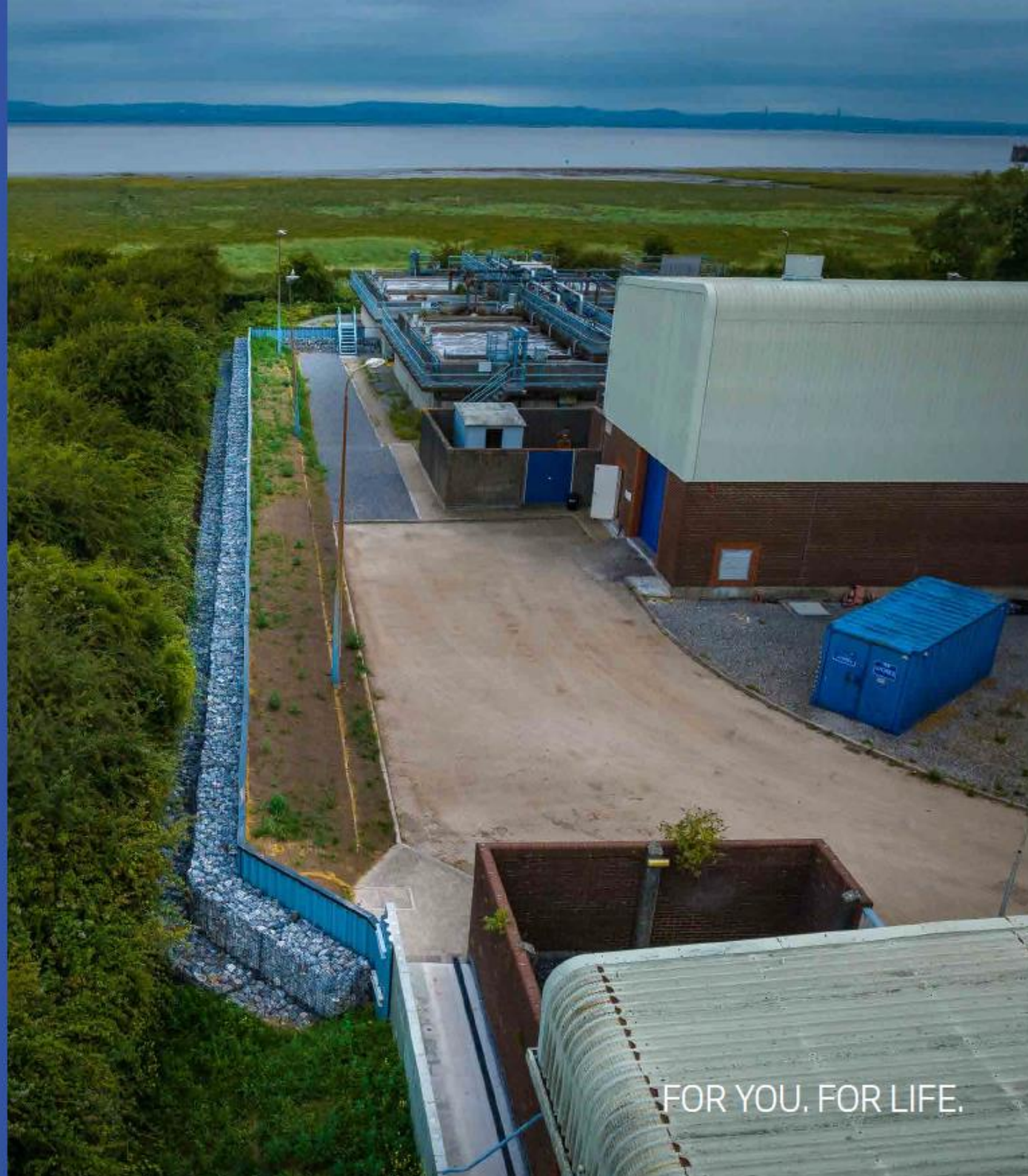
Wessex Water's **Climate change adaptation** report 2024



Wessex Water
YTL GROUP

About this report

This report sets out how we plan to adapt to climate change. It covers the climate-related hazards that could affect us, the level of risk that they pose for our business, and the adaptation options that we have in place or propose.

