation, local authority, regulatory and academic partners to identify and develop new financing mechanisms for delivery of climate adaptation measures focusing on flooding and heat island. This seeks to drive far greater delivery of green infrastructure such as sustainable drainage to support climate adaptation in Greater Manchester.	2018-2022

Existing actions

The table below lists actions which have been included in previous reports and provide an overview and update on what progress has been achieved.

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A01	Carry out 2010-2015 flood protection programme. Review flood risks for the next regulatory submission and extend to include service reservoirs.	Assets identified as 'at risk' have been protected. For cost-efficiency reasons, we deferred the River Eden scheme into AMP6 to coincide with planned maintenance at this facility.	Complete
A02	Review emergency electricity supply arrangements for all key assets.	Arrangements have been reviewed and advice from our insurers sought with respect to implementation of additional flood mitigation measures.	Embedded
A03	Carry out flood protection programme (2015 onwards) and continue resilience activities at sites at highest risk of flooding. Include service reservoirs in flood risk work and develop risk plans for all sites through asset planning.	We have assessed whether our wastewater facilities are in a flood risk zone (identified by Environment Agency flood risk maps) and as a result resilience work was identified for 5 facilities. All sites categorised as at risk of flooding now have a Flood Emergency Response Plan (FERP). To safely minimize the business and environmental impact of a flood or spillage event affecting the facility and to ensure a return to normal operation as quickly as possible.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A04	Review Climate Change impact on water resources using UKCP09 and rainfall run off modelling, and review drought plan and standby sources available.	We worked with UKWIR and the Environment Agency to apply the UKCP09 projections for our WRMP14 using best-practice methods. We fully reassessed the effects of climate change on water source yields, water demand and target headroom within the revised plan. Climate change did not trigger a deficit in any of our water resource zones. Our drought plan has been reviewed and updated. It sets out actions for drought events including those significantly worse than on historic record. We are now working with UKCP18 for WRMP24.	Complete
A05	Reassess climate change risk on borehole Deployable Output using more sophisticated UKWIR methodology (looking at more intense rainfall events and increased evapotranspiration).	Ground water is now considered as integral part of our WRMP that uses UKCP18 data and scenarios.	Embedded
A06	Complete 2010-2015 water treatment works (WTW) and SCaMP investment and continue to maintain WTWs and water supply catchments.	Planned water treatment quality investment and to maintain water treatment works have been completed. In addition, some water treatment works have been fitted with water quality failsafe shutdown triggers. For surface water sources these are based on a series of water quality triggers at key stages of the treatment process. For groundwater sources turbidity monitors have been installed.	Embedded
A07	Understand risks for those sites without appropriate treatment capability (Algal growth and micro-organisms).	Algal blooms can necessitate the requirement for secondary treatment to reduce the occurrence of taste and odour issues. We have identified sites that have repeated circumstances of algal growth and therefore are at risk of taste and odour issues. We have installed Granular Activated Carbon (GAC) treatment at these sites but we also use Powder Activated Carbon (PAC) as a temporary treatment option for other sites that need it on an ad hoc basis.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A08	Continue to closely monitor and review chlorine residual requirements throughout WTW to tap.	Monitoring at supply points is routinely done to meet both company and regulatory standards. A 'Site Specific Disinfection Policy' was established where chlorine treatment protocol is specified for each site, rather than having regional/catchment standards. This allows for local variations to be accounted for and titrated against. Monitoring enables appropriate treatment values to be defined and also the effectiveness to be assessed.	Embedded
A09	Review risks, to identify likelihood regarding Tidal limits moving upstream and increasing salinity at intakes (e.g. constant or spring tide) and develop mitigation/adaptation measures for River Dee and River Lune intakes.	The flood protection programme indicated that only one site has the potential to be affected by tidal intrusion; Low Shaw Pumping Station (Millom, Cumbria).	Complete
A10	Continue statutory 10 yearly inspections of impounding water bodies, supervising engineer reservoir inspections and maintenance programme.	Inspections have been completed as required with no significant issues arising.	Complete
A11	Complete programme of work to enhance spillways design to prevent damage to masonry structures during intense rainfall events.	Work to enhance spillways was completed at nine target sites.	Complete
A12	Carry out studies on impact of climate change on increased drawdown and duration of drawdown on earth embankments. Assess measures to protect upstream face of earth dams if required.	Reviewed probability of earth slips causing overtopping. During 2015-25 we will carry out studies on the impact of climate change on increased drawdown and duration of drawdown on earth embankments and assess measures to protect upstream face of earth dams if required.	2015-2025

