Dŵr Cymru
Welsh Water

CLIMATE CHANGE ADAPTATION REPORT

2023

CONTENTS

GLOSSARY AND ABBREVIATIONS

Term	Definition
Climate	Long-term weather conditions in an area. *World Meteorological Organisation*
Climate adaptation	Anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause or taking advantage of opportunities that may arise. This includes responses to actual or expected climatic stimuli. *United Nations Framework Convention on Climate Change (UNFCCC)*
Climate change	A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. *UNFCCC*
Climate hazard	Any identified climate-related event or long-term change to which Welsh Water assets can be vulnerable. These hazards are described as either "slow in their onset" (such as changes in temperature and precipitation leading to droughts, or agricultural losses), or more sudden (such as tropical storms and floods). *UNFCCC*
Climate mitigation	Mitigation of climate change is defined as a human intervention to reduce emissions or enhance the sinks of greenhouse gases. Note that this encompasses carbon dioxide removal (CDR) options. Mitigation measures include technologies, processes, or practices that contribute to mitigation. *The Intergovernmental Panel on Climate Change (IPCC)*
Climate risk	The potential impacts of climate change on an organisation, including physical risks that can be event-driven (acute), and related to longer term shifts (chronic) in precipitation and temperature and increased variability in weather patterns. Climate-related risk can also be associated with the transition to a lower-carbon global economy, linked with policy and legal actions, technology changes, market responses and reputational considerations. All categories of risk are a combined result of the hazard, level of exposure and existing vulnerability. *Task Force for Climate-Related Financial Disclosures (TCFD), Implementing Guidance Glossary (2021).*
Interdependencies	A single hazard can have knock-on impacts across a range of sectors, amplifying the resulting risk. Similarly, risks can interact across different sectors; impacts on infrastructure can cascade through to the built environment and natural environment, and vice versa. The extent depends on the magnitude of the disruption, the strength of the interdependencies and the ability to adapt. *C40 Cities Climate Leadership Group, How to manage infrastructure interdependencies and cascading risk (2022).*

Term	Definition
Physical climate risk	Risks caused by physical climate change hazards to infrastructure and natural systems (e.g. drought). Physical risk is a combined result of the hazard, level of exposure and existing vulnerability. *IPCC, Sixth Assessment Report (2022).*
Representative Concentration Pathway (RCP)	RCPs are scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs), aerosols, and chemically active gases, as well as land use and land cover. The word 'representative' signifies that each RCP provides only one of many possible scenarios that would lead to the specific radiative forcing characteristics. The term 'pathway' emphasises that not only the long-term concentration levels are of interest, but also the trajectory taken over time to reach that outcome. These pathways have been used in the latest UK Climate Projections, UKCP18, as they incorporate a more comprehensive range of factors as well as the latest climate science. They also form the basis of our climate change planning and adaptation activities, as can be seen in this report. *Met Office, UKCP18 Guidance: Representative Concentration Pathways (2018).*
Transition risk	Risks that arise as a result of economic and regulatory transition toward a low carbon future. Depending on the nature, speed, and focus of changes, transition risks may pose varying levels of financial and reputational risk to organisations. You can see our latest TCFD disclosure in our 2022/23 Annual Report and Accounts[1]. *TCFD, Recommendations of the Task Force on Climate-related Financial Disclosures (2017).*
Weather	The state of the atmosphere at a particular place and time. Elements include temperature, precipitation, storminess, and cloudiness, and is influenced by latitude, altitude, and local and regional geography. *National Geographic Society*

List of Abbreviations

AMP	Asset Management Period (AMP7 is 2020-25, AMP8 is 2025-2030)
CEO	Chief Executive Officer
DWMP	Drainage and Wastewater Management Plan
ESG	Environmental Social Governance
ERM	Enterprise Risk Management
IPCC	Intergovernmental Panel on Climate Change
LTDS	Long-Term Delivery Strategy
PCC	Per Capita Consumption
PFAS	Per- and polyfluoroalkyl substances
RCP	Representative Concentration Pathway
SDG	Sustainable Development Goals
SO	Storm Overflows
UK	United Kingdom
UKCP18	UK Climate Projections 2018
UKWIR	United Kingdom Water Industry Research
WRMP	Water Resources Management Plan

FOREWORD

Climate change is a global existential threat. Water is on the front line in terms of its impacts – whether it drives increased drought, storms, flooding, or sea level rise inundating communities.

Doing all we can to adapt to the challenges of climate change, so we can continue to provide affordable and resilient services, is one of our primary responsibilities and a growing priority for our customers. Wales, I am proud to say, was the first country in the world to declare a climate emergency. Our government was also the first globally to have set out in law a Future Generations Act, ensuring that any decision public bodies make today must be the right thing for our children and grandchildren, and their children too. Our 2050 Vision, closely aligned to both the Well-being of Future Generations (Wales) Act 2015 and to the UN Sustainability Goals, sets our purpose as "providing high quality and better value drinking water and environmental services so as to enhance the well-being of our customers and the communities we serve, both now and for future generations to come". Adapting and mitigating the impacts of climate change are therefore, both critical for us as a business if we are to deliver our Vision and Purpose.

Recent flooding and dry weather events, both in Wales and globally, have reminded us of the havoc our changing weather is already wreaking. The science is telling us events such as these will continue to increase and intensify as our world gets warmer. As the principal provider of water and wastewater services in Wales, we are driving our science and innovation agendas forward to both support our net zero ambitions, and also to adapt our asset base to meet the challenges that are yet to come. The global climate outlook is grave, and we will not shy away from driving our emissions down to meet our net zero target at a pace our customers can afford, or from making our assets more climate resilient by deploying the latest science and technology to ensure our services can continue uninterrupted. All the while, we must be conscious of the affordability of services for our customers, particularly in a period of significant financial hardship and uncertainty. As a non-shareholder company, we are able to be guided solely by what is in the best long-term interests of our customers and the environment.

But we cannot adapt to climate change without the support and action of others. We are impacted by how others manage their land in the catchments from where we abstract water and their surface water drainage which connects into our sewerage system. Working in partnership with government, local authorities and landowners remains key for our plans to adapt affordably to climate change. One thing is certain, without the support of our partners in government, local authorities and our regulators, preparing and meeting the impact of climate change will be very challenging. Together as 'Team Wales', by preparing well, and then delivering the resilient new infrastructure we need, I am confident we can adapt and meet the demands placed on us at a price our customers can afford.

Our AMP8 (2025-2030) climate change plans for adaptation are focused on 'no/low regrets' activities and investments. These include driving leakage down; increasing customer metering; helping customers reduce their water use; protecting water quality and improving biodiversity; investing in further sustainable urban drainage systems and nature based solutions, and driving innovation and technology developments. We will also be undertaking extensive environmental monitoring and asset planning work, so as to improve the confidence in our two main planning tools for the longer term – our drainage and waste water management and water resource management plans.

Our plans for AMP8 also include considerable investment in areas which are likely to be significantly impacted by a changing climate, including tackling storm overflows, improving wastewater treatment, and replacing mains that are bursting more frequently in hot, dry conditions. We have already started on a journey to enhance our resilience, and we are proud of what we have achieved. There is more to do, and to enable us to take an adaptive approach, we will monitor our progress including updating this Climate Change Adaptation Report at least every five years.

By the next iteration of this Climate Change Adaptation report in 2027 we look forward to being better placed to narrow down the likelihood of adaptive strategies being triggered. We will have better models to predict the future climate, and how our assets will respond, and we will have developed and implemented new technologies to assist us to find affordable solutions to this challenge for our customers and society.

Peter Perry
Chief Executive Officer

EXECUTIVE SUMMARY

A CHANGING CLIMATE

There is unequivocal evidence that climate change is happening now. We know that we need to mitigate climate change to keep alive the aim of global temperature increases no higher than 1.5°C[2], a target countries have pledged to under the the 2015 Paris Agreement on climate change. At the same time, we need to be preparing for the worst effects of a changing climate. We must plan and prepare for higher global temperatures and its effects. Our customers expect no less.

The main hazards that we can expect to face as a result of climate change are:

- Warmer, drier summers
- More intense rainfall
- Increased flood risk of all types
- Higher sea levels

As well as the principal risks that are the focus of this report, we have also identified other risks of relevance to our organisation. These can be found in Appendix A.

OUR PRINCIPAL CLIMATE CHANGE RISKS

We have worked to identify the principal climate change risks that we face as an organisation:

CLIMATE HAZARD	RISK	
Extreme weather events: flood and storms	P1	**Inundation of sewer networks in high rainfall events.** There is a risk of sewer inundation during periods of increased rainfall intensity or duration, leading to a pollution event (internal/external flooding, Storm Overflow (SO) discharge).
Extreme weather events: drought and hot weather	P2	**Climate change impact on drinking water quality.** There is a risk that drought conditions change the composition of raw inlet water to treatment plants, changing the chemical treatment regime and the ability to treat the same volume of water.
Extreme weather events: drought and hot weather	P3	**Increase in customer demand under hot conditions.** There is a risk that customers require more water under hot conditions, limiting the ability of Welsh Water to adequately meet local demand.
Extreme weather events: flood and storms	P4	**Risk to our assets during extreme weather events and sea level rise.** There is a risk that our assets (e.g. treatment works, pumping stations, pipework) are damaged during high rainfall and other extreme events, leading to an inability to supply customers or a pollution event.
Extreme weather events: flood and storms	P5	**Risk to infrastructure supply chains during extreme weather events.** There is a risk to other infrastructure systems on which we rely through the direct impact on telecoms, transport or energy infrastructure damage and disruption.

RISING TO THE CHALLENGE

Our Welsh Water 2050 strategy sets our mission: "to become a world-class, resilient, and sustainable water company water service for the benefit of future generations". This means that we must be prepared to overcome and adapt to the stresses, shocks and challenges of climate change, so that we can meet the needs of customers, society, and the environment both today and long into the future.

All the while, we must be conscious of the affordability of services for our customers, particularly in a period of significant financial hardship and uncertainty. As a non-shareholder company, we are able to be guided solely by what is in the best long-term interests of our customers and the environment. However, we cannot adapt to climate change without the support and action of others. We are impacted by how others manage their land in catchments where we abstract and their surface water drainage which connects into our sewerage system.

There has been a lot of recent focus on the operation of storm overflows (SO), and while we agree that we need to reduce their impact, we need to be mindful of how we do this. Just removing overflows would exacerbate flooding risk to customers. More sustainable approaches to managing rainwater runoff require strong partnerships to be forged and so take time to deliver. We are committed to working closely and collaboratively with the Welsh Government, local authorities, our regulators and other stakeholders as 'Team Wales', all guided by the Well-being of Future Generations (Wales) Act 2015, to deliver the performance and sustainability customers expect in the face of climate change.

WHAT WE ARE DOING NOW

Climate change adaptation is focused on addressing the potential physical impacts of climate change: adjusting systems, processes and practices in response to the changing climate, both extreme events such as flooding and heatwaves and long-term stresses such as sea level rise. We are planning to adapt to a world that is 2°C warmer in 2050. At the same time, we will prepare for the effects of more extreme warming (4°C) by the end of the century.

Between 2025-2030 (which we refer to as Asset Management Plan 8 or AMP8), subject to agreement of funding for our business plan, we expect to make significant progress in improving our monitoring and modelling, so that we can produce robust, higher confidence improvement plans both for water resources, drainage and wastewater management and asset maintenance. These improvements to our plans will be captured and set out in our next Climate Change Adaptation report in 2027.

We will also invest in AMP8 and beyond in adaptation activities as part of 'no/low regrets' programmes including those described in our Long-Term Delivery Strategy[3] (LTDS):

Leakage
We will deliver significant reductions in leakage by 2030, set within a longer-term ambition to halve leakage levels by 2050.

Customer metering
We will proactively install meters as part of our progressive metering strategy, moving towards full metering by 2035. This will enable us to better understand customer use of water and to support customers in using water more efficiently ahead of switching to metered bills on change of occupancy.

Water efficiency
We will enhance water efficiency messaging to customers and businesses, in order to achieve the ambitious PCC target of 110 litres per person by 2050 and reducing business demand by 9%.

Catchment management
We will continue to enhance the condition of our water catchments, working in partnership with others to protect water quality and improve biodiversity.

Sustainable Urban Drainage systems (SuDS) and Nature based solutions
We will make further investments where we can, to promote low carbon and resilient solutions to both reduce urban flooding and the impact of storm overflows.

Innovation and technology development
We will maximise our use of innovation and new technology not only to reduce costs, carbon and resource use, but also to find new ways of managing our systems so as to reduce the natural footprint of our services and support greater resilience.

Flood Protection
We will protect more of our critical assets from flooding by rivers and sea including an allowance for flood depths expected with future climate change.

Our plans for 2025-2030 include considerable investment in areas where service impacts are likely to be significantly impacted by a changing climate, including tackling storm overflows, improving wastewater treatment and replacing mains that are bursting more frequently in hot, dry conditions. We will make progress on drainage, in collaboration with Welsh Government, to define new design standards as well as improve collaborative working with other flood risk authorities. We are also looking to make better use of the environmental monitoring we and others do, to improve our understanding of the impact of our services and activities on the environment and make better investment decisions.

Where possible, we have detailed adaptation actions, with timescales for delivery, for each of our principal risks (see chapter 5). However, there is more modelling and research planned, notably on development of our next Drainage and Wastewater Management Plan (DWMP) and our Water Resources Management Plan (WRMP), both of which will be published in time to support our next investment plan in 2029. Many of our responses to the climate change risks identified are detailed in both our current Water Resources Management Plan (2024) and our Drainage and Wastewater Management Plan (2024).

A MORE RESILIENT FUTURE

We have started on a journey to enhance our resilience, and we are proud of what we have achieved so far. There is more to do, and to enable us to take an adaptive approach, we will monitor our progress, including updating this Climate Change Adaptation Report at least every five years. We will continue to focus on further analysis to optimise our long-term adaptation plans, working in partnership with others. One thing is certain, without the support of our partners in Welsh Government, local authorities and our regulators, preparing and meeting the impact of climate change will be very challenging. Together as 'Team Wales', by preparing well, and then delivering the resilient new infrastructure we need, we can adapt and meet the demands placed on us, at a price our customers can afford.

This report sets out our adaptation approaches to respond to our principal risks. All these risks require partnership and collaboration, as interdependencies and cascading consequences mean that we cannot solve them alone, or without innovation. We know we are stronger together and look forward to continuing to work with others on this critical endeavour.

By the next iteration of this Climate Change Adaptation Report in 2027 we will be better placed to narrow down the likelihood of adaptive strategies being triggered. We will have a clearer idea of the future climate path with five more years of climate data and global efforts to limit emissions. We will also have better models to predict the future climate, and how our assets will respond to that, we will have developed new technologies to assist us in finding affordable solutions for our customers and society.

OUR GOAL IS TO ADAPT TO A WORLD THAT IS 2°C WARMER IN 2050

1. INTRODUCTION

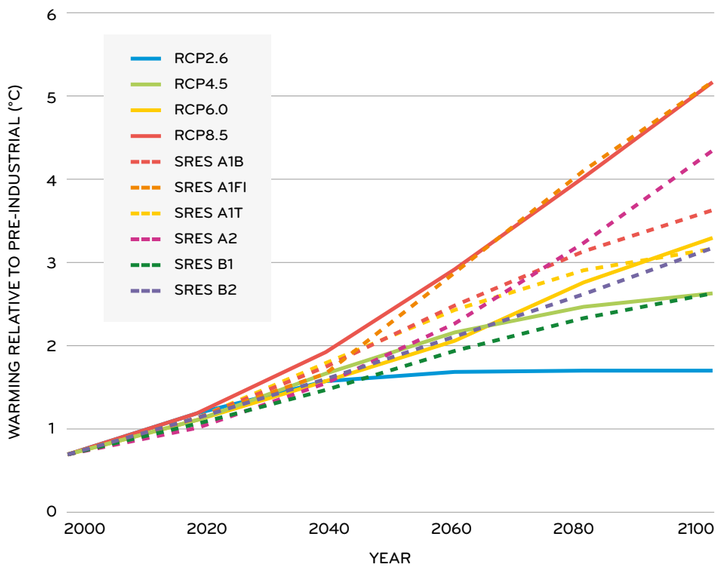
1.1 A GLOBALLY CHANGING CLIMATE

There is unequivocal evidence that climate change is happening now. We know that we need to mitigate climate change to keep the aims of 1.5°C[4] alive, while at the same time preparing for the worst effects of a changing climate. While it is essential to work to meet this aim, it is projected that limiting global heating to 1.5°C is looking increasingly unlikely, indeed impossible based on current global commitments, therefore we must plan and prepare for higher temperatures.