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A13	Sustainable Catchment Management Programme (SCaMP) investigation into correlation between land condition and raw water quality.	The SCaMP programme includes monitoring to observe and measure the effectiveness of the intervention actions taken. Comparisons are made between locations impacted by project activity and historic data and control sites elsewhere in the region. Observed trends in colour production and delivery in stream flow are beneficial, with many SCaMP catchments showing a stationary, or else improving raw water quality, which is opposite to many untreated, un-restored upland blanket bog catchments in the UK uplands, where colour appears to be continually increasing year on year.	Complete
A14	Continue to deliver catchment management activities on United Utilities owned and non-owned catchments.	During 2015-20 our focus for catchment management was on the Water Framework Directive safeguard zones which are designated areas to be carefully managed to prevent pollution and deterioration of raw water. We utilise knowledge from pilots to work in partnership on non-owned catchments to work with the variety of different stakeholders.	Embedded
A15	Increase use of turbidity monitors for sites at risk of elevated turbidity as a surrogate for adverse water quality.	Turbidity adversely impacts the effectiveness of chlorine treatment with the potential consequence of residual pathogens. Turbidity measurements can therefore be correlated to water quality challenges and can be used to titrate chemical dosing for instance of coagulants.	Embedded
A16	Deliver Climate Change Investment (supply and demand actions) including West-East Link pipeline and South Egremont Boreholes.	Construction of the 50km West-East Link pipeline was completed and South Egremont boreholes have been constructed.	Complete

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A17	Reduce leakage by 28.4Ml/d and demand by 16Ml/d through demand management activities such as the water efficiency programme and customer metering.	We implemented a wide range of activities to encourage our customers to be more water efficient, and exceeded the water efficiency targets set by Ofwat of 1 litre per property per day saving each year between 2010 & 2015. In West Cumbria where there is an urgent need to promote water efficiency we launched a bespoke water efficiency campaign called 'Watertight'. We have maintained an extensive programme of leakage control actions and met or outperformed our regulatory target every year since 2007. We also took to the skies to in an award winning project using aerial surveys to detect leaks on rural large diameter pipes in West Cumbria.	2010-2035
A18	Review WTW treatment capabilities for sites where ground water and surface water sources are blended during droughts.	Our Drought Plan sets out the actions we will take to protect water supplies should a severe drought occur. Customer acceptability of water is a fundamental consideration where blending or change of source is required.	Embedded
A19	Continue to upsize priority sections of sewer (increase sewer network capacity) to alleviate hydraulic inadequacy and provide mitigation to customers.	We have been delivering our hydraulic flooding and unsatisfactory intermittent discharge programme 2010-15 which includes increased capacity to alleviate hydraulic inadequacy. To date we have delivered 107 DG5 flooding projects (benefitting 520 properties) at a cost of £119m. The programme for 2015-20 plans to further reduce sewer flooding. One way in which this is being implemented is by including in all projects allow for an additional 10% storm rainfall volume specifically for climate change. In PR19 we developed the Hydraulic Flood Risk Resilience measure around which we have developed a programme of interventions in AMP7 aimed at reducing flood risk at repeat flooding properties as well as conducting a review of our mitigation programme to maximise effectiveness.	Ongoing