The International Energy Agency[5] suggests that current international climate policies mean that an increase in global temperature of 2.6°C by 2100 is the most likely outcome (closest to Representative Concentration Pathway 6.0), that is well above the target of the Paris Agreement (RCP2.6). Current and future efforts to reduce greenhouse gas emissions will only start to have a significant impact on global temperatures from the 2040s onwards due to a lag in the climate response (as illustrated by the delay in divergence between different scenarios in Figure 1).

In March 2023, the Intergovernmental Panel on Climate Change (IPCC) stated that global surface temperatures have reached 1.1°C above 1850–1900 levels in 2011–2020[5]. Increasing global concentrations of greenhouse gases in the Earth's atmosphere have changed and will continue to change: this will affect the UK's climate.

Figure 1: Global mean temperature projections from a climate model (MAGICC6) for RCPs and the older Special Report on Emissions Scenarios scenarios



Met Office: UKCP18 Guidance: Representative Concentration Pathways

On average the UK will experience milder, wetter winters and hotter, drier summers along with an increase in the frequency and intensity of extreme events and a rising sea level (see Table 1). The UK Climate Change Committee states that the changes in climate that we are already experiencing are projected to continue and intensify. In the second half of the 21st century, the amount of change that occurs will much depend on how successful we are in reducing greenhouse gas emissions globally.

Table 1: Predicted changes in Wales's climate for key climate variables (Source CCC[6])

	2050s RCP 2.6 (50th percentile)	2050s RCP6.0 (50th percentile)	2080s RCP2.6 (50th Percentile)	2080s RCP6.0 (50th Percentile)
Annual Temperature	+1.2°C	+1.1°C	+1.3°C	+2.3°C
Summer Rainfall	-15%	-15%	-18%	-26%
Winter Rainfall	+6%	+5%	+7%	+13%
Sea level rise (Cardiff)	22cm	28cm	43cm	76cm

THE CHANGES IN CLIMATE THAT WE ARE ALREADY EXPERIENCING ARE PROJECTED TO CONTINUE AND INTENSIFY.

1.2 HOW CLIMATE CHANGE IS ALREADY IMPACTING OUR OPERATIONS

Climate change has been a matter of strategic concern for Welsh Water for many decades, particularly in water resources planning. Government bodies including the Climate Change Committee and both the UK and Welsh National Infrastructure Commissions have highlighted climate change and the impact on water and drainage as a key strategic concern. The Welsh Government has stated that "there is no greater challenge facing government, public bodies, businesses and third sector organisations and communities across Wales" and have subsequently declared a climate emergency[7].

We are already seeing the physical impacts of climate change in Wales, with increasingly frequent extreme rainfall events causing greater risks of flooding and pollution, and hotter, drier summers and increasing water demand resulting in localised water supply deficits. Discharges into water courses during periods of drought present risks of greater environmental impact, and rising sea levels are putting our coastal assets at greater risk of storms and floods.

Table 2: Key impacts of climate change for the water sector[8]

Warmer summers and lower summer rainfall	A drier climate could result in water supply deficits and the potential for increased water demand and reduced availability for public water supply, agriculture, industry and the environment. Drier weather could also have raw water quality impacts and risks to underground assets as a result of changing ground conditions.
More intense rainfall events	Intense rainfall increases the risk of sewer and surface water flooding, leading to increased damage caused by overflows of stormwater into the environment. It could also lead to increased erosion and landslips which affect our catchments.
Increased flood risk of all types	More frequent flooding (from rivers and coasts) and coastal erosion increase the risk of disruptions to our services. Our network's resilience could be reduced and some of our assets could fail.
Higher sea levels	Rising sea levels and more frequent and intense storm events increase the risk of coastal and river flooding and speed up the rate of coastal erosion.

These hazards don't just influence our service delivery: there are wider impacts on our rivers, catchments, and environments. For example, changes in river temperature impact the fish and animal species that call them home, threatening our rich biodiversity. A recent Natural Resource Wales evidence report[9] has shown that Atlantic Salmon are declining at unprecedented rates in Welsh rivers, with climate change (including changing ocean conditions and higher river temperatures) the most likely cause of decline.

While the climate is changing, society's interaction with and use of the land is changing too, which could exacerbate our collective climate change risk. For example, changes in farming practices can influence the behaviour of nutrients and diffuse pollution in the environment. Wider changes in land use, such as increased urbanisation, can increase the amount of impermeable ground and influence surface water flow.

There is a widespread consensus that the frequent extreme weather events we have seen in our area and further afield since 2017, from freeze/thaw to rainstorms and very long dry periods, constitute evidence of the accelerating impact of climate change. Over the past few years, we have responded to a number of significant weather events, including:

Table 3: Recent significant weather events

2020	2021	2022	2023
STORM DENNIS	**DRY AND COLD WINTER**	**EXTREME HEAT/DROUGHT**	**FREEZE THAW**
Many of our sites were damaged by flooding. Mayhill water treatment works in Monmouth flooded, leading to limited storage of drinking water and requiring reduced water use from customers and provision of bottled water.	Variation in volumes received at our treatment works from a very dry and cold winter resulted in deterioration in performance of seven wastewater treatment works.	Extended hot period in August 2022 when Wales received just 38% of its average monthly rainfall severely reduced reservoir levels. Hosepipe ban established in West Wales. High temperatures also led to dry/shrinking soils causing an increase in pipe bursts.	Temperatures in Wales dipped to the lowest levels since 2010 and were below freezing for around a week before rapidly returning above zero. This significantly impacted customers with loss of supply in some localised areas due to the number of bursts we witnessed during this time.

The above extreme weather events have all impacted our ability to deliver the service that our customers expect to receive and often require costly responses. While we work to respond quickly to both prevent and resolve any service disruption, we know that we need to better understand how these changing climate risks may impact our operations, ensuring that any interventions are affordable and commensurate to address these risks. This is in the context that we will continue to see these kinds of weather-related events occurring and occurring more frequently because of climate change.

WE ARE ALREADY SEEING THE PHYSICAL IMPACTS OF CLIMATE CHANGE IN WALES

1.3 PURPOSE AND OUTLINE OF THIS REPORT

This report aims to provide visibility to our customers and stakeholders of the actions we are taking to understand our risks, and the steps we are taking to increase our resilience to a changing climate.

The science around climate change is continually evolving and it is, therefore, important that, as Welsh Water, we regularly review how the findings and recommendations of climate science are reflected in our strategic planning. This report, therefore, also highlights the current gaps in our understanding of how climate change will impact our activities, proposals for research to understand impacts, and the development of tools, models or other innovative solutions to affordably address these risks. We have committed to review this report at least every five years.

Specifically, this report will:

- **Summarise how we are embedding climate change adaptation across everything we do to support future generations in the long term;**
- **Set out our approach to assessing the climate risks to our assets, operations and subsequently our customers and the environment;**
- **Identify and summarise our principal physical climate change risks and how they affect our operations considering multiple climate scenarios broadly consistent with 2°C and 4°C global warming;**
- **Summarise our key risks related to the transition to a low carbon economy and how they may affect us;**
- **Show how we are planning to address these key physical climate change and transition risks.**
- **Set out our proposed approach to the governance and monitoring of our climate adaptation and mitigation actions to inform us as to the effectiveness of recent and planned adaptation actions.**

We will update this climate change adaptation report every 5 years. We'd therefore like to hear from you in advance of our next iteration. We've listed some specific questions that we'd welcome your input on in section 7.

1.4 WHO IS THIS REPORT FOR?

We anticipate that this report will be of interest to several audiences, including:

- Most importantly, this report is for our **customers**. We will continue to be open and honest in our approach to climate change adaptation and to listen to customer's views on our approach to tackling emerging climate risks and delivering wider sustainability which will help guide Welsh Water's strategic planning.
- Our **regulators** and anyone who wants to understand how Welsh Water is working towards our mission and vision as set out within the Welsh Water 2050 report and working within UK and Welsh legislation such as the Well-being of Future Generations (Wales) Act 2015, the Environment (Wales) Act, the Wales Water Strategy, and the current Programme for Government.
- **Organisations**, for example, voluntary sector and community groups, looking for opportunities to work in partnership with Welsh Water in the delivery of initiatives that will help support climate resilience for our customers and communities.
- **Colleagues** throughout Welsh Water who are keen to learn further about our role in supporting climate change adaptation and mitigation, and who want to understand how we can all support climate adaptation as we go about our daily work of delivering essential water and wastewater services to our customers.

2. PROVIDING CLIMATE RESILIENCE FOR FUTURE GENERATIONS

2.1 WHO WE ARE AND THE COMMUNITIES WE SERVE

Welsh Water is the statutory water and sewerage undertaker that supplies over three million people in Wales and some adjoining parts of England. We are owned by Glas Cymru, a single purpose company, run solely for the benefit of customers. We are a not-for-profit company without shareholders, and therefore we retain all financial surpluses for the benefit of our customers.

We provide essential public services to our customers by supplying their drinking water and then carrying away and dealing with their wastewater. We are responsible for the provision of statutory water and wastewater services to around 1.3 million households and businesses across much of Wales, Herefordshire and parts of Deeside. In this way, we make a major contribution to public health and to the protection of the Welsh environment. Our services are also essential to the sustainable economic development in Wales.

Much of what we do day-to-day to deliver a high quality and reliable public service involves operating and maintaining an enormous network of mainly long-life assets worth some £26 billion.

We do this by:

- Operating 63 water treatment works to treat and supply an average of 830 million litres of safe, clean drinking water through some 27,400 km of pipes to over three million people and businesses every day;
- Collecting wastewater (including surface water) through a network consisting of some 30,000 km of sewers, 1,912 sewage pumping stations (SPSs) and 2,300 combined storm overflows (SOs), and treating it at 838 wastewater treatment works;
- Owning 40,000 hectares of land. This includes five visitor centres that attract around 1 million visitors each year;
- Using a fleet of over 1,200 vehicles;
- Employing and developing some 3,500 employees across Wales, Hereford and Deeside who, as a team, work to ensure that we provide a first-class service.

Figure 2: The areas we serve

2.2 CUSTOMER PRIORITIES AND OUR STRATEGIC RESPONSES

The level of concern amongst customers about the impact of climate change on water and wastewater services is high.

Our customers have told us that they want us to invest more to tackle future issues around infrastructure and climate change. They also consider that the pace of climate change and the perceived importance of the environment are valid justification for further investment in resilience and sustainability. There is a growing understanding and awareness of the biodiversity crisis, which is being addressed through our Biodiversity Strategy[10].

With it being forecast that limiting global heating to 1.5°C is looking increasingly unlikely, indeed impossible based on current global commitments, we must plan and prepare for higher temperatures and more severe weather. We will need to invest to protect the essential services we provide against the effects of climate change. Without such investment there is a significant risk of deteriorating performance and more frequent service failures, which customers have told us would not be acceptable. Our customers also want an increased understanding of the risks that climate change poses to their water and wastewater services and the decisions we make to mitigate these risks. However, in all cases, we need to be mindful of the need to ensure that our services remain affordable for all.

In Welsh Water 2050, we outlined 18 strategic responses that describe how we will respond to the challenges we face, including climate change. These responses are shown in Figure 3. Delivering on these responses will allow us to achieve our mission for 2050 "to become a world-class, resilient and sustainable water service for the benefit of future generations".

Figure 3: Our Strategic responses to long term challenges identified in Welsh Water 2050[11]

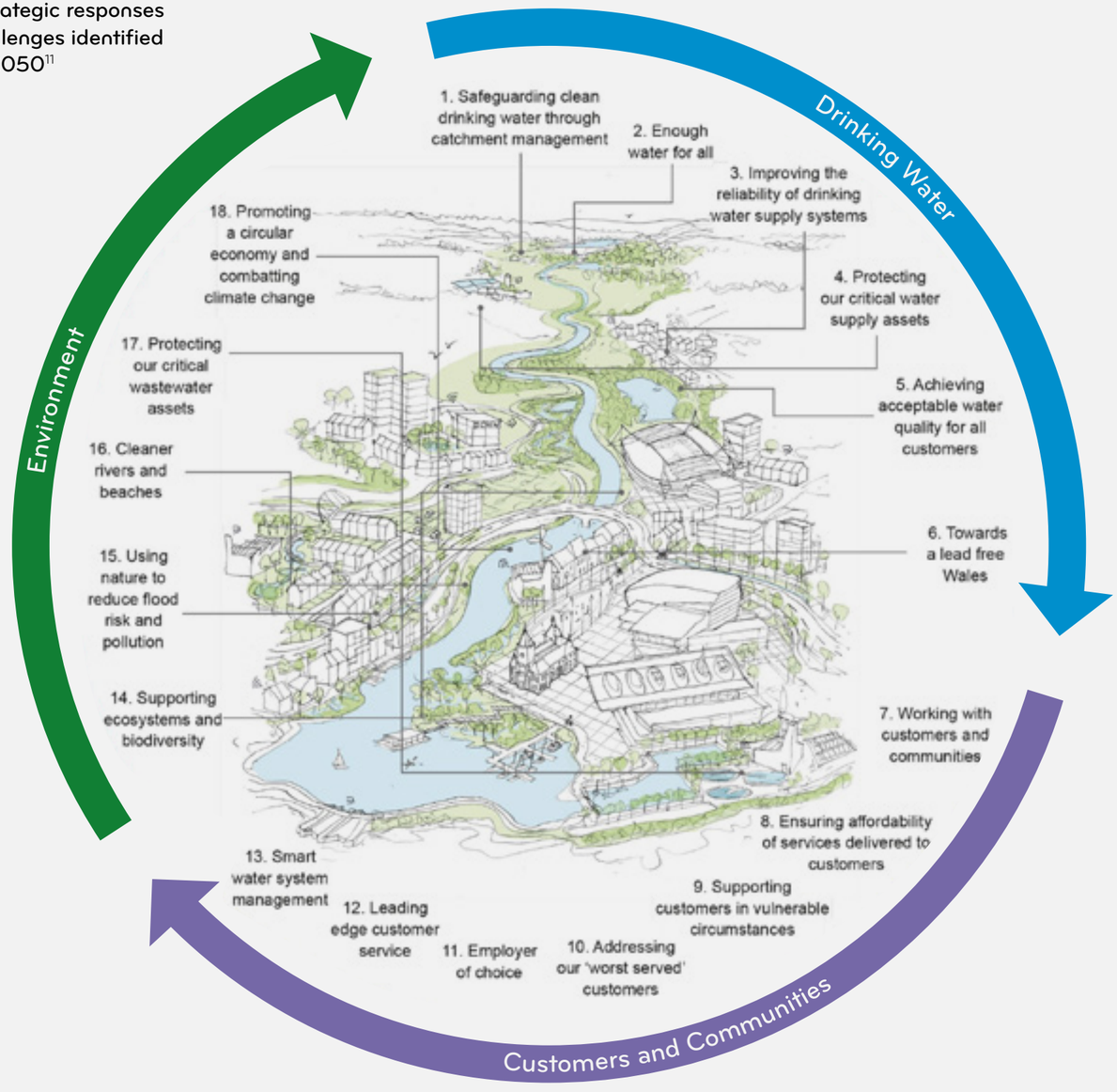


Image: ©Arup

2.3 OUR APPROACH TO MITIGATING AND ADAPTING TO THE IMPACTS OF CLIMATE CHANGE

Climate change adaptation is focused on addressing the potential physical impacts of climate change: adjusting systems, processes and practices in response to the changing climate, both extreme events such as flooding and heatwaves and long-term stresses such as sea level rise.

In 2019, the Welsh Government declared a climate emergency and set a target to reach net zero carbon by 2050[12]. As expressed in the UK's latest Climate Change Risk Assessment[13], as we redouble our efforts to achieve net zero, we must also raise ambitions on adaptation to ensure that we are resilient to a warming world.

Our commitment to our customers and the environment involves us both mitigating and adapting to the impacts of climate change. Our plan is to adapt to a world that is 2°C warmer in 2050. At the same time, we will assess the risks and prepare for the effects of more extreme warming by the end of the century. This way, we will be able to consider the need for projects that take a long time to implement. Our plans need to be adaptive to cope with the high level of uncertainty in the future climate. In the long term we know our plans need to be prepared to cope with the possibility of 4°C warming by 2100 or higher (as forecast by the RCP8.5 high emissions scenario) but flexible also to lower outcomes (as forecast by the RCP6.0 and RCP2.6 scenarios).