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A20	Investigation to enhance network models (coverage and capability). Prioritise wastewater treatment works (WwTWs) and drainage networks according to their relative exposure to the impact of climate change.	We continue to develop and maintain our regional models. Future design requirements and climate forecasting are factored into our models for long term resilience. Development of these models has continued and is being used as part of the DWMP scenario modelling, of which climate change is a key part and the Risk of Flooding in a Storm measure which tracks the percentage of the region at risk of flooding in a 1 in 50 year storm.	Embedded
A21	Joint working with the Environment Agency and Local Authorities on surface water management issues.	We have initiated flood partnership meetings across our region with local authorities and the Environment Agency representatives. Jointly funded solutions were considered in priority areas (for delivery in 2015-20) where it is cost effective to do so. We attend Local Resilience Forums (LRFs) with response partners including the Environment Agency, local authorities and emergency services. We developed a fully integrated hydraulic model of the entire drainage system with in the with Liverpool City Council area and worked with them to assess the interaction with our drainage systems in the catchment. We are supporting Defra working groups advising on the implementation of the Flood and Water Management Act 2010, and the encouragement of using Sustainable Drainage Systems (SuDS) on new developments now being implemented though changes to national planning guidance.	Embedded
A22	Continue with our Integrated Asset Planning (IAP) approach.	We have developed our IAP with specific methodologies for identifying integrated solutions for network and treatment assets which includes the impact of climate change.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A23	Sustainable drainage demonstration project.	The SuDS retrofitting demonstration project has been completed and we assessed 4 sites for possible SuDS solutions.	Complete
A24	Implement recommendations from the sustainable drainage demonstration project.	We have created a £9m programme for the installation of SuDS and NFM as part of our Green Recovery submission. This will enhance our systems, tools and processes when delivering BGI in partnership. An example of this, the SuDS studio tool has been further developed and to better understand future opportunities. Other schemes are our partnership with the RHS, the Ignition Project and SuDS for Schools programme.	Complete
A25	Use UKCP09 scenarios to review climate change risk assessment and adaptation plans as part of on-going wastewater asset planning.	UKCP09 has been compared with the Climate Modelling Inter-comparison Project (CMIP5) published in 2014. There are differences in the model outputs in relation to summer rainfall patterns but broadly they are consistent and UKCP09 is still considered to still to provide the most a valid UK climate predictions.	Complete
A26	Improved sewer monitoring and targeting of intervention on network to reduce service failure.	Our Wastewater network management Project considered different activities to improve how the network performs examples include sewer monitoring, remote control capability, improving asset records, and using models with accurate forecasting. The objectives of the project were to improve decision making as the data is available and consistent, enabling interventions at the right time and place as a result of monitoring and performance analysis and to build scenario and fact based response plans to reduce the impact on our customers if an incident occurs. In addition to our Wastewater network management our Sewerage Management Planning (SMP) modelling allows us to identify places at particular risk of flooding and enable preventive and mitigation actions. The learning from these activities has now led to the development of DNM and fed in to the DWMP.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A27	Identify Sewer monitoring investment requirements for 2015-2020.	We will progress the roll out of a wider programme of in sewer monitoring in prioritised areas. This includes monitoring on Combined Sewer Overflows. We have installed spill monitoring on 239 named intermittent discharges by March 2018. These discharges impact on high amenity water bodies. An additional 1800 storm discharges were fitted with event duration monitors (EDMs) by 2020.	Complete
A28	Integrated Catchment Modelling (ICM) work with the Environment Agency to identify future water quality improvements required by legislation.	We have completed ICM modelling for all high priority catchments. We have embedded the outputs into our Integrated Asset Planning approach and Sewerage Management Plans and use outcomes to inform investment plans for future water quality improvements.	Embedded
A29	Long-term surface water management activities.	We are actively involved in pursuing a more sustainable approach to surface water drainage at many levels; involvement with Defra/Department for Communities and Local Government (DCLG) on SuDS implementation, working with the Regional Flood and Coastal Committee, liaison with the Lead Local Flood Authorities and local partnerships with LAs and the Environment Agency.	Embedded
A30	Short-term surface water management activities.	We have an appropriate maintenance operating regime to ensure customer service does not deteriorate. All asset failures are logged for input to our common framework tool enabling us to predict the expected long term performance of our assets. Consequences are reviewed based on failures to obtain an updated consequences model to feed back into the system.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A31	Changes to asset design standards to - Accommodate changed usage profile; - Accommodate or withstand corrosion; and - Remove the need for recirculation.	We will continue to maintain our assets and review asset standards taking account of climate change impacts when planning over the next 25 years for instance to account for increased rainfall. Asset standards will be amended if appropriate. Asset design standards have been updated to take account of future hydraulic conditions. Appropriate hydraulic assessments are also undertaken to take account of current and future inflow compared to pumping capacity.	Embedded
A32	Review asset design standards against CP09 scenarios to identify unsustainable practices and amend for 2015-2020.	The network modelling team have reviewed the UKCP09 scenarios and amended asset design standards against them. We have uplifted the rainfall intensities over 25 years as projected which is in line with Environment Agency/Defra guidance. Revised asset standards have been updated to take account of climate change.	Embedded
A33	Short term – increase chemical dosing into sewers and at WwTWs to prevent gas creation.	We are continuing to use chemical dosing where it is appropriate to do so.	Embedded
A34	Involvement in national work on the management of flooding from sewer to land under the Waste Regulations.	Wastewater escaping from the sewerage network is classed as controlled waste under the EU Waste Framework Directive. We have been involved in Defra working groups to advise implementation of the Flood and Water Management Act 2010 and with the Environment Agency and other parties on SuDS implementation. We continually influence implementation of the SuDS hierarchy contained in planning policy guidance, yet find no right or recourse or escalation where an LPA/LLFA are non-compliant. We continue to experience numerous opportunities missed due to developer pressure and local authority apathy and can provide examples on request. It is currently envisaged that schedule 3 of FWMA 2010 may be enacted in England through the forthcoming environment bill. We continue to explore SuDS opportunities through retrofit or initiatives such as SuDS for Schools, IGNITION and the green roof pilot in Manchester.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A35	Work with our energy supplier to identify critical sites and develop a plan to manage the risk of outages and service failure.	We work closely with Electricity North West's (ENW) to support independent resilience. We are delivering more self-generation of renewable energy. This will reduce our reliance on the grid in order to build resilience to power outages. We also have contracts set up with back-up generator suppliers for critical sites. Energy management plans for each area aim to reduce energy consumption through site specific initiatives.	Embedded
A36	Piston effect study to investigate solutions to relieve the impact of rapid variation in inflows/dilution to WwTWs.	The piston effect is a theoretical steep increase in load caused by a "first flush" increased flow in a storm. This higher concentration may not be treatable causing permits to be exceeded. Studies on a sample of works gave mixed results. The observed piston effect varied according to site but it was typically lower than previously estimated. Further investigation revealed that investment was not economically viable though recirculation will continue to be considered as an option for the future. In the meantime the effect will be managed at site level.	Embedded
A37	Implement the investment identified by the piston effect study.	No viable investment identified.	Complete
A38	Implement the investment identified by Integrated Catchment Modelling (ICM) and carryout further modelling to identify future water quality improvements in light of better information on climate impacts on base flows.	We have an evolving programme of work identified in the National Environment Programme based on the modelling outputs to deliver Water Framework Directive requirements.	Embedded
A39	Short-term approach to addressing lower average peak flows.	Business as usual practice is to manage and monitor, in real-time where appropriate.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A40	Produce an odour management plan for all sites using a risk based approach. Identify sites where there is a case for investment.	Odour management plans are in place for all appropriate wastewater treatment sites. These individual plans vary in scale and complexity, depending on the nature of the site.	Embedded
A41	Implement the investment identified by odour management plans. Review the plans and identify further investment required.	At the highest priority sites, odour control investments were delivered as part of our business plans for 2015-2020.	Embedded
A42	Continue involvement in national Research & Development work regarding changes in domestic waste disposal practices impacting dry weather flow pollutants.	In 2011 it was expected that use of domestic macerators would increasingly cause additional network issues (e.g. blockages) and nutrient load challenges. Since then local authorities have dramatically extended their door to door food waste recycling reducing the shift towards domestic maceration. Domestic Maceration is still at a low level.	Embedded
A43	Investigation/trial UV treatment of storm discharges.	A study has been undertaken on UV storm treatment of discharges however this method will not be taken forward as the Environment Agency had concerns regarding this method of treatment.	Complete