As a major energy user, and as an 'anchor company' in Wales, we have a duty to reduce carbon emissions. We must innovate and invest to reduce these emissions, pursue research to better understand our contribution, and encourage others to play their part. We're proud to commit to delivering net zero carbon emissions by 2040, as set out in our 'Journey to Zero' plan[14]. This isn't simply a target in relation to infrastructure or operational emissions as it's about changing the way we think, plan and deliver. This is the right thing to do, but it is also important to help protect the ecosystems and communities on which we depend. As a landowner we can and should make a real difference. (More on this can be found in section 6 of this report).

We are committed to working closely and collaboratively with the Welsh Government, our regulators, and other stakeholders as 'Team Wales'. Our approach to climate adaptation and resilience has taken account of the legislative and policy context in Wales, including the Well-being of Future Generations (Wales) Act 2015, the Environment Act, the Wales Water Strategy, and the current Programme for Government. However, it is also important to consider the broader UK and European context.

We are also ensuring that our plans are aligned with the United Nations Sustainable Development Goals (SDGs) and we have mapped where these align with our Strategic Themes.

Above all, we are aligning with the key principles for good climate adaptation in the water sector, set out by UKWIR (2021)[15], that include those outlined overleaf.

Figure 4: Adaptation vs. mitigation

ADAPT FOR THE CLIMATE OF 2050; PREPARE FOR POSSIBLE CLIMATES OF 2100.

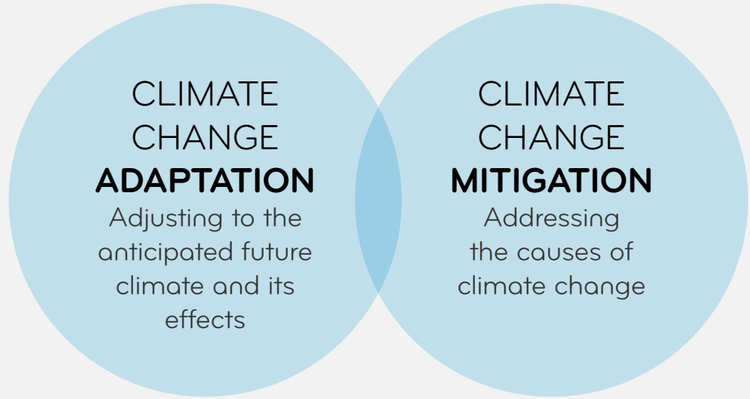


Table 4: UKWIR principles for good climate adaptation summary

PRINCIPLE	DESCRIPTION	WHERE THIS IS ADDRESSED IN THIS REPORT
Use best available science	Using the most up-to-date and appropriate science and data is essential for adaptation planning. Currently, in terms of climate data, for the UK this means the use of UKCP18 data. This also includes the best available data for economics, social science, data science, natural sciences, and engineering. Our science and knowledge will continue to improve around delivering resilience and assessing value.	Our Climate Change Planning Policy set out in section 2.4 Our scenarios described in section 3.2
Prepare for a shared view of the future	Working towards a shared vision for 2030 across the sector, supported by actions such as ensuring that all of the water sector is planning for the same climate scenarios to encourage a joined up, collaborative approach to adaptation in the future.	Our scenarios described in section 3.2
Assess interdependencies and cascading impacts	Understanding the risks to infrastructure networks from cascading impacts, such as how a single hazard, like flooding, could have a knock-on impact between sectors, leading to more significant impacts. For example, ground shifting caused by drought can cause water main bursts. Mains bursts in turn can flood gas or electricity network assets, causing interruptions in the energy network, which in turn can have further knock-on impacts on energy users and communication networks.	Considered in identifying our principal risks in sections 4 and 5. Section 7.3 on collaboration
Integration of decision-making and investments	Ensuring that climate data and scenarios are embedded as business-as-usual in decision-making and investments is essential to ensuring that climate adaptation solutions have the resources needed for implementation. This is vital both for water company and regulator decision making and models and looking at investments in the long term is vital to improve long-term resilience in the face of short-term funding cycles.	Section 2.4 demonstrates our approach to embedding climate change adaptation into our planning and decision-making
Ensure long-term affordability and address inequalities	Work to ensure that customers are provided with the best value service now and in the future. The sector should be mindful that climate change is likely to widen existing inequalities and unfairly disadvantaging future generations should be avoided.	Section 2.2 demonstrates our commitment to our customers' views and affordability
Prepare for unpredictable extremes	Planning for unpredictability and the potential for sudden shifts in the climate is key for adaptation. Therefore, it is essential to consider low likelihood, high impact changes including looking at warming of more than 4°C by 2100 and other major global events, like jet stream changes.	Our scenarios (section 3.2), whilst centred on 4°C recognise the potential disorder and unpredictability of extremes
Take an innovative and adaptive approach to avoid lock-in	Early planning for adaptation reduces the vulnerability to climatic changes and supports creating appropriate responses to the scale of the problem at the right time. Adaptive pathways are focused on low- or no-regret approaches in the shorter term and integrating these with long-term action. Failing to do this leads to 'lock-in', where decisions are made that don't consider the long-term risks, increasing the damages, cost and resources required for actions later. Avoiding 'lock-in' is important for all areas like physical assets, non-physical assets and for regulatory decision making.	Section 7.2 sets out our monitoring approach
Set clear roles and responsibilities	Effective adaptation needs collaboration and co-delivery with a number of partners across the sector. Setting clear roles and responsibilities throughout the process supports effective delivery of adaptation actions.	Section 7.1 describes our management responsibilities
Clear and accessible communication and engagement	Communication is a vital part of working in partnership. The sector must bring customers and other stakeholders along on the adaptation journey with them through accessible communication and engagement.	This report as a whole supports our commitment to sharing our approach

These principles are supported by objectives to guide adaptation action across the sector:

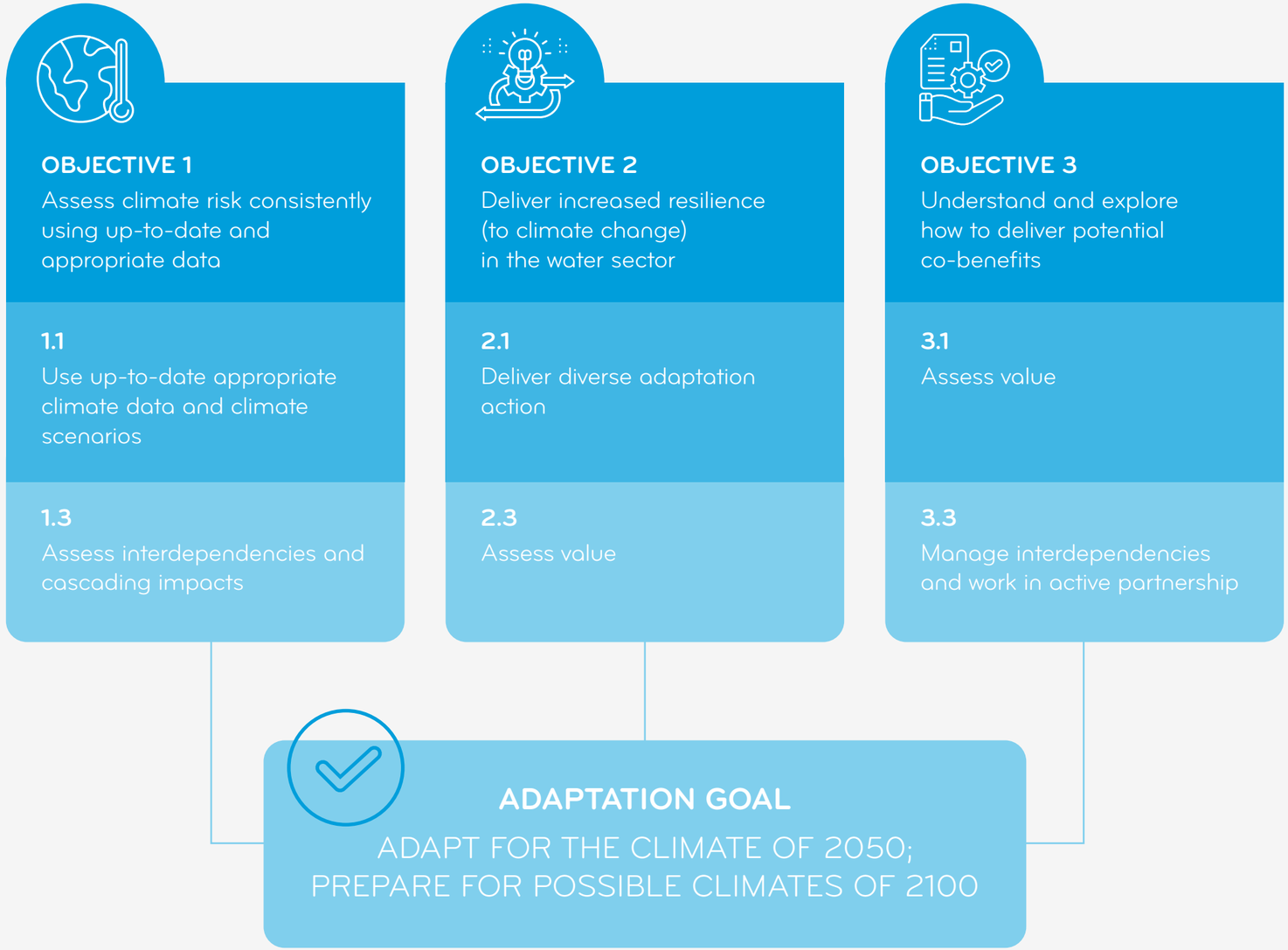
Objective 1
'Assess climate risk consistently using up-to-date and appropriate data' is focused on setting out how to assess risk effectively.

Objective 2
'Deliver increased resilience (to climate change) in the water sector' is focused on implementing activity to address this climate risk across the sector, including in the regulatory regime, delivering action to increase resilience and also to understand the residual exposure.

Objective 3
'Understand and explore how to deliver potential co-benefits' is focused on assessing the wider value of this activity and how to work with others to achieve it, including making sure the regulatory regime supports and enables this.

These objectives and principles guide our approach as Welsh Water.

Figure 5: Water sector climate adaptation framework



2.4 EMBEDDING CLIMATE CHANGE ADAPTATION IN OUR LONG-TERM PLANNING

Ensuring that our services are resilient to the impacts of climate change is a top priority. Our long-term approach to planning, highlighted by Welsh Water 2050[16], allows us to understand and tackle the long-term challenges (e.g. climate change) which will affect our business and to embrace the opportunities to improve our services to customers, and the communities that we support. Our long-term plan and not for profit status, which allows us to retain all financial surpluses for the benefit of our customers, ensure we have long term sustainability, meaning we can continue to make a difference for generations to come.

Welsh Water 2050

Five years ago we launched our Welsh Water 2050 document with a mission statement 'to become a truly world-class, resilient and sustainable water service for the benefit of future generations'. The strategy describes our commitment to plan for the long term, anticipating and responding proactively to the emerging risks and opportunities that could impact on our ability to deliver great service to customers and the environment, now or in the foreseeable future. This will enable us to respond in a way that is timely, effective, fair and affordable.

Welsh Water 2050 set out the key trends that we could face over the very long term, informed by experts, academics and partners. But, how can we plan for 2050 given the difficulty in predicting the future with any certainty? The answer is that we have to proceed wisely based on the information that is available, recognising the uncertainty through adaptive planning, and updating our view regularly. This is why we committed to a five-yearly review of the strategy, the first of which was published in 2022. To update our view of long-term trends, in 2021 we commissioned Cardiff University's Water Research Institute to undertake a review of the latest evidence and to gather the views of experts and stakeholders such as regulators, government representatives, academics and non-governmental organisations.

Climate change has consequences for many aspects of strategic planning. There is a need to consider policy and processes to ensure climate change is being adequately considered and incorporated. Without this we risk future performance and increase the pressure to spend more to retrospectively address the issue at higher cost.

We will need to invest to protect the essential services we provide against the effects of climate change. Without such investment there is a significant risk of deteriorating performance and more frequent service failures, which customers have told us would not be acceptable. There is a tension between the needed investment in climate change resilience and affordability of bills which will be put under greater strain in future price reviews.

We will therefore need a model of greater collaboration and flexibility with regulators and policy makers, facilitating more innovation over longer time frames, to deliver even better value for money.

Given the high level of uncertainty around the future climate, it is critical that this uncertainty is reflected in our planning either through the explicit inclusion of uncertainty in projections and/or testing plans against more than one scenario (particularly where climate change is driving significant investment in AMP8). A simplistic approach selecting a single outcome or single projection is not appropriate for most water sector strategies due to the significant impact climate change is likely to have on the water cycle on which we are so reliant. There is often reference to planning for a 2°C or a 4°C world, for example, through the Task Force on Climate-related Financial Disclosures (TCFD) recommendations[17] or through the UK Climate Change Committee recommendations.

Our Asset Planning Directorate integrates business processes and systems, supported by robust governance activities that enable us to deliver Asset Management Plans (AMPs) in accordance with our commitments to customers, regulators and other stakeholders. Our strategy for future challenges includes the use of adaptive planning to account for plausible scenarios to at least 2050 for climate change, population growth, technology and environmental ambition, based on the same Ofwat common reference scenarios. We have embedded consideration of climate change scenarios in the work underpinning our WRMP, and with increasing sophistication in our DWMP.

Key adaptation actions to respond to our climate change risks will form part of the next Ofwat Price Review, PR24, and we will submit our business plan proposals to Ofwat in October 2023. We are working closely with stakeholders to further define the vision for water in our supply area, and the long-term outcomes that we, working together, wish to achieve for customers and for the environment. Given that we will not be able to do everything at once, we will need to set out a long-term plan with the key expenditure required in each five-year period, resulting in an optimised and efficient plan for 2025-30. One way we are doing this is through our Long Term Delivery Strategy. Variations in climate change scenarios are mandated by Ofwat for this strategy, and likely to lead to at least one adaptive pathway. For example, we are developing an adaptive plan for our wastewater systems, to combat the increasing risk of more frequent, more intense rainfall as a result of climate change overwhelming sewer capacity which if not addressed would lead to increased sewer flooding spills from storm overflows (you can find more detail on this risk in Section 5.0 Deep dive into our key physical climate change risks).

Our Climate Change Planning Policy

Welsh Water has developed a climate change planning policy, the aims of which are to improve climate readiness through:

1. Defining the planning assumptions, scenario testing requirements and expectations for adaptive planning for all climate impacted strategies and plans.
2. Committing to production of a Climate Change Adaptation Report at least every five years.

As a result, each strategy and plan must consider the extent to which climate change is likely to influence the cost, performance and risk associated with plans resulting from that strategy. If climate change has the potential to be consequential to strategies and plans, we will apply scenario testing and, where appropriate, develop adaptive pathways in addition to the required core pathway.

Subject to regulatory recommendations and requirements, Welsh Water strategies will normally use RCP 6.0 (medium-high) as the 'most likely' planning scenario wherever possible but should be "stress tested" against RCP2.6 (low) and RCP8.5 (high).

A 'core pathway' plan to 2050 is required for all long-term plans and strategies. This would consist of activities always required irrespective of climate change scenarios, i.e. low or no-regrets expenditure, and activities required to keep long term options open. Adaptive plans will be developed where significant investment is required above the core pathway under one or more of these scenarios to address a high level of divergence in outcomes due to climate change impacts.

The role of Innovation and new technology
Innovation is a vital component of economic growth. Investment in innovative ideas and technologies has the potential to transform our performance and increase resilience to the impacts of climate change as a sector.

Driving innovation, in particular the application of new technologies to help us mitigate and adapt to climate change will be critical to our success. Such innovations and new technologies are being developed both within the water sector and outside it. Examples of this includes the development of novel chemical free water and sewage treatment processes which are more resilient to the impacts of climate change and new battery storage technologies which can be used to again make our infrastructure more resilient.

Such developments, supported by our sector's innovation fund and managed by Ofwat, from 2025 will be set at a forecast £400m for the subsequent five years.

Innovation progress to date
For any proposal to be funded it must align to one of a number of specific criteria, one of which is responding and adapting to climate change – including achieving the sector ambitions of net zero carbon, zero waste and zero leakage. The water sector is critical to ensuring the sustainability of human and ecological systems, and it is also highly vulnerable to the impacts of climate change. Adapting to climate change and achieving net zero are important to the water sector to ensure water availability and quality, at a price and pace our customers can afford.

Over £100m has been allocated to 77 initiatives so far by Ofwat. Such projects sponsored through the sector's innovation fund to date include:

Destruction of high impact greenhouse gases and generation of green electricity at wastewater treatment sites using fuel cell technology

Energy harvesting micro-turbine for powering remote equipment

Nonthermal 3D plasma – a novel advanced oxidation process for water treatment

Renewable energy via aqueous-phae reforming

Enabling whole life carbon design

Transforming the energy balance of wastewater treatment

As these initiatives deliver, so we hope to see them catalyse changes in our approach to investment, supporting the growth of blue green solutions in particular, so that we can not only provide more resilient services but also enhance biodiversity and ecological resilience at the same time.

We will report the progress we have made on our use of innovation to adapt to climate change in 2027 when we refresh this report.

DRIVING INNOVATION TO HELP US MITIGATE AND ADAPT TO CLIMATE CHANGE WILL BE CRITICAL TO OUR SUCCESS

3. OUR APPROACH TO ASSESSING CLIMATE RISK

3.1 OVERVIEW

We have embedded consideration of climate change into our company-wide Enterprise Risk Management (ERM) process, with ownership and reporting led by our Board's Environmental Social Governance (ESG) Committee (see Section 7.1 for our approach on governance of climate risks).

We continually manage these risks through our risks registers, specifically our:

- **Strategic risk register** which focuses on longer-term risks with significant uncertainty
- **Corporate risk register** which focuses on risks with lower levels of uncertainty.

Strategic risk and monthly management reports are produced for each of the Board meetings. ESG risk reports are reviewed by the ESG Committee on a six-monthly basis with quarterly updates. Risk owners are identified for all strategic and ESG risks, with responsibilities assigned at Executive Team meetings.

Building on this, we have undertaken a renewed and detailed risk assessment for this report. These identified risks have been reviewed, assessed and challenged by subject matter experts through a common approach to enable us to compare all our physical climate risks on a like for like basis.

We developed scenarios (see overleaf) that represent sufficient diversity to explore the potential climate change that we might be exposed to over different time horizons. Based on UKCP18 data, these are plausible scenarios and we have used these as a starting point to explore relevant climate change impacts and anticipated policy and technology changes.

In assessing the risks under each RCP and under each time horizon, we considered the unmitigated risk for our organisation, excluding future planned mitigations. We consider our unmitigated position to understand how severe our position would be in alternative futures. We understand that planned mitigation is not the same as completed mitigation.

Through our definition of future scenarios, we broadly considered how the impacts may occur in the short-term (i.e. through AMP8 from 2025-2030), medium-term (up to 2050) and long-term (up to 2100 and beyond).

Through the identification of these scenarios and risk drivers, a long list of risks was developed by mapping asset categories against each of the drivers, to ensure we captured the widest range of risks across our asset base. We assessed risk consequence and likelihood, following our ERM process, with some adjustments made to allow us to better analyse the uncertainties and timescales relating to climate change.

We then assessed and prioritised these risks through a series of workshops to identify the top 5 physical and transition risks and opportunities. You can read more about our scoring criteria and approach in Appendix C. We've also looked to identify the key mitigations that respond to one or more of these risks, which are detailed within each deep dive.

3.2 PLANNING FOR 2 DEGREES, PREPARING FOR 4 DEGREES

Planning for unpredictability and the potential for sudden shifts in the climate is key for a robust approach to adaptation. Therefore, it is essential for us to consider low likelihood, high impact changes including warming of more than 4°C by 2100 and other major global events.

Where available, we consider how these hazards are likely to change in a 2°C world by 2050 and a 4°C world by 2100.

Physical risks

Risks resulting from climatic events and hazards, which can be both acute (e.g. a major storm or heatwave), and chronic (e.g. rising sea levels, extended drought).

Physical hazards driving risk:

- Flood and storms
- Drought and hot weather
- Sea level rise

Physical risk scenarios

We set out our risks under three scenarios[18], based on the IPCC representative concentration pathway (RCP) 8.5 at three different time horizons

Unpredictable weather

(RCP 8.5 in 2030[19])

The world has not done enough to limit warming and is on track for 4 degrees. There are increasing occurrences of severe weather.

We expect that, in 2030:

- Winter rainfall[20] will have increased by 6%
- Summer rainfall[1] will be down 9% and mean summer temperature[1] will have increased by 1.4 degrees
- Average sea level[21] will have risen by 0.11m – 0.2m

Tempestuous climates

(RCP8.5 in 2050[22])

The world is still not taking action, and has missed 2050 emissions targets. The climate is now stormy with unprecedented extremes.

We expect that, in 2050:

- Winter rainfall[23] will have increased by 12%
- Summer rainfall[3] will be down 21% and mean summer temperature[3] will have increased by 2.6 degrees
- Average sea level[2] will have risen by 0.2m – 0.39m

Catastrophic storms

(RCP 8.5 in 2100[24])

The world has failed to choose a low carbon future and catastrophic storms regularly take lives and damage livelihoods.

We expect that, in 2100:

- Winter rainfall[25] will have increased by 22%
- Summer rainfall[4] will be down 36% and mean summer temperature[4] will have increased by 8 degrees
- Average sea level[2] will have risen by 0.51 – 1.13m

4. SUMMARY OF OUR CLIMATE RISKS AND ADAPTATION APPROACH

4.1 OUR KEY PHYSICAL CLIMATE RISKS

This section presents our key physical climate change risks mapped onto our risk matrices. Here, we can see the relative consequence of our risks across the three timescales: 2030, 2050 and 2100. These risks are reported on pre-mitigation; in other words, before we have completed planned or intended activities to mitigate this risk. You can read more detail on these risks, what we will do about them and our target risk level in the deep dive in the following section.

Our planned activities to 2050 are adaptive to all climate change scenarios (around 2°C of warming), we also need to prepare for the possibility of the high climate change scenario RCP8.5 by 2100 (around 4°C of warming). Our risk assessment is based on the high emissions RCP8.5 scenario, we know there will be more to do to adapt to climate change should the worst case occur. We will prepare our models and data gathering so as to have the flexibility to deal with such an eventuality.

Table 5: Primary risks: physical

DRIVER	RISK	
Extreme weather events: **flood and storms**	P1	**Inundation of sewer networks in high rainfall events** There is a risk of sewer inundation during periods of increased rainfall intensity or duration, leading to a flooding event (internal/external flooding, Storm Overflow (SO) discharge)
Extreme weather events: **drought and hot weather**	P2	**Climate change impact on drinking water quality** There is a risk that extreme weather conditions, including drought conditions, increase in rainfall intensity, more extreme wet/dry cycles and other indirect causes change the composition of raw inlet water to treatment plants, changing the chemical treatment regime and the ability to treat the same volume of water.
Extreme weather events: **drought and hot weather**	P3	**Increase in customer demand under hot conditions.** There is a risk that customers require more water under hot conditions, limiting the ability of Welsh Water to rely on PCC reduction to meet local capacity supply/demand restrictions.
Extreme weather events: **flood and storms**	P4	**Risk to our assets during extreme weather events and sea level rise** There is a risk that our assets (e.g. treatment works, pumping stations, pipework) are damaged during high rainfall and other extreme events, leading to an inability to supply customers or risk of environmental harm due to loss of treatment capability.
Extreme weather events: **flood and storms**	P5	**Risk to infrastructure supply chains during extreme weather events.** There is a risk to other infrastructure systems on which we rely through the direct impact on telecoms, transport or energy infrastructure damage, causing disruption to our systems and leading to an inability to supply customers and the risk of environmental harm due to a loss of treatment capability.

Figure 6:
Top unmitigated risks under inclement weather scenario
(RCP 8.5, 2030)

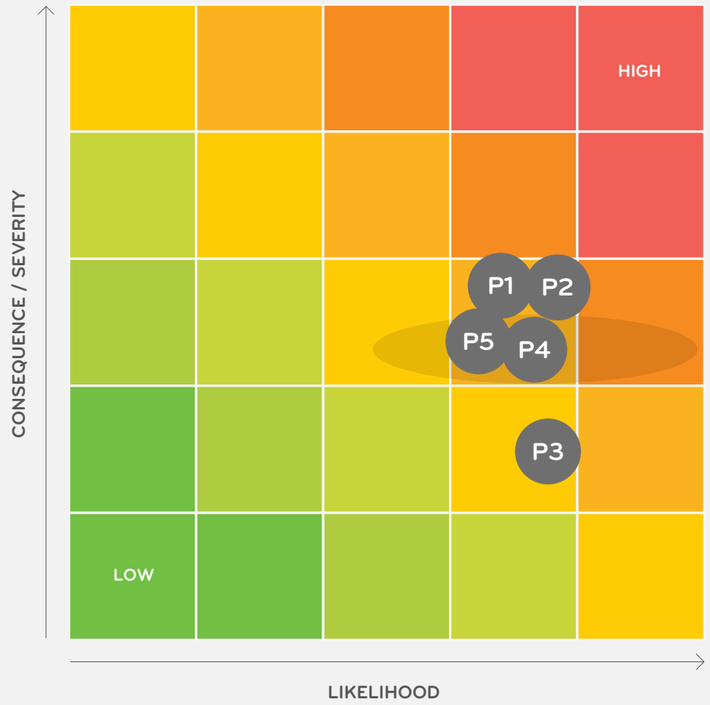


Figure 7:
Top unmitigated risks under stormy climates scenario
(RCP 8.5, 2050)

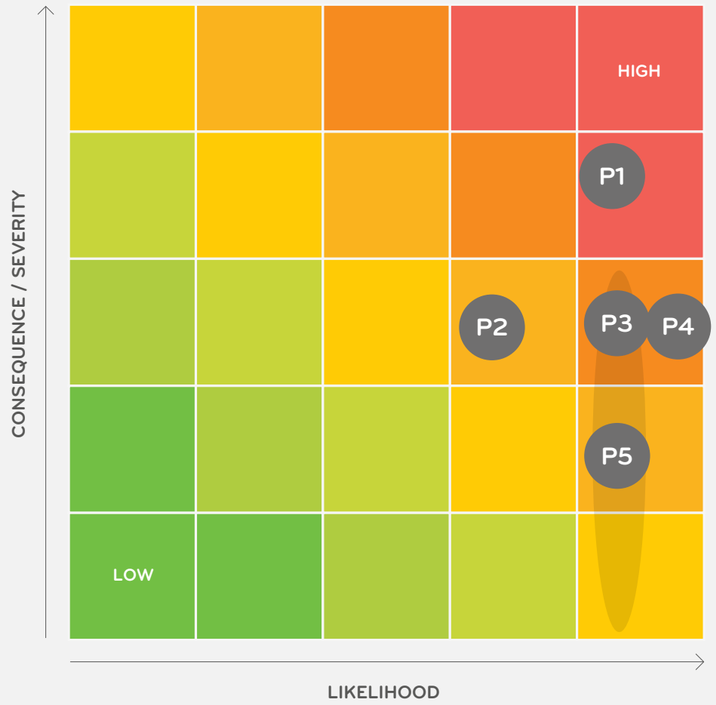
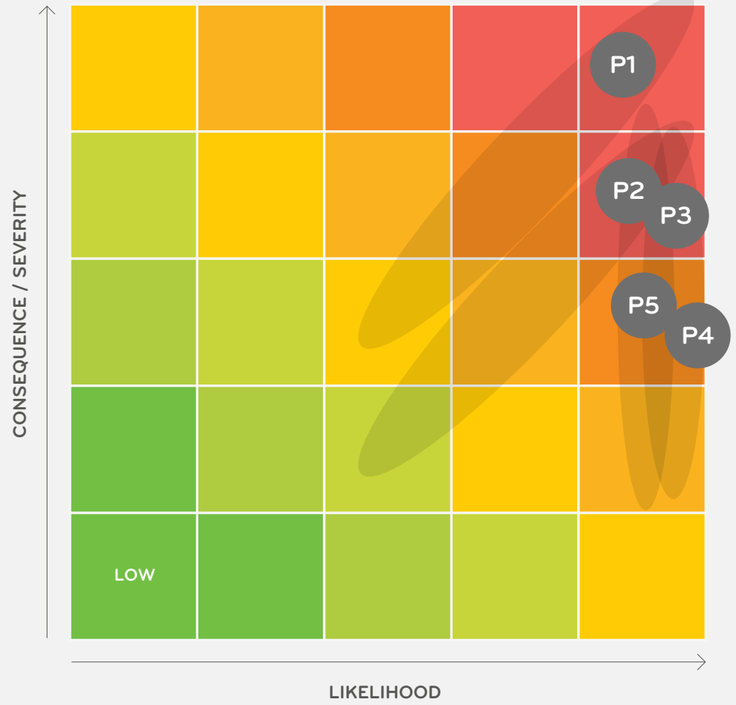


Figure 8:
Top unmitigated risks under catastrophic storms scenario
(RCP 8.5, 2100)



P1 Inundation of sewer networks in high rainfall events

P2 Climate change impact on drinking water quality

P3 Increase in customer demand under hot conditions

P4 Risk to our assets during extreme weather events and sea level rise

P5 Risk to infrastructure supply chains during extreme weather events

Likelihood

< 1-in-100 year event (low)

1-in-100 year event

1-in-30 year event

1-in-5 year event

1-in-1 year event (high)

Consequence/Severity

Unchanged from the Welsh Water Risk Management Framework, scored against operational, reputational and/or financial risks. This can be found in Appendix C of this report.

Displays the range of outcomes due to uncertainty, including uncertainty related to our intended risk mitigations.

4.2 OUR ADAPTATION APPROACH

Following the identification of our primary climate change risks, we identify ways in which we can adapt to respond to these risks. These include:

1. Consideration of diverse adaptation actions
We recognise that there are a range of different types of adaptation actions, depending on the risk. We therefore consider the widest possible range of actions, including:

Engineered solutions
Improved building design and retrofit, drainage, flood defence investment.

Nature-based solutions
Habitat creation, peatland restoration, soil conservation, green sustainable urban drainage.

New and emerging technologies
New designs for infrastructure assets, remote sensing, big data for monitoring evaluation and management.

Behavioural
Information sharing, public engagement, skills development. This might include, for example, customer education on sewer misuse and water efficiency.

Institutional
Adaptation standards, supply chain diversification, regulation, governance.

Financial
Customer bills, investment, insurance, risk disclosure, adaptation finance.

Data and R&D
Monitoring and surveillance, inspections, forecasting, research and decision support tools, and big data.

2. Delivering wider benefits through integration of multi-capitals
We have developed an approach to integrating multi capitals into our decision-making that is on par with best practice in the sector. This should enable us to optimise our investment programme to deliver wider societal and environmental benefits through our climate change adaptation action to respond to the primary risks.

5. DEEP DIVE INTO OUR KEY PHYSICAL CLIMATE RISKS AND ASSOCIATED ADAPTATION ACTIONS

This section presents a deeper analysis of our principal risks and what we are doing about them.

The mitigations have timescales, in line with best practice from the UK Climate Change Committee. Mitigations listed as occurring in AMP8 are included, where applicable, in our PR24 business plans. As the PR24 business plans are yet to be approved by Ofwat, these schemes are intended but not guaranteed. There is an underlying risk that the regulatory framework as currently set out, will not support funding for the adaptation and mitigation investments we wish to deliver. To mitigate this, we will seek to influence the regulatory regime under which we operate, and the surrounding market conditions for accessing capital, and we'll seek the support of key partners and stakeholders.

We are also monitoring a number of emerging opportunities related to our physical climate change risks; these can be seen in Appendix B.

HOW CAN I HELP AS AN INDIVIDUAL?

We want everyone to join us in this exciting, yet challenging, endeavour to look after where we live, work and play.

Throughout this section, we'll have call out boxes like this one outlining things you can do in everyday life to join our collective effort to manage these risks.