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A44	Identify investment required in 2015-2020 for UV trial.	No longer applicable.	Complete
A45	Implement the investment identified by the UV trial.	Additional capacity has been delivered through developments at Shell Green and Davyhulme facilities	Complete
A46	Produce detailed action plan identifying alternative biosolids disposal routes.	Additional incineration capacity plant was provided an alternative disposal route, but has since been superseded. Detailed planning was achieved through rollout of the Regional Sludge Operational Management programme (RSOM).	Embedded
A47	Carry out modelling work to identify land areas for sludge recycling at risk from flooding.	The land bank has been mapped against the Environment Agency Flood Map. A report was produced on flood risk, implications for the land bank and mitigation measures should flooding take place. Any loss in land bank can be absorbed and mitigated against by disposing of sludge to non-flooded areas, supported by RSOM.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A48	Review the type and number of insurance claims to inform work to reduce or remove the risk where appropriate.	We have continued to monitor the claims numbers and values across our assets and public liability. As our exposure through 2010 to 2014 had not increased, and this suggests our exposure had not increased. We produced 21 'facility resilience assessments' for our insurers based on our high value/high risk sites from climate change impacts. These document the risk of the sites flooding.	Embedded
A49	Work with suppliers to help them adapt to the impacts of climate change.	We have requested carbon reduction plans from key suppliers, prioritising Network Maintenance suppliers first as they are larger contributors based on analysis of available data. In addition, we are taking action to further explore with some of our key suppliers in 2022.	Embedded
A50	Identify lessons learned from previous emergency events and put measures and actions in place.	Business Continuity Plans produced for each business area stipulate arrangements for severe weather/emergency situations. Severe weather arrangements are also put in place during winter. Teams are also advised to cross-skill and document procedures and for office based staff there is now increased provision for remote working including on own devices.	Embedded
A51	Work with operational delivery partners to identify potential resources for emergency events.	Business Continuity Plans are in place for each business area and stipulate arrangements for severe weather/emergency situations. These include reprioritising work, including that done by partner organisations, so that resources are effectively utilised in the circumstances.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A52	Use study by NHS to inform actions.	The latest heat wave plans for England are obtained and advice is used to inform actions in the event of a heat wave.	Embedded
A53	Continue to monitor and implement health and safety policies related to hot weather risks.	UU has a belief for health and safety which aims to make UU a safer place to work; “Nothing we do is worth getting hurt for”. This applies to all of our business regardless of the nature of the work or the particular risk entailed.	Embedded
A54	Minimise the impact of flooding by providing mitigation to customers.	Our mitigation team deliver local bespoke solutions such as non-return valves, flood gates and doors, sump and pumps, ground re-profiling, waterproof coating and smart air bricks. In AMP7, we have expanded and refocussed our mitigation programme to prevent repeat flooding. While not considered mitigation, we have also developed a programme of cellar disconnections.	Embedded
A55	Establish Integrated Control Centre ICC.	Since 2013 we have established the Integrated Control Centre to centrally monitor, control and report on performance for both water and wastewater sides of our wholesale activities. As the wastewater network management pilots deliver enhanced monitoring and control of our wastewater system outputs will, where possible, be integrated into the ICC. The centralisation of this capability has allowed efficient interventions to be undertaken either remotely or efficiently scheduled in a consistent manner.	Embedded