5.1 INUNDATION OF SEWER NETWORKS IN HIGH RAINFALL EVENTS

5.1.1 Where are we?

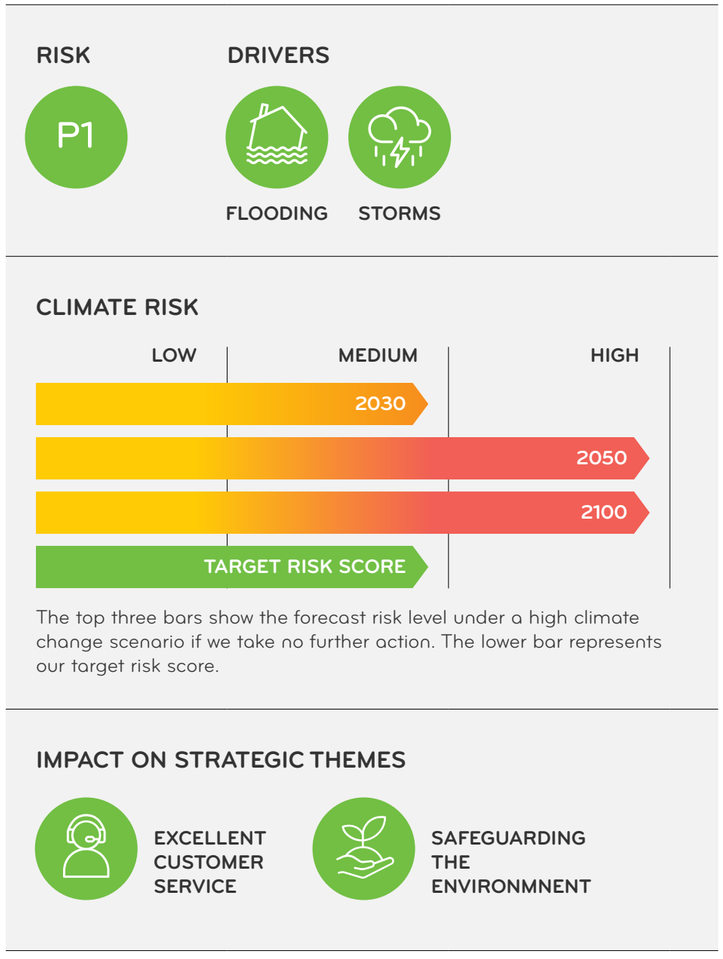


Figure 9: At a glance risk summary: P1

5.1.2 Understanding the risk

Intense rainfall increases the risk of sewer inundation, which can lead to internal[26] and external[27] flooding, and Storm Overflow (SO) spills, where highly dilute but untreated wastewater is released into the environment. During heavy rainstorms, more water enters the pipes of our older 'combined' (stormwater and wastewater) systems than they are designed to cope with, so they have been designed to safely relieve the pressure through release points known as SOs[28]. SOs release the flows — which are around 95% surface water — into rivers or the sea. Without these release points, the sewerage system would back up, and cause sewer flooding to streets, highways and cause toilets to overflow inside properties.

Flooding from sewer events affecting properties are rare, however we fully understand that they have a significant impact on our customers and the communities we serve when they do happen. Therefore, mitigating the potential for this to occur is a key priority for us.

This risk is linked to a lack of volume and treatment capacity in drainage systems, exacerbated by climate change. While SOs are essential infrastructure, we know we must reduce our reliance on them. On top of the effects of climate change, there is an increasing amount of rainfall collected into our combined sewage systems due to urban creep, a lack of control over the entry of rainwater into our sewers, and an increase in impermeable areas. These increase infiltration to the stormwater network in an uncontrolled way, exacerbated by climate change, and impact flows within our network and at wastewater treatment plants. This risk is heightened in the autumn and winter months, where rainfall intensity is at its highest, and in the spring when we experience periods of quick, heavy precipitation.

5.1.3 What we are doing about it

As a water and environmental services provider, the wellbeing of our customers and communities is our number one concern. Since 2017, the regulatory and political context has evolved rapidly in this area. The introduction of mandatory DWMPs as the basis for long-term planning is a welcome development.

Since 2015, we've also installed event duration monitors (EDMs) on over 99.5% of our overflows so we can better understand their operation and report these to the community. As well as EDM installation, we have increased flow monitoring across our asset network, to assess condition and operation.

Our "Manifesto for Rivers in Wales"[30] published in May 2023 describes our concern for river health and plans to reduce our impact. We are making a very significant investment in SOs over the coming years, building on £140 million spent in AMP7 (2020 to 2025) on nutrient impacts to improve river health. We will continue to improve storm overflows with a further £420m investment from 2025 to 2030 (and our Long Term Delivery Strategy forecasts over £3 billion investment between 2030 and 2050) with priority given to those storm overflows causing environmental harm or concerns from an aesthetic or bathing water perspective.

We recognise that as the climate changes it may become more challenging to maintain the progress we have made and the improvements we are aiming for. We are responding though our DWMP 2025-2050[31] to find the optimal solutions that reduce environmental impact and are adaptive to an uncertain future climate in line with our own and our customers' expectations. Wherever possible, we are looking to reduce spills through investment in nature-based solutions, which tend to have wider benefits, including lower carbon emissions due to requiring less concrete to be poured and the ability to cope better with more adverse climate scenarios.

CASE STUDY: RAINSCAPE LLANELLI

Llanelli was prioritised for sustainable urban drainage investment due to the impact of flooding on customers and on economic development. The total investment in Sustainable Drainage schemes (RainScape) in Llanelli and nearby Gowerton is £115 million since 2012.

Issue

The key issue to be overcome in Llanelli was the large volumes of rainwater which were entering the sewers during periods of heavy rainfall. This led to some sewer flooding in residential areas, frequent spills of storm sewage into the sea and adjacent shellfishery waters, and restrictions to economic development. It was clear that we could not solve this problem solely using traditional methods such as building additional storage tanks to capture storm flows, as they would be unaffordable, difficult to operate, and not resilient to climate change. For these reasons we pursued alternative and at the time novel, sustainable urban drainage solutions which essentially removed or slowed up the flow of surface water from rainfall events into the sewerage system.

Action taken

A variety of RainScape solutions have been installed in Llanelli to collect and store rainwater. These include construction of a new surface water tunnel and increased treatment capacity at two treatment works. In addition to this:

Queen Mary's Walk

Construction of a swale on a playing field;

Stebonheath School

The transformed playground includes a pond, a swale, planters, permeable paving, water butts and an outdoor educational area;

Glevering Street/Swansea Road

Installation of new drainage kerbs, grass channels and planters.

Welsh Water's communications team opened a RainScape information station in Llanelli town centre, liaised with more than 3,500 customers, issued in excess of 65,000 letters, hosted public exhibitions and surgeries, and answered all questions openly and honestly.

Result

Welsh Water have reduced peak flows by 6,000 litres per second, reduced storm overflow spill volumes by more than 95%, and removed 41 properties from the flood risk register. The reduced flows in sewers mean we no longer pump and treat 1.5 million cubic metres of surface water each year which also saves 27 tonnes of carbon dioxide emissions.

Queen Mary's Walk swale completed summer 2013

Cambrian North swale completed summer 2017

Glevering Street completed summer 2014

Station Road surface water tunnel completed May 2020

Key mitigations of this climate-related risk (inundation of networks in high rainfall events) with associated timescales are set out below:

Table 6: Risk mitigations and timescales: P1

ACTIVITY	TIMESCALES
Sewer network sensor technology and continued use of Event Duration Monitoring (EDM) to provide greater visibility on SOs that are frequently spilling.	Current and ongoing
99% of SOs are actively monitored and openly reported on our website.	Current and ongoing
Multi-capitals approach to embed the benefits of green solutions	Current and ongoing
Delivery of our DWMP, which includes plans for increasing sewer network capacity and delivery of sustainable drainage solutions. Including £420m investment in tackling storm overflows in AMP8 and over £4 billion by 2050.	AMP8 and beyond
Undertake further research into ways of treating storm flows at the point of discharge to reduce the need for carbon intensive storage solutions.	AMP8 and beyond

HOW CAN I HELP AS AN INDIVIDUAL?

- Don't pave over your driveway with impermeable concrete. Consider permeable paving options, like the ones here: www.rhs.org.uk/garden-design/permeable-paving
- Install water butts to collect rainwater that your garden will love.
- Consider establishing rain gardens or planters that take excess rainwater from the roof and slow the water down, saving water in the process: www.rhs.org.uk/garden-features/rain-gardens

5.2 CLIMATE CHANGE IMPACT ON DRINKING WATER QUALITY

5.2.1 Where are we?

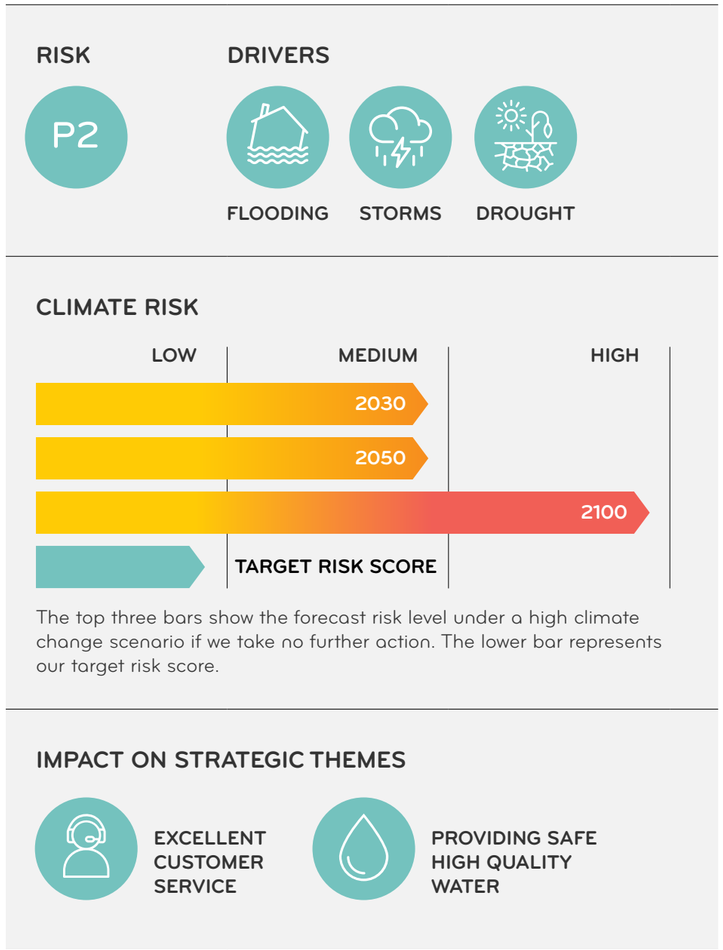


Figure 10: At a glance risk summary: P2

5.2.2 Understanding the risk

Warmer weather will extend the seasonal impact of the production of naturally occurring compounds from bacteria and algae present in raw water sources which can affect taste and odour. Extreme weather conditions, including drought and intense rainfall periods, can result in an increase in the washing of pollutants and sediment into watercourses feeding our raw water sources making the water more challenging to treat. Changing weather conditions can also result in changes in land cover, due to different flora thriving under different conditions, which can exacerbate this risk. This can present both a risk to drinking water availability and quality, as changes in raw water can impact our chemical treatment regime and make it more difficult and costly to treat the required volumes to meet demand.

Changes in soil water content and the associated swelling and shrinking of soils (where susceptible) can cause landslides on natural and engineered slopes and foundations, damaging infrastructure and increasing sediment load once again making the treatment of the raw water more challenging. Land use changes, brought about by changes in weather patterns can also change soil structure and composition, further influencing our inlet water composition. Sediment, bacteria, pesticides and nitrates are not the only concern, with emerging contaminants such as Per- and polyfluoroalkyl substances (PFAS) and the performance of invasive plant and animal species also influencing this risk and compounding the effects of climate change.

5.2.3 What we are doing about it

We are currently monitoring the water quality in our reservoirs and have modelled in our WRMP 2024-2049[30] and associated studies how we expect treatability to change under future climate change scenarios. We have installed monitoring equipment in some of our reservoirs to give us real time information across the depth to enable us to choose the best level at which to draw water off for treatment. We have also worked with universities to research taste and odour compounds, what produces them, how, why and when, to enable us to look at land management options within catchments to reduce risk of these compounds being produced in the future.

To help prevent the run-off of pollutants into our raw water sources we have installed upstream monitoring stations on our river abstractions and undertaken research into buffer strips to reduce contaminant loss into watercourses. We also operate PestSmart[31] – funded by a £1m grant from Welsh Government – to encourage the safe use, storage and disposal of pesticides. PestSmart outcomes include: 7700kg of unwanted pesticide collected during pesticide amnesties which has been disposed of safely, awareness campaign has included 64,874 microsite views, coverage including key BBC Wales and ITV Wales broadcasts, 14.3m digital and social advertising impressions, 2,544,000 commercial radio impacts and 1,120 community radio spots.

We have also had initiatives such as the weed wiper trial which has been successful in offering an alternative piece of equipment which does not allow spray drift from chemical spraying and has reduced the detections of herbicide in a number of rivers. Based on the outcomes of this initiative Welsh Government have included weed wipers within farm business grants enabling land managers across Wales to purchase this equipment at an affordable price.

Key mitigations of climate related risks with associated timescales are below:

Table 7: Risk mitigations and timescales: P2

ACTIVITY	TIMESCALES
Raw water quality monitoring (monitoring upstream of intakes and in reservoirs)	Current and ongoing
Catchment management, scaling up the work in the Brecon Beacons to other catchment areas	Current and ongoing
Operating PestSmart to encourage the safe use, storage and disposal of pesticides	Current and ongoing
Schemes designed for water treatment plans (including Pendine) included in PR24 business plan	Planned to be delivered in AMP8
Developing future schemes for water treatment plants	Beyond AMP8
Undertake further research into ways of preventing algal growth in reservoirs and new ways of treating water to reduce water quality and taste impacts.	AMP8 and beyond

HOW CAN I HELP AS AN INDIVIDUAL?

Don't use pesticides on allotments and gardens – these can have a large cumulative effect on our water system.

CASE STUDY: PENDINE WATER TREATMENT WORKS

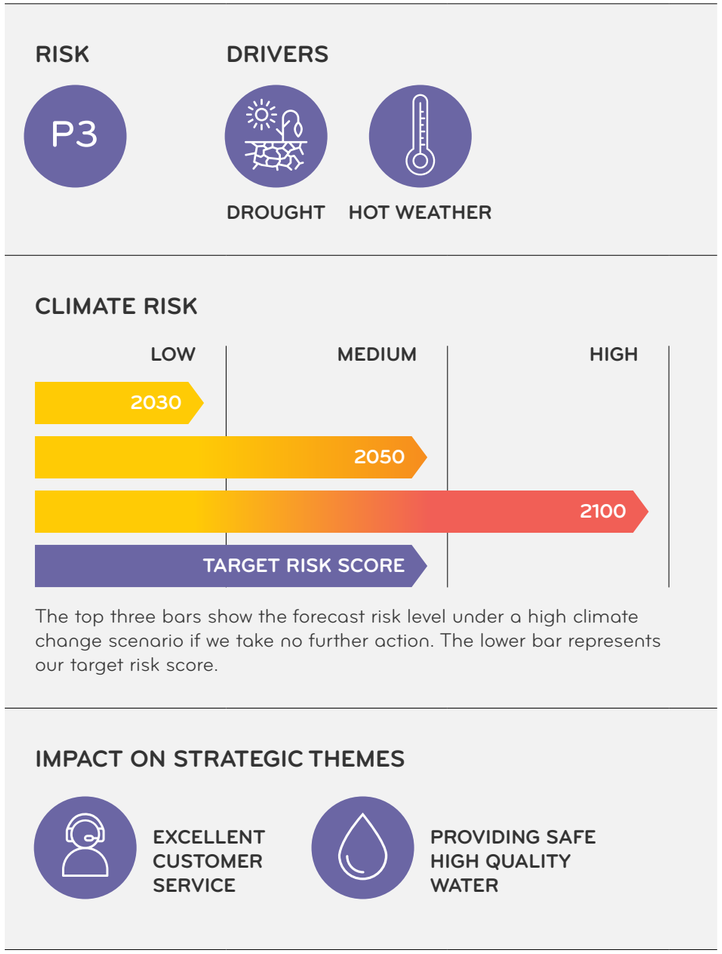
Our water treatment works at Pendine is an example of how we are including climate change in options development and selection. We have been monitoring borehole quality, which is being influenced by saline intrusion due to the proximity to the coast, and run-off from nearby catchments. Our proposed solution to protect the water source and treatment infrastructure considers how climate change, specifically sea level rise and drought, may impact the area of Pendine in the future, and incorporates this into a resilient design.

Our Watersource Strategy sets out our approach to catchment management. A key highlight of this approach is our long-term Brecon Beacons mega-catchment concept. The Brecon Beacons supplies over half the drinking water to our customers. We recognise that by improving and restoring terrestrial and aquatic habitats we can and will make improvements to water quality, lock up carbon, mitigate flooding risks, and improve the wellbeing of our customers.

Image: ©Visit Wales

5.3 INCREASE IN CUSTOMER DEMAND UNDER HOT CONDITIONS

5.3.1 Where are we?



The top three bars show the forecast risk level under a high climate change scenario if we take no further action. The lower bar represents our target risk score.

Figure 11: At a glance risk summary: P3

5.3.2 Understanding the risk

As we increasingly see periods of hot weather, we know from experience that our customers seek to use more water to cool off and manage their gardens. This increase in demand can be difficult to predict and manage, especially as demand changes with tourism.

For example, between March and August 2022, Wales received just 56.7% of its expected rainfall, the third driest six-month period since records began in 1865. In August alone, Wales received just 38% of its average monthly rainfall with heatwaves in both July and August leading to very high demand for water especially in the tourist areas of west Wales. This led to very low reservoir storages across most of south Wales and parts of northeast Wales, culminating in the first restrictions being placed on our customers since 1989, whereby on the 19th August a 'Temporary Ban on Water Use' (formerly known as a 'Hosepipe Ban') came into effect in our Pembrokeshire Water Resource Zones (WRZs).

These supply challenges are localised, with our infrastructure in general only capturing around 3% of effective rainfall in Wales. Our WRMP 2024 supply-demand balance assessment anticipates zonal surpluses and deficits under a 1 in 200 year drought at the UKCP18 medium emissions scenario (RCP6.0) 50th percentile at 2050, as shown in Figure 12.

The climate change impact has increased in all zones from the WRMP19 assessment. In WRMP19, climate change was forecast to reduce our supply capability in South East Wales (shown as 'SEWCUS' in Figure 6) by 4.3% at 2050. In WRMP24, the equivalent impact in 2050 is a reduction of 6.3% for a medium emissions (RCP6.0) scenario, increasing to 9.2% under a high emissions (RCP8.5) scenario.

Figure 12: Surplus and deficit WRZs from our WRMP; 1 in 200 year drought supply demand balance under RCP6.0 medium emissions scenario (Source: WRMP[32]).

5.3.3 What we are doing about it

Aligned with the regional Water Resources West plan, our WRMP assesses future water supply under the 'most likely' scenario (RCP 6.0), and 'stress-tests' this against RCP2.6 (low) and RCP8.5 (high). It is important that we understand and analyse within these climate extremes, as we are already seeing extreme events.

Through our WRMP we have developed an ambitious, long-term demand management strategy that recognises the need to take action to reduce leakage and help customers use water wisely. Through this activity, we expect to have sufficient water resources to be able to continue to supply water to our customers in the long-term across all climate change scenarios. You can read more on our WRMP in our latest Annual Report and Accounts[1] (ESG report objective 1).

We have gained improved confidence in our understanding of drought resilience through a step change in the techniques we are now using. These include:

- The development of 60 new catchment models that better represent inflows to our reservoirs and rivers.
- Use of a new systems modelling platform, which provides a better representation of asset operation and demand.
- The use of statistical modelling of weather pattern data to understand the severity and frequency of drought events. More detailed information on this process can be found in our WRMP.

We are also committing significant resources to our own leakage reduction programmes and are working in partnership with our customers and communities on demand reduction measures. Over the past 25 years, the quantity of water we supply to our customers has reduced from an average of over 1000 million litres per day (Ml/d) to about 850 Ml/d today. Approximately half of this is a result of leakage reduction, with the rest due to reduced demand from heavy industry and our customers increasing appreciation of the value of their water supply leading to a reduction in their water usage. We are committed to significantly reducing the amount of water lost from our network each year and have invested to ensure that leakage is minimised as far as possible.

Key mitigations of climate related risks with associated timescales are below:

Table 8: Risk mitigations and timescales: P3

ACTIVITY	TIMESCALES
Drought and supply modelling in WRMP	Current and ongoing
Leakage reduction programme (to achieve a 50% reduction in leakage levels, set against a 2017/18 baseline, by 2050)	Current and ongoing
Per capita consumption reduction programme (to achieve a target consumption of 110 litres per person per day by 2050 in combination with our metering strategy)	Current and ongoing
Tackling localised pinch points within our strategic network to optimise water resource in times of drought, through strategic planning (WRMP and LTDS core pathway)	AMP8 and beyond
Our metering strategy aims to achieve 96% meter penetration by 2050.	AMP8 and beyond

HOW CAN I HELP AS AN INDIVIDUAL?

- Apply for a smart meter when they become available and use this to identify when you're using excess water and opportunities to reduce use.
- Reduce the amount of potable water you're using when you don't need to (i.e. on the garden or washing the car), by installing a water butt or reusing washing up water.
- Have a shower, not a bath (or share your bath water with friends!)
- For more tips, check out our website here: dwrcymru.com/savewater

5.4 RISK TO OUR ASSETS DURING EXTREME WEATHER EVENTS OR SEA LEVEL RISE

5.4.1 Where are we?

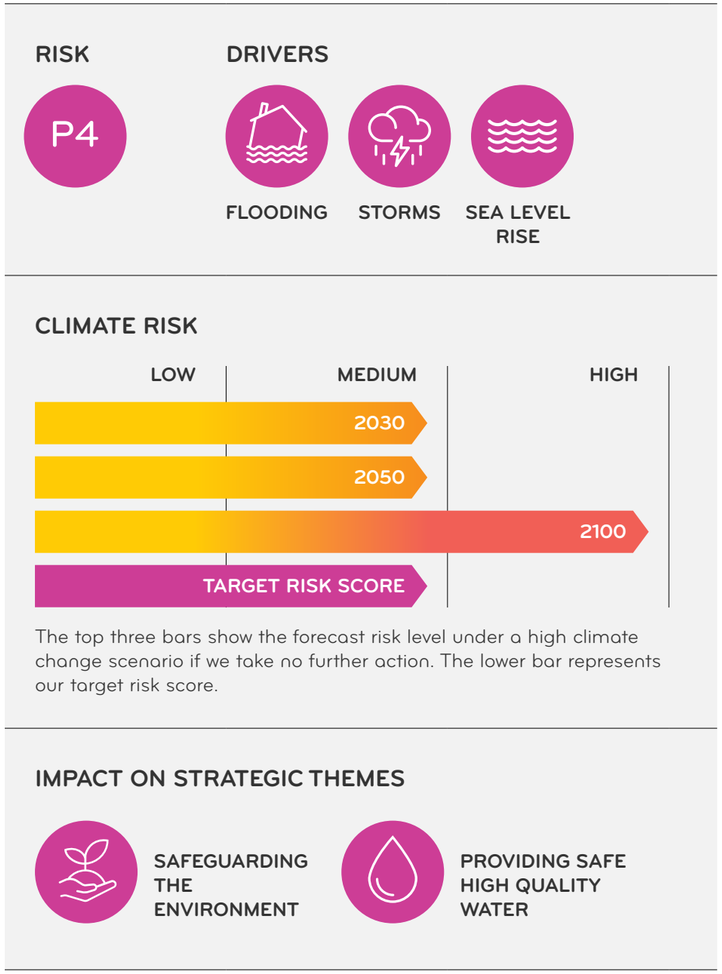


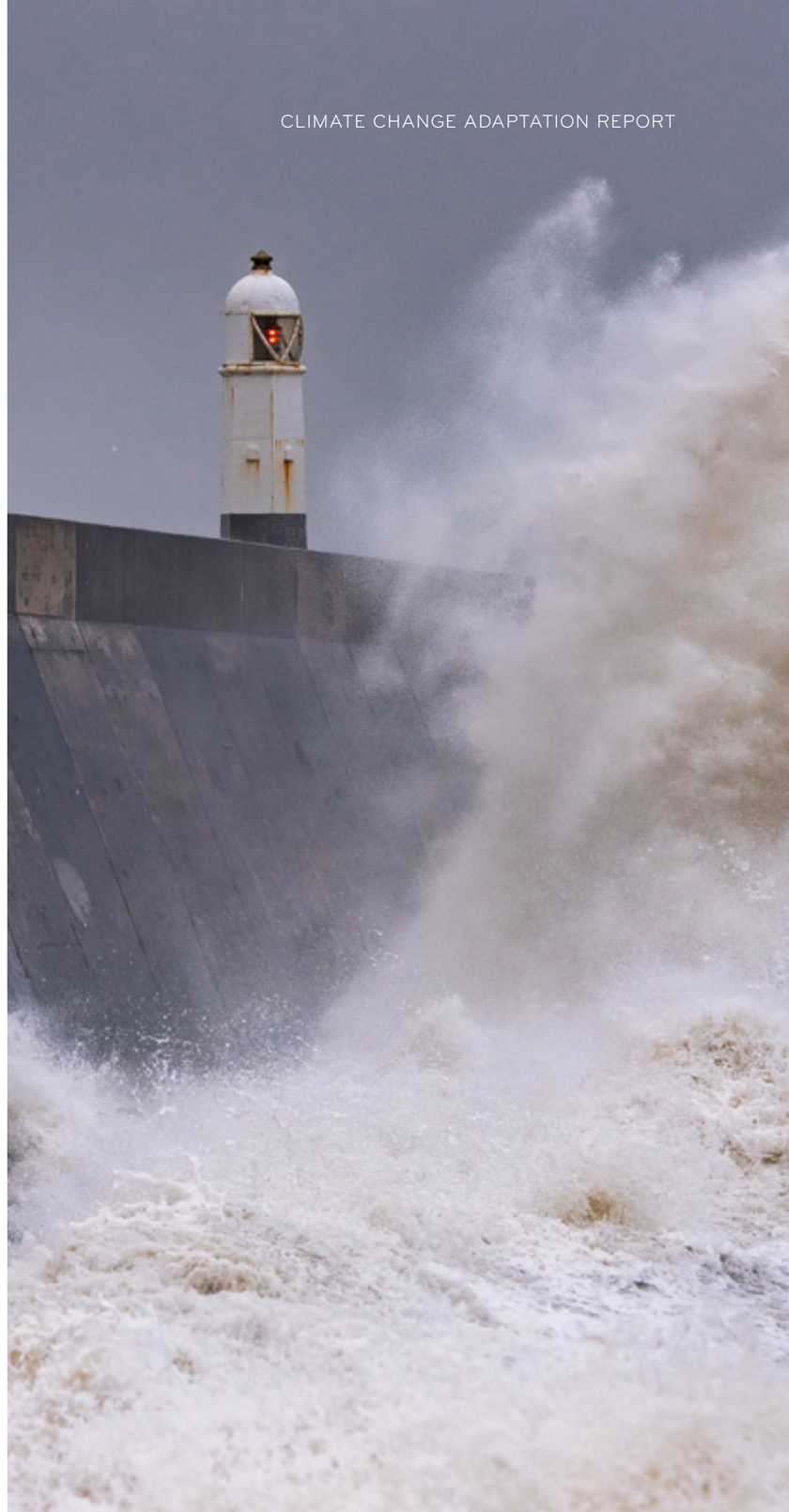
Figure 13: At a glance risk summary: P4

5.4.2 Understanding the risk

Having a constant supply of water is important for our customers. We manage our network every day to try to ensure any operational challenges we encounter do not impact customers' supply. However, sometimes circumstances outside our control do impact on customer supply, particularly in difficult weather conditions.

It is not only our water supply network that is at risk, our wastewater assets can also flood or be damaged during stormy conditions, and all assets located on the coast are at risk of sea level rise. Our pipes can burst with extreme temperature changes, for example when they freeze during very cold winter temperatures (known as freeze-thaw events), and when pressure builds during very hot weather. With climate change we are expecting the number of freeze-thaw events to decrease with warmer winter temperatures, and the number of summer burst events to increase as summer temperatures increase. Burst events may also increase generally due to ground movement during both wetter and drier conditions.

For example, in February 2020, during Storm Dennis, our Mayhill treatment works in Monmouth was flooded and residents had to be kept in supply by tankers and bottled water. This is a risk that our assets, like at Mayhill (e.g. treatment works, pumping stations, pipework), are flooded or damaged during extreme events, leading to an inability to supply customers or risk of environmental harm due to loss of treatment capability.



5.4.3 What we are doing about it

We are tackling the risk to our assets from climate change though a number of avenues, ranging from modelling to understand the problem and provide evidence for future investment, to direct schemes to mitigate these risks and adapt to climate change.

This section includes three examples:

CASE STUDY: ASSET FLOODING

To better understand the risk of current and future flood risk to our assets we have undertaken an assessment of assets at risk from pluvial, fluvial and tidal flood risk in order to support embedding resilience. The assessment built on a screening exercise to review the number of assets at risk from flooding for 1:100 and 1:1000 return period events. This assessment undertook a wider assessment of varying flood return period events incorporating National Resources Wales (NRW)/Environment Agency (EA) 1:30 high risk scenarios and identifying those sites at risk by acquiring the relevant NRW National Flood Hazard Map data and the nearest EA equivalent (Risk of Flooding from Multiple Sources: Risk Band) data sets on specific asset site areas.

The assessment identified 73 asset sites at risk from climate change driven flooding. These were reviewed to determine whether they needed further assessment, resulting in eight locations identified. The remainder were either only affected by localised ponding or on the fringes by surface water flooding. As well as identifying at risk sites, the assessment identified different flood protection options, such as flood walls for 1:100 and 1:1000 flood events. We plan to mitigate the flood risk at the remaining unprotected critical water assets during AMP8.

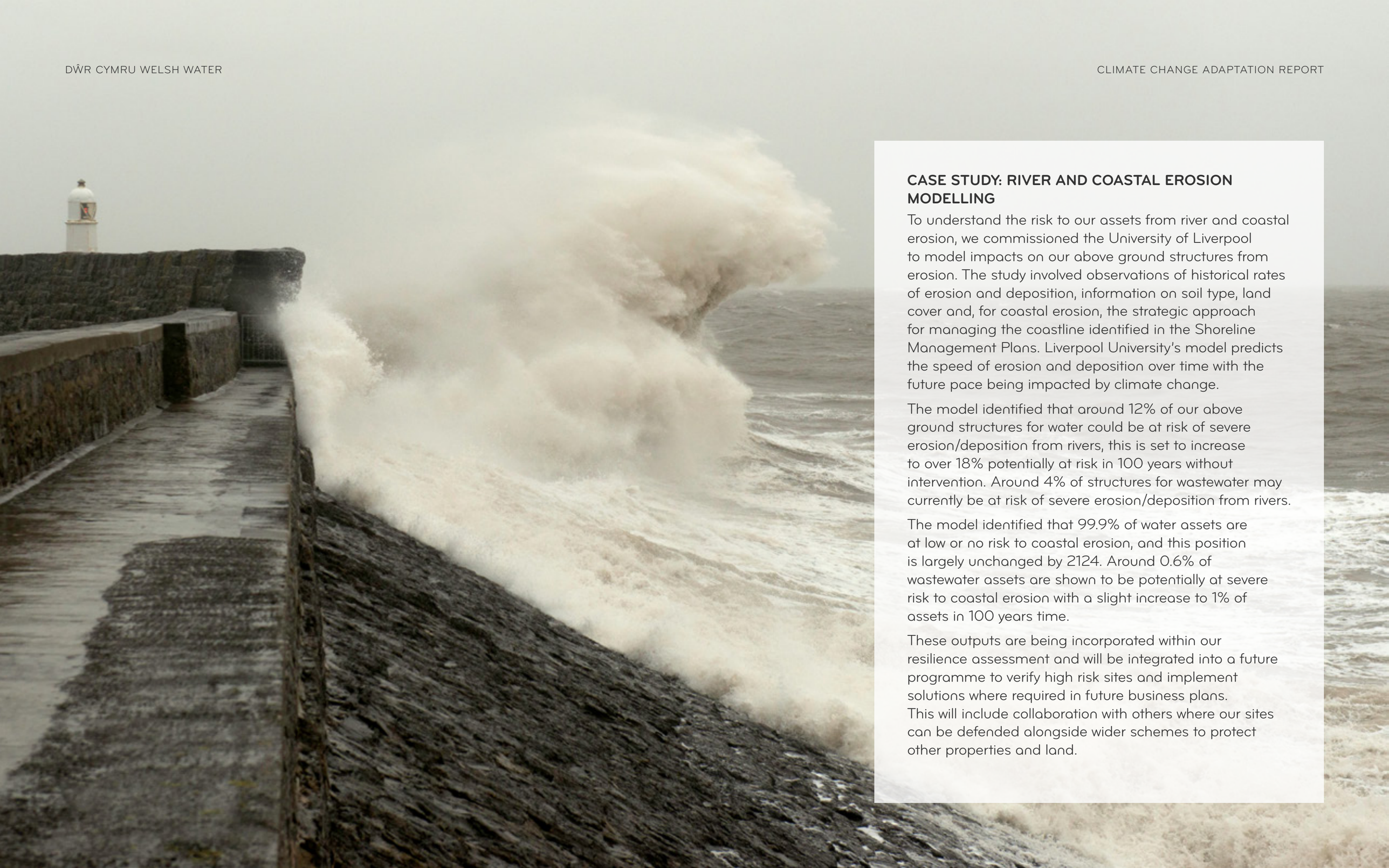
CASE STUDY: PARTNERSHIP FLOOD ALLEVIATION PROGRAMME

Our Partnership Flood Alleviation Programme provides risk management authorities and community groups within our operating area the opportunity to work with us to manage the risk from surface water flooding, both in terms of our assets and those of others.