ID	ACTION DESCRIPTION	PROGRESS/OUTPUT	TIMESCALE
A56	Investigate further opportunities for Sludge treatment and use.	We are reviewing other low cost, flexible routes for sludge such as treating to use as top soil post construction or in wider agricultural settings. SBAP reduces pathogen levels which will increase the potential locations/ ale opportunities. In addition to more incineration capacity we are considering de-watering and storage and other technologies. Assessment of flood risk every 5 years where the land bank is most affected by flooding, especially around the River Alt catchment	2015-2020
A57	Develop framework for implementation and maintenance of SuDS for new developments.	In December 2014 the government announced that they would not be enacting the SuDS element of the Floods and Water Act 2011 but would be seeking to encourage more SuDS by strengthening planning policy. We are taking a positive approach and seek to support from developers to build effective drainage solutions to more sustainably manage surface water runoff in the North West.	Embedded
A58	Reduce impact of freeze/thaw events.	Install more insulation to water treatment works to prevent freezing. Implemented following 2010-11 winter which was the coldest since 1890.	Complete

A.3 Water industry risk reporting template

This section outlines risks that have been identified through the second Climate Change Risk Assessment (2017) and the actions that we have in place to address them. An assessment has been made against the likelihood (L), magnitude (M) and our understanding (U) of the risks.