Our policy here contains the principles that support our partnership flood alleviation programme and provides a clear and consistent framework for others to successfully engage and work with us. We will consider contributing to surface water flooding alleviation projects that also benefit the public sewer network or Welsh Water in the following ways:

- Reduced risk of flooding to vulnerable communities
- Reduced peak river flows (by up to 25%) in a small number of catchments
- Reduction in surface water entering our networks in affected catchments
- Reduced impact of flood events on water quality
- Enhanced reputation.

We are looking to work collaboratively with NRW and local authorities, and contribute to solutions that encourage a partnership approach to managing surface water flooding, through sustainable techniques such as natural flood management or SuDS.



CASE STUDY: RIVER AND COASTAL EROSION MODELLING

To understand the risk to our assets from river and coastal erosion, we commissioned the University of Liverpool to model impacts on our above ground structures from erosion. The study involved observations of historical rates of erosion and deposition, information on soil type, land cover and, for coastal erosion, the strategic approach for managing the coastline identified in the Shoreline Management Plans. Liverpool University's model predicts the speed of erosion and deposition over time with the future pace being impacted by climate change.

The model identified that around 12% of our above ground structures for water could be at risk of severe erosion/deposition from rivers, this is set to increase to over 18% potentially at risk in 100 years without intervention. Around 4% of structures for wastewater may currently be at risk of severe erosion/deposition from rivers.

The model identified that 99.9% of water assets are at low or no risk to coastal erosion, and this position is largely unchanged by 2124. Around 0.6% of wastewater assets are shown to be potentially at severe risk to coastal erosion with a slight increase to 1% of assets in 100 years time.

These outputs are being incorporated within our resilience assessment and will be integrated into a future programme to verify high risk sites and implement solutions where required in future business plans. This will include collaboration with others where our sites can be defended alongside wider schemes to protect other properties and land.

Key mitigations of climate related risks with associated timescales are below:

Table 9: Risk mitigations and timescales: P4

ACTIVITY	TIMESCALES
Asset flood modelling	Current and ongoing
Asset flood protection improvements	AMP 8 and beyond
River and coastal erosion modelling	Current and ongoing
Erosion risk mitigation programme	Beyond AMP8
Partnership flood alleviation programme	Current and ongoing

HOW CAN I HELP AS AN INDIVIDUAL?

- Tell us if you notice extreme weather events that are likely to have an impact on our assets, or you spot something out of the ordinary.
- Get involved with local community groups looking to manage flood risk.

5.5 RISK TO INFRASTRUCTURE SUPPLY CHAINS DURING EXTREME WEATHER EVENTS

5.5.1 Where are we?

Figure 14: At a glance risk summary: P5

5.5.2 Understanding the risk

There is a risk from the direct impact on infrastructure such as telecoms, transport or energy, causing disruption to our systems and leading to an inability to supply customers and the risk of environmental harm due to a loss of treatment capability.

In times of uncertainty effective two-way communication is vital. We need to understand how the uncertainty impacts our principal stakeholders and what they and we are doing to respond, and why this represents the most effective way we can mitigate climate impacts.

Risks have been identified by other organisations in their own climate change adaptation reports. We work with other organisations to understand how risks that they face might result in cascading failures to us and our assets.

5.5.3 What are we doing about it

In the face of the growing threats, we are currently reviewing our register of critical water and wastewater assets and prioritising investments to secure assets against physical and cyber threats. We are reviewing our programme of resilience upgrades, to include security upgrades, flood protection, power resilience and twinning of strategic mains crossing under rivers, roads and railways. We are also updating our site contingency plans.

For wastewater assets (e.g. treatment works but also pumping stations and critical mains in sensitive areas), we are implementing a number of schemes in the current period to improve resilience against power outages and we are updating our business continuity plans.

We are taking account of the recommendations of the National Infrastructure Commission's National Infrastructure Assessment[33] (November 2021) and will engage with the National Infrastructure Commission for Wales on the interdependencies with key infrastructure providers such as power and transport to understand the system implications. Additionally, we are working with the UK Government's Department for Business, Energy and Industrial Strategy (BEIS) and local resilience forums to consider the impacts and our response to potential national-level power loss ('black start') events.

We work closely with local resilience forums and our logistics partners to provide alternative supplies, and focus on our vulnerable customers to ensure they receive the level of support they expect, including hand delivering alternative supplies where necessary.

The introduction of the regional water resources planning process has meant that through the Water Resources West group, of which we are a member, we have had regular weekly/monthly engagement with neighbouring water companies (United Utilities, Hafren Dyfrydwy, Severn Trent Water, South Staffs Water) and other key stakeholders such as EA, NRW, Ofwat/RAPID, the Canal and River Trust, the National Farmers Union, Natural England as well as representatives from the power sector.

Our RainScape programme reduces community level flood-risk which could subsequently reduce flood risk to other key infrastructure networks. A project in Llanelli was an early example of how to apply low-carbon, nature friendly solutions to a problem – excess surface water run-off – that would otherwise require a capital-intensive solution. However, this approach takes time to develop and implement, and the costs are very significant. Our aim is to apply this same approach to other urban areas in Wales, to help adapt to the changing climate by slowing down the run-off into combined sewers during heavy rainstorm events, which can cause flooding and pollution.

Key mitigations of climate related risks with associated timescales are below:

Table 10: Risk mitigations and timescales: P5

ACTIVITY	TIMESCALES
Engagement with the National Infrastructure Commission for Wales on the interdependencies with key infrastructure providers such as power and transport to understand the system implications.	Current and ongoing
Designing back-up generators on specific sites to improve resilience	Current and ongoing
Sustainable procurement strategy	Current and ongoing

6. CONSIDERING OUR TRANSITION RISKS

6.1 TRANSITION RISK SCENARIOS

Transition risks are those stemming from a risk of transitioning to a net zero economy. These can be both acute (e.g. legislation change), or chronic (e.g. societal behaviour change over time).

Transition risk scenarios:

Accelerated net zero (RCP 2.6 in 2030[34])

The world is on track to limit warming to 1.5 degrees. This means significant political action realigns economies and society:

- UK and Welsh Government policy and regulation incentivises significant reductions in GHG emissions before 2030
- Technological developments are made at speed, fossil fuel intensive items are made redundant, impractical or too costly to operate and replaced by nature-based solutions and efficient technology
- Social behaviour sets expectations of businesses, and the licence to operate is tied to delivery of net zero commitments. The value of water is acknowledged and costs are more easily accepted by customers.

Delayed and disorderly (RCP8.5 in 2030[35])

After decades of inactivity, there is a charge to decarbonise after missing carbon reduction targets. This means:

- Governments and society are sent into a state of urgency to act leading to policy and legislation instigating huge costs for emitting GHGs and incentivising immediate emissions reductions
- Technological developments are fast, but supply chains are heavily constrained
- Society reacts strongly to climate change impacts and is supportive of climate action, however customers are less willing to accept costs of previous inaction

Transition risk drivers:

- Policy legislation and funding change
- Technology shift
- Social behaviour change

6.2 OUR KEY CLIMATE RISKS — TRANSITION

While this report focuses on physical climate change risk and our approach to adaptation, we have also considered risks arising from the transition to a low carbon economy. More detailed information about our transition risk can be seen alongside key opportunities in our most recent Annual Report and Accounts 2022/23[1].

We are committed to achieving net zero by 2040 for all scopes of emissions and have set out several milestones to achieve this. Details for other mitigation measures for our key transition risks are outlined below alongside them. As with our physical climate-related risk, there is an underlying risk that the regulatory framework as currently set out will not support funding for the mitigation investments we wish to deliver. This is particularly relevant for our net zero strategy, detailed further under transition risk 5.

Figure 15: Top unmitigated risks under accelerated net zero scenario (RCP2.6, 2030)

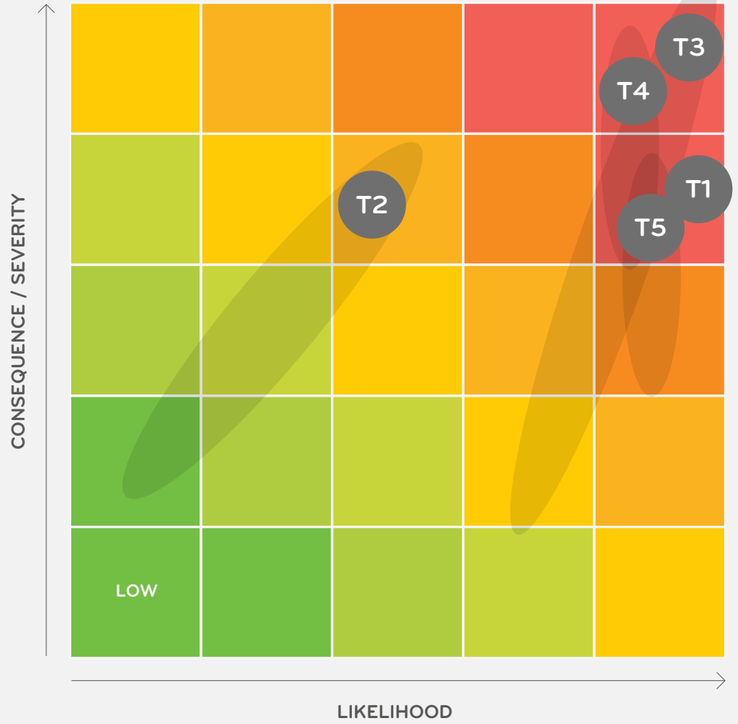
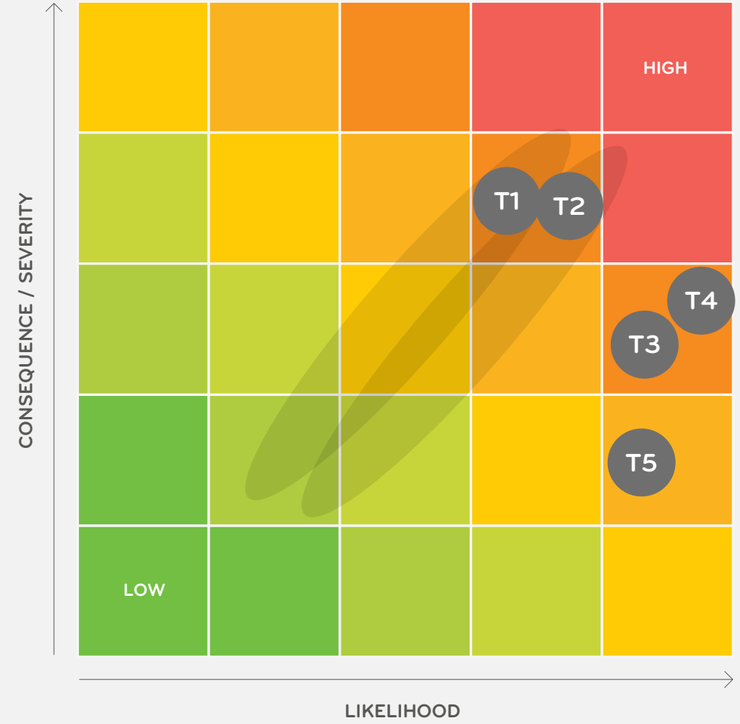


Figure 16: Top unmitigated risks under delayed and disorderly scenario (RCP 8.5, 2050)



- T1 Inaccuracy of emissions reporting
- T2 Inability to adopt new technologies at pace
- T3 Financial impact of extended emissions trading and carbon tax.
- T4 Speed of transition raises costs and competition for resources in supply chain.
- T5 Regulatory targets related to embodied carbon are incompatible with the regulatory targets from the National Environment Programme (NEP).

Likelihood

Policy, legislation, and funding change
From 'Change in government structure required for this change' (low) to 'Discussions about bringing in this policy' (high)

Technology shift
From 'No known discussions about this technology' (low) to 'Technology trials are currently in progress' (high)

Societal behaviour change
From 'No examples of these behaviours seen anywhere' (low) to 'Evidence of pockets of behaviour in Welsh Water's areas' (high)

Consequence/Severity
Unchanged from the Welsh Water Risk Management Framework, scored against operational, reputational and/or financial risks. This can be found in Appendix C of this report.

Displays the range of outcomes due to uncertainty.

Table 11: Primary risks: transition

DRIVER	RISK	MITIGATION MEASURES (WITH TIME FRAMES)
Technology shift	T1 **Inaccuracy of emissions reporting** There is a risk that actual emissions are different to those reported. This uncertainty results in under or over investment in mitigation activities, and exposes the organisation to financial impacts associated with the price controls for emitting GHGs.	Investment in better scientific understanding of our emissions, including estimation of our Scope 3 emissions: ongoing Fugitive emissions reduction programme to monitor and reduce 50,000 tons CO_2e per year: ongoing
Technology shift	T2 **Inability to adopt new technologies at pace** There is a risk that our technological capabilities to support the transition are insufficient to mitigate residual emissions and manage future challenges, e.g. disposal of biosolids, and abating process emissions.	Collaborative innovation programmes, including £35.7M via the Ofwat innovation fund and partnerships with up to 100 academic and other institutions; ongoing
Policy, legislation and funding change	T3 **Financial impact of extended emissions trading and carbon tax** There is a risk that there is increased legislative and regulatory pressure to enter into emissions trading schemes or the enforcement of carbon tax, leading to significant costs	Sustainable Procurement Policy to strengthen supply chains and reduce scope 3 emissions; ongoing
Policy, legislation and funding change	T4 **Speed of transition raises costs and competition for resources in supply chain** There is a risk that policy forces companies to transition at the same time, causing competition for the same resources. Furthermore, the supply chain does not yet have the technological solutions to mitigate residual emissions (e.g. process emissions).	Sustainable Procurement Policy to strengthen supply chains and reduce scope 3 emissions; ongoing Adaptive pathways within our LTDS to invest responsibly in line with our understanding of risk; ongoing, delivery of plan for AMP8.
Policy, legislation and funding change	T5 **Regulatory targets related to embodied carbon are incompatible with the regulatory targets from the NEP** There is a risk that regulatory tensions between NEP and embodied carbon lead to a failure to meet either targets, resulting in reputation damage and/or negative environmental impact.	Service measure framework development and use to make the case for blue/ green solutions to reduce carbon impacts of interventions and contribute to the Sustainable Management of Natural Resources (SMNR); ongoing

6.3 MITIGATING OUR TRANSITION RISKS: OUR JOURNEY TO NET ZERO

We have an objective to achieve net-zero emissions in 2040. To deliver this, we have identified six work packages:

1. **Reducing use of energy and increasing own renewable energy generation.**
2. **Utilising sewage derived biogas to decarbonise heat and/ or transport.**
3. **Gradual transition to a low carbon-fuelled fleet.**
4. **Actively control and reduce fugitive emissions from treatment processes.**
5. **Monitor and reduce construction-related carbon emissions.**
6. **Maximise carbon sequestration and biodiversity.**

We have already made good progress over the last decade or so, through electricity decarbonisation, increased renewable generation and reducing construction carbon.

7. WHERE NEXT?

7.1 GOVERNANCE FOR DELIVERY OF CLIMATE CHANGE ADAPTATION

Climate change represents one of the biggest challenges we face as a business. Rooted in the Well-being of Future Generations (Wales) Act 2015, our Welsh Water 2050 vision "to become a truly world class, resilient, and sustainable water service for the benefit of future generations" means that adapting to future climate conditions is central to everything we do.

This year, we have developed a Climate Change Planning Policy to better guide our business to consider and respond to climate change. The policy sets out management's role:

- The Board has ultimate responsibility for the group's preparedness for adapting to climate change and driving our mitigation strategy. The responsibility to develop and implement a plan to achieve this is delegated by the Board to the CEO and the Executive management team.
- The Environmental Social Governance (ESG) Committee of the Welsh Water Board is our primary vehicle for oversight of climate related risks and opportunities. The Committee meets on a quarterly basis, and formally reviews risks and their mitigations every six months.
- The Chief Risk Officer (CRO) has executive responsibility for risk management governance including the identification, management and proper reporting of climate-related risks and opportunities to the ESG Committee and Board.
- Managing Directors for Water and Waste Services are responsible for implementing climate change response and adaptation plans. Along with the other members of the executive team, they are tasked with managing the risks and mitigating actions, for example by ensuring we have the necessary financial resources and skilled people in place to achieve our climate-related objectives.