CCRA2 RISK DETAIL	L	M	U	ACTIONS	TIMESCALE	METRICS
In1: Risks of cascading failure from interdependent infrastructure networks	**M**	**M**	**M**	Partnership working through our Systems Thinking approach supports collaboration and knowledge sharing in order to effectively identify and mitigate interdependent risks, such as those shared with power suppliers. Our Catchment Systems Thinking (CaST) approach encourages us to think differently and go beyond our owned catchment land. Looking at the wider environment and incorporating natural capital decision making to consider what is best for the environment, customers and communities by integrating whole catchment risks by factoring in stakeholders from across the system. Business continuity processes are in place in the event of failure within an interdependent network (e.g. transport, power), and we engage with businesses with which we share an independent infrastructure to identify and address risks. We actively participate in multi-agency response exercises, as a tier 2 civil contingencies act responder, this enables us to share information and policies with other service providers and better understand our cascade failure risk. **1.2 Engaging with our stakeholders** **3.5 Understanding Interdependencies**	**5 year cycle** Investment within asset management period.	Water supply interruptions Unplanned outage Water service resilience

CCRA2 RISK DETAIL	L	M	U	ACTIONS	TIMESCALE	METRICS
In2: Risks to infrastructure services from river, surface water and groundwater flooding	**H**	**H**	**H**	Green and sustainable interventions are considered where suitable to reduce flooding risk identified as part of extensive flood risk assessments, and explored further as part of our CaST approach to managing our catchments with other land owners, partners, and the Environment Agency. We collaborate and work in partnership with the Lead Local Flood Authorities (LLFAs) in our region to ensure a joined up approach to understanding and mitigating flood risk to communities and infrastructure including our vulnerable assets. Extensive flood risk assessments, using the latest fluvial (including coastal) and pluvial flood extent projections, across multiple return periods, support the identification of risk to flooding of operational sites from all surface and ground water sources. Enhancements to critical assets vulnerable to flooding have been completed and updated asset design standards support suitable adaptation to flood risk. In addition we have modelled over 99 per cent of our drainage network to simulate overland flow patterns, considering the typography of the land that surrounds our assets. Using this model we have developed our approach to incorporate flooding risk into our DWMP Baseline Risk And Vulnerability Assessments (BRAVA). Enhanced planning and defence capabilities have been developed for at risk sites which permit the deployment of temporary flood protection assets to maintain resilient services. **3.2.2 Wastewater** **3.3 Business wide**	**5 year cycle** Investment within asset management period. **25 year cycle** Investment needs identified through DWMP and WRMP.	Water supply interruptions Unplanned outage Water service resilience Raising customer awareness to reduce the risk of flooding

CCRA2 RISK DETAIL	L	M	U	ACTIONS	TIMESCALE	METRICS
In3: Risks to infrastructure services from coastal flooding and erosion	**M**	**M**	**H**	Partnership working through our Systems Thinking approach across catchment areas supports multi-benefit approaches to projects to ensure flood risk protection is in place. Coastal flood risk assessments have been included within our approach to all flood risk assessment. Long-term strategy includes erosion risk evaluation as part of our BRAVA resilience assessments, including both river and coastal erosion factors cross referenced against assets type, land type and potential slope instability. Identifying risks and opportunities to reduce the likelihood and magnitude of impact from erosion. **3.2.4 Environment** **3.3 Business wide**	**5 year cycle** Investment within asset management period. **25 year cycle** Investment needs identified through DWMP.	Water supply interruptions Unplanned outage Water service resilience Raising customer awareness to reduce the risk of flooding
In4: Risks of sewer flooding due to heavy rainfall	**H**	**H**	**H**	Partnership working through our Systems Thinking approach across catchment areas supports multi-benefit approaches to projects to ensure flood risk protection is in place. Long-term strategy through the DWMP identified risk and opportunity to action in order to reduce the likelihood and magnitude of impact from sewer flooding. Technology driven approaches to network management are being developed to provide further opportunity for proactive response to sewer flooding. **3.2.2 Wastewater** **3.3 Business wide**	**5 year cycle** Investment within asset management period. **25 year cycle** Investment needs identified through DWMP.	Internal sewer Flooding Risk of sewer flooding in a storm Sewer collapses External flooding incidents Raising customer awareness to reduce the risk of flooding Hydraulic internal flood risk resilience Hydraulic external flood risk resilience