We're committed to delivering progress towards climate mitigation and resilience for our customers and the wider community. This accountability is reflected in a disclosure for the Task Force for Climate-related Financial Disclosures (TCFD) in our 2022/23 annual report, which includes details of our scope 1, 2 and 3 emissions, and our comprehensive and ambitious plan to achieve net zero by 2040, which is ahead of statutory obligations.

7.2 DELIVERING NO REGRETS INVESTMENT TO 2030

We are expecting significant investment in activities that contribute to climate change adaptation and support this planning as part of 'no/low regrets' programmes including those described in our LTDS; such as

- Demand-side management through investment in leakage management, metering programme, water efficiency,
- Water catchment management, as described in our WaterSource strategy.

Our Business Plan for 2025-2030 includes significant accelerations in investment programmes, where we believe that service performance is likely to be increasingly impacted by climate impacts, including SO and river water quality investments, and replacing mains vulnerable to dry weather bursts.

We will also continue to develop our own and the market's approach to water management by:

- making the case that the entry of rainwater into drainage systems should be managed in an integrated way, i.e. controlled at source,
- further developing close working relationships with local authorities to drive SuDs, and
- using the innovation agenda to establish working infrastructure solutions which treat storm spills for discharge with no impact on the environment, rather than having to store and pass forward flows to a wastewater treatment works for costly treatment.

7.3 MONITORING AND REVIEW: AN ADAPTIVE APPROACH

When it comes to climate change adaptation, we know that we are on a journey. We're proud of the progress we have made to date, which includes:

- Development of a multi-capitals approach that is on par with best practice in the sector, which allows us to optimise across our investment programme and value wider societal benefits,
- Further maturing our approach to climate change in our WRMP, to include UKCP18 data and develop an adaptive plan,
- Championing the need for DWMPs which consider multiple climate futures, and
- Development of a Climate Change Planning Policy to further strengthen our climate change governance, modelling and risk management, and reporting.

To monitor our performance along this journey, we use a number of metrics, including our performance commitments. These are reported annually on our website via our Annual Report and Accounts, alongside our wider Environmental and Social Governance (ESG) objectives[36] and progress towards Welsh Water 2050 strategic responses[37]. The AMP7 performance commitments below are sector-wide performance commitments from the Price Review 2019. Note these are subject to change in 2025, as they are likely to be updated at Price Review 2024 for the duration of AMP8.

We accept that these measures are retrospective and are not directly assessing our progress on climate adaptation. This is because the performance they report can be impacted by many other factors. We will work with our partners in academia and the rest of the sector to develop better leading adaptation metrics ahead of the next update of this report, and secure the support of both our environment partners and government for their use as soon as they are available.

Table 12: Risks mapped against AMP7 performance commitments

RISK		AMP7 PERFORMANCE COMMITMENTS
P1	Inundation of sewer networks in high rainfall events	En3: Pollution incidents (Per 10,000km of sewer) Rt1: Internal sewer flooding (per 10,000 sewer connections)
P2	Climate change impact on drinking water quality	Wt1: Water quality compliance (CRI) Wt2: Water supply interruptions Wt3 Acceptability of drinking water
P3	Increase in customer demand under hot conditions	En5: Per Capita Consumption (% reduction) – 3-year average Wt2: Water supply interruptions
P4	Risk to our assets during extreme weather events	Wt2: Water supply interruptions Wt5: Unplanned outage % En1: Treatment works compliance %
P5	Risk to infrastructure supply chains during extreme weather events	En1: Treatment works compliance % En3: Pollution incidents (Per 10,000km of sewer) Wt2: Water supply interruptions

7.3.1 An adaptive approach for the future

Whilst we know unequivocally that climate change is happening, there remains some uncertainty as to the extent of the impact across our region and business. We are therefore committed to taking an adaptive approach, as outlined in this report and supported by strategic planning, like our LTDS. This approach requires us to monitor both:

- changing weather patterns and latest climate projections, and
- our performance, through our performance commitments, and the impact of extreme weather events on this.

Our Climate Change Planning Policy (2023) commits us to updating this Climate Change Adaptation Report every 5 years to continue to review and reflect on the latest climate science and on our adaptation progress. We will also continue to monitor and review our net zero plan.

Up to 2030, we will continue to focus on further work to optimise our adaptation plans. This means that we will be making significant investment in investigations, with a focus on data gathering and modelling, notably including the refinement of the DWMP such that our plans can become a statutory reporting exercise and align with the WRMP.

From 2030 onwards, in addition to continuing to invest in those things that are critical now, we anticipated that large scale investments are likely to be dependent upon, and adapted to reflect:

- Key learnings from investigations; notably how to optimise drainage investments for both water quality and flooding purposes.
- Any new national design criteria for resilience and adaptation that may be agreed with governments and regulators.
- Understanding of climate science and the pathway that we are on, and hence the degree to which adaptive strategies are triggered.

7.4 A COLLABORATIVE JOURNEY: TEAM WALES

This report sets out our adaptation approaches to respond to our principal risks. All these risks require partnership and collaboration, as interdependencies and cascading consequences mean that we cannot solve them alone.

We know we are stronger together, and this partnership extends to our regulatory and funding environment. Both our adaptation actions and our net zero plan[38] are ambitious, pro-active plans, that are subject to funding and affordability, and influenced by our customers' priorities. We are an active participant in Team Wales, and seek to optimise the regulatory regime under which we operate and the surrounding market conditions to obtain sufficient investments to reach climate safety.

To this end, we want to continue improving our approach to climate risk assessment and adaptation, and have the following questions. You can respond to these questions or provide any other feedback on this report by contacting assetplanning@dwrcymru.com.

Climate change is critical for our business, and indeed our communities, and we remain committed to tackling both adaptation and mitigation together.

QUESTIONS FOR YOU:

- Who else is working on addressing similar risks that we could collaborate with?
- Do you know of any additional data or information that would support us in getting an even better understanding of the risks we face?
- Are you aware of any innovative techniques or technologies that could support us in addressing these risks?
- Are there any other major risks that you are aware of that you think we should be considering?
- Can you think of any opportunities to work with others to deliver wider benefits alongside our work in addressing these risks?

APPENDIX A: LONG LIST OF RISKS

Table 13: Long list of physical risks scored over three scenarios (ranked by long-term risk)

RISK NAME		DESCRIPTION	RISK RATING: UNPREDICTABLE WEATHER (RCP8.5 IN 2030)	RISK RATING: TEMPESTUOUS CLIMATES (RCP8.5 IN 2050)	RISK RATING: CATASTROPHIC STORMS (RCP8.5 IN 2100)
P1	Inundation of sewer networks in high rainfall events	There is a risk of sewer inundation during periods of increased rainfall intensity or duration, leading to a flooding event (internal/external flooding, SO discharge)	MED	HIGH	HIGH
P2	Climate change impact on drinking water quality	There is a risk that extreme weather conditions, including drought conditions, an increase in rainfall intensity, more extreme wet/dry cycles and other indirect causes change the composition of raw inlet water to treatment plants, changing chemical treatment regime and the ability to treat the same volume of water.	MED	MED	HIGH
P3	Increase in customer demand under hot conditions.	There is a risk that customers require more water under hot conditions, limiting the ability of Welsh Water to rely on PCC reduction to meet local supply/demand restrictions.	LOW	MED	HIGH
P4	Risk to our assets during extreme weather events.	There is a risk that our assets (e.g. treatment works, pumping stations, pipework) are flooded during high rainfall events, leading to an inability to supply customers or risk of environmental harm due to loss of treatment capability.	MED	MED	MED
P5	Risk to infrastructure supply chains during extreme weather events.	There is a risk that other infrastructure systems may be damaged or disrupted through the direct impact of extreme weather events (e.g. telecoms, transport or energy infrastructure). This can cause disruption to our own systems and can lead to an inability to supply our customers and present a risk of environmental harm due to loss of treatment capability.	MED	MED	MED

P6	Risk of pollution events damaging environmentally important sites, such as Sites of Special Scientific Interest (SSSI).	There is a risk that flooding or bursts pipes lead to pollution of SSSI and / or other special interest sites, leading to fines and environmental damage.	LOW	LOW	MED
P7	Increase in asset deterioration rates as a result of extreme weather.	There is a risk that asset deterioration rates will increase due to pumps operating more often due to higher rainfall levels. Underground assets would deteriorate at different rates due to changing ground conditions.	LOW	LOW	MED
P8	Coastal erosion (and sea level rise) causes land instability and damage to wastewater networks.	There is a risk of wastewater networks or other infrastructure being damaged due to unstable ground due to coastal erosion, leading to a pollution event. Inundation of pipes and treatment works from seawater.	LOW	LOW	LOW
P9	Risk of injury / harm to employees (and employee unavailability) due to extreme weather	There is a risk that extreme weather causes a health and safety incident, and / or results in a lack of employees due to road incidents.	LOW	LOW	LOW
P10	Licenses and permits change as a result of drought and other changes to the natural environment	There is a risk that Welsh Water permits/licenses are reduced due to drought or other changes to the natural environment causing extreme weather.	LOW	LOW	LOW
P11	Risk of lightning strikes directly impacting Welsh Water's operations	There is a risk that increased storminess and extreme weather directly impacts Welsh Water operations through lightning strikes.	LOW	LOW	LOW

APPENDIX B: OPPORTUNITIES

We recognise that the opportunities emerging from a changing climate for Welsh Water are less significant than the risks identified in Appendix A, therefore at this stage we have sought to identify high-level opportunities. We will continue to horizon scan and monitor these.

Table 14: Key opportunities for physical climate change risk management

OPPORTUNITY NAME	DESCRIPTION OF OPPORTUNITY	OUR APPROACH TO OPPORTUNITY REALISATION
Water pipe bursts	With warmer winters due to climate change, there will likely be a decreased amount of winter pipe bursts as these usually occur when temperatures dip below freezing. However, this may be countered by an increase in bursts in the summer months with higher temperature peaks and potential ground movement.	This opportunity is best managed through our robust asset management and monitoring systems, including modelling under climate change scenarios as outlined in our 2023 Climate Change Planning Policy.
Natural flood management and surface water management	Adopting more nature-based solutions to flood management could increase vegetation present across catchments (increasing biodiversity), and reduce the potential for erosion and run-off events. This would have a positive impact on water quality and reduce the chemicals required for treatment.	It will also provide an opportunity to work with different organisations and stakeholders to alleviate sources of flood risk and provide wider social, environmental and biodiversity benefits. We are already doing this in our Brecon Beacons mega catchment work, and intend to scale this up.
Changing agricultural practices	Climate change may lead to changes in agricultural practice, which could subsequently change crop types. Depending on the crop, these have the opportunity to provide improved land and soil quality, leading to less nutrient runoff and improving water quality.	There is currently a soil policy statement being drafted by Welsh Government (gov.wales/soil-management), and through our involvement in Team Wales we intend to continue to support decision makers, our customers and communities to make the best choices.
Restoration of peatland	Peatland is a precious wetland ecosystem that presents strong carbon capturing and stormwater management opportunities. Protecting and restoring more peatland areas could not only improve water quality, but also support our ambitions for net zero and connect to wider natural flood management goals.	This is a key part of our journey to net zero plan. It also has wider benefits for biodiversity, such benefits being captured in our multi-capitals approach to investment decision making.
Collaboration and innovation within supply chains	This opportunity is particularly relevant for managing our interdependent and cascading risks.	Working more closely and proactively with our supply chains and stakeholders, as seen through our mega catchment work and 'Team Wales' approach can create opportunities for joint management of our risks and opportunities.

APPENDIX C: RISK SCORING APPROACH

The consequence thresholds and risk rating matrix are unchanged from the Welsh Water ERM framework. We have adopted a different approach for the likelihood thresholds, to reflect the changing needs of likelihood scales across climate scenarios and multiple time periods. These are reflected in the likelihood summaries below and were refined during the risk prioritisation workshop.

Reputation	Operational	Operational health & safety	Operational organisation	Operational customer service	Financial (cash)
Severe and lasting impact on all relationships of trust	Affecting key stakeholders and significant numbers of customers	Fatality or major incident, e.g. fire/explosion	Significant impact on recruitment and retainment activity	Affecting all key stakeholders and significant numbers of customers: > 200,000 customers	> £100M
Impact on key stakeholder, government, or investors	Affecting significant numbers of customers and/or pervasive impact on several performance commitments	Life-changing injury/illness or significant incident e.g. RIDDOR Dangerous Occurrence	Impact on ability to retain / attract key individuals	Affecting significant numbers of customers and / or persuasive impact on several PCs: 200,000 customers	> £50M - £100M
Impact on key stakeholder relationships	Affecting one, or a few, performance commitments	RIDDOR injury or disease	Impact on morale internally and on external reputation as responsible employer	Affecting one or a few PCs: 50,000 customers	> £25M - £50M
Wider reputational / trust impact but considered manageable	Significant operational issues but considered manageable	Lost time injury / work-related illness / property damage	Wider impact on multiple teams/functions but considered manageable	Significant operational issues but considered manageable: 15,000 customers	> £10M - £25M
Local / minor impact only	Minor, manageable	Minor injury / near miss	Impact on team/function morale	Minor, manageable: < 10,000 customers	< £10M

Score matrix rating from existing Welsh Water ERM framework v1.0.

CONSEQUENCE / SEVERITY	< 1-in-100 year event	1-in-100 year event	1-in-30 year event	1-in-5 year event	1-in-1 year event
	Low	Medium	Medium	High	High
	Low	Low	Medium	Medium	High
	Low	Low	Medium	Medium	Medium
	Low	Low	Low	Low	Medium
	Low	Low	Low	Low	Low

LIKELIHOOD

Physical risk	All drivers					
Transition risk	**Policy, legislation, and funding change**	Change in government structure required for this change.	No government appetite, some mass movement organisations campaigning for this change	Government leadership / political party change required to bring in this change	Other jurisdictions are bringing in this policy	Discussions about bringing in this policy
	Technology shift	No known discussions about this technology		Some academic research in this field / technology.		Technology trials are currently in progress
	Societal behaviour change	No examples of these behaviours seen anywhere		Some examples of this behaviour in other geographies.		Evidence of pockets of behaviour in Welsh Water's areas

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4. Compared to pre-industrial levels
5. https://www.iea.org/reports/world-energy-outlook-2021/scenario-trajectories-and-temperature-outcomes
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11. https://corporate.dwrcymru.com/en/about-us/our-plans
12. Through the Environment (Wales) Act 2016
13. https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-2022
14. https://corporate.dwrcymru.com/en/journey-to-zero
15. https://ukwir.org/climate-change-adaptation-a-common-framework-6
16. https://corporate.dwrcymru.com/en/about-us/our-plans
17. https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf
18. This section presents our three physical climate change risk scenarios. To view our two transition risk scenarios, please see Section 6.0 Considering our transition risk.
19. 2030 is the end of the next regulatory price review period for water companies, and climate change will already be experienced in the form of more extreme weather patterns
20. Using UKCP18 data 50th percentile change for time horizon 2030 – 2049: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-key-results.xlsx
21. Using UKCP18 data for 5th and 95th percentile change for sea level rise for Cardiff under RCP8.5 in 2030, 2050 and 2100: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-key-results.xlsx
22. We plan ahead to 2050 in our long-term strategy, Welsh Water 2050, as well as our other regulatory planning documents. It also represents the date that climate projections RCP 6.0 and RCP 8.5 begin to significantly diverge
23. Using UKCP18 data 50th percentile change for time horizons 2050 – 2069: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-key-results.xlsx
24. Assets that we have in place or are planning for now will still be around in 2100. This also represents the long-term climate projection data available.
25. Using UKCP18 data 50th percentile change for time horizons 2080 – 2099: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-key-results.xlsx
26. Wastewater that enters properties through the floor or into garages attached to the building.
27. Wastewater that enters the external areas of a property, such as gardens, pathways or unattached garages.
28. https://corporate.dwrcymru.com/en/community/environment/combined-storm-overflows
29. https://www.dwrcymru.com/en/our-services/wastewater/drainage-and-wastewater-management-plan
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34. 2030 has been chosen as the period to 2030 has been cast as the "decade of action" globally for climate and sustainability action. It also represents the end of the next regulatory price review period for water companies.
35. We plan ahead to 2050 in our long-term strategy, Welsh Water 2050, as well as our other regulatory planning documents. It also represents the date to achieve net zero cast in legislation.
36. https://corporate.dwrcymru.com/en/about-us/investors/environmental-social-and-governance
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