CCRA2 RISK DETAIL	L	M	U	ACTIONS	TIMESCALE	METRICS
In5: Risks to bridges and pipelines from high river flows and bank erosion	**L**	**M**	**M**	Criticality assessments for identified at risk pipe lines and bridges, identified following lessons learned from previous events with local response and recovery plans developed, supported by a centralised view of network performance data and early warning detection systems. Regional emergency response capability provided by alternative supply vehicles and network maintenance providers. Strategic crossings of our large diameter trunk main systems inspected regularly for asset condition. Long-term strategy includes erosion risk evaluation as part of our BRAVA resilience assessments, including both river and coastal erosion factors cross referenced against assets type, land type and potential slope instability. Identifying risks and opportunities to reduce the likelihood and magnitude of impact from erosion on wastewater assets. **3.3 Business wide**	**5 year cycle** Investment within asset management period. **25 year cycle** Investment needs identified through DWMP.	Water supply interruptions Unplanned outage Water service resilience
In8: Risks to subterranean and surface infrastructure from subsidence	**L**	**M**	**M**	Project specific risk assessments undertaken in areas of known subsidence risk when planning investment. Geotechnical expertise is maintained within the company supported by external experts such as the British Geological Survey (BGS) and Coal Authority to understand risk and develop mitigation measures. Industry best practise approach to monitoring and inspecting statutory impounding water bodies to detect and asses the effects of movement/subsidence on the asset base. Risk assessments of slope instability in close proximity to operational wastewater assets. Identifying risks and opportunities to reduce the likelihood and magnitude of impact. Risk assessments of critical catchment land to landslip potential putting surface infrastructure at risk. Natural land stabilisation schemes to reduce risk exposure. **1.2 Engaging stakeholders** **3.2.4 Managing our environment** **3.3 Business wide**	**5 year cycle** Investment within asset management period.	Water supply interruptions Unplanned outage Water service resilience

CCRA2 RISK DETAIL	L	M	U	ACTIONS	TIMESCALE	METRICS
In9: Risks to public water supplies from drought and low river flows	**M**	**H**	**H**	Partnership working through our Systems Thinking approach and Water Resources West leading involvement. Including developing future raw water transfer schemes between companies and regions. Long-term strategies developed through the WRMP provide a climate change aware assessment of future water resource requirements, against a range of possible future climate change and demand scenarios. This is supported by an 'explore all options' approach to mitigating the risks identified. Commitments to halve leakage by 2050 and reduce water consumption to 110 litres per person per day, to provide resilience in the supply demand balance. Drought mitigation is outlined by our drought plans, supported by a strong governance and prescribed trigger levels and system performance monitoring. Drought plans are reviewed annually. **3.1 Managing Risk** **3.2.1 Water, Managing water sufficiency** **3.2.4 Managing our environment**	**5 year cycle** Investment within asset management period. **25 year cycle** Investment needs identified through WRMP.	Water supply interruptions Leakage Per capita consumption Unplanned outage Risk of severe restrictions in a drought Reducing areas of low water pressure Water service resilience
In14: Potential benefits to water, transport, digital and energy infrastructure from reduced extreme cold events	**M**	**L**	**L**	We use up to date time series climate data (observed) and forecast (climate change) in our WRMP process to understand the likely supply and demand requirements as part of our long-term planning. Climate trends will therefore be included in our cyclical review of future supply and demand requirements, taking into account the reduced likelihood of future freeze thaw events resulting in seasonal high demand (leakage) occurrences. Warming temperatures to the point at which extreme cold events become less likely is a long-term factor. We will continue to maintain our polices of cold weather preparedness to ensure that our sites remain operational and that access to sites as a result of winter weather conditions, for both our operational teams and supply chain deliveries, are proportionate to the risks. **3.6 Opportunities**	**Variable** Reviewed on a rolling basis.	Water supply interruptions Unplanned outage Water service resilience