It is published as our fourth report under Defra's adaptation reporting power that was introduced with the Climate Change Act 2008, and provides updates to the previous edition in 2021.

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EXECUTIVE SUMMARY

Our climate and extreme weather

The warming trend since the end of the nineteenth century has been unequivocal, we are experiencing a trend of increasingly wet winters, and rainfall intensity (measured as the percentage of total annual rainfall that happened on very wet or extremely wet days) is steadily increasing in our region. Unusually wet winters were more frequent since 1990 than the preceding 120 years. Impacts of prolonged rainfall events have included increased nitrate levels in groundwater sources; some customers experiencing restricted wastewater service; and localised flooding of some sites. Dry extremes have occurred less often, and we have not imposed water use restrictions in our supply area since 1975-76. Notable temperature events have included the 2018 ‘Beast from the East’ cold wave and the subsequent thaw which caused widespread outbreaks of leaks and pipe bursts, and heatwaves in 2018 and 2022.

Future climate change risk and adaptation in the UK

We use UK Climate Projections to help assess climate risks and plan investment. Across all scenarios and timescales, for a typical year, future summers will be drier and winters will be wetter. While changes to average conditions are important, the resilience of our services will continue to be affected more by extreme weather events, and these are likely to occur more frequently in future. We pay heed to the successive UK Climate Change Risk Assessments (CCRA) and National Adaptation Programmes. CCRA3 (2022) includes specific findings for the water sector, including risks for water infrastructure related to the frequency and intensity of surface water and coastal flooding; subsidence; failures of other infrastructure types due to extreme weather, due to flooding and subsidence; water quality, and availability. NAP3 (2023), brings together policies and actions to address the risks and opportunities arising from climate change identified in CCRA3. For the water sector it includes a range of policy measures and action areas. Our own approach and plans for these items are provided throughout this report.

Our main climate-related risks

We carry out climate risk assessments at various levels, using best available evidence, good quality information from outside our company and the accumulated knowledge of our own staff. We consider how hazards can affect the reliability and quality of the services we provide, and increased stress on the wider environment.

Regarding **water quantity**, the headline climate change effects of warmer and wetter winters and hotter and drier summers will affect supply system resilience to drought conditions. Detailed climate risk assessments are conducted for our Water Resources Management Plans (WRMP), factored into forecasts of available water supplies and water demand. While available supplies are forecast to decline gradually over 2025-50, this is primarily because of increased demand relating to population and property growth, consumption change, and significant licence change reductions required to protect the environment. Compared with these pressures, climate change impacts are minor, accounting for at most 1% of the supply-demand balance deficit that we forecast from 2035. Distribution networks may be affected by wetter winters and drier summers, which may affect ground conditions, and by extreme storm events that cause flood damage. Climate-related risks for **water quality** come in the form of extreme wet conditions as well as warm or dry. Deterioration in raw water quality as a result of climate change and more extreme weather events, contribute to a historic and changing threat to drinking water quality.

For **sewerage**, while there are significant uncertainties about the impact of climate change on storm frequency and severity, increasing storm intensity will increase flood risk and storm overflows discharged to the environment. Wetter winters will increase the risk of seasonal groundwater inundation leading to flood flooding, restricted toilet use and storm overflow discharge volumes and duration. Increase sea and tide levels will increase the risk of flooding due to submerged discharges. Our core plan for flooding and storm overflow improvements includes a 20% increase in design rainfall intensity for climate change. We calculate that 30% more properties would

also be at risk of flooding in a storm, and an 8% increase in storm overflow discharge volumes, compared to the core scenario. For our **water recycling** centres, the more adverse climate scenario points to reduced river flows prompting a tightening of discharge permits; longer drier summers punctuated by more extreme rainfall events causing reduction in overall flows; increasing resilience costs to cover rising sea levels and flooding; an increase in odour and other nuisance costs; increased fugitive emissions of methane and potentially nitrous oxide. For **bioresources,** more storage barns would be needed to mitigate the impact of more rainfall and wetter winters impacting our ability to spread biosolids.

***Updates since 2021*.** For the purpose of this 2024 report we have carried out a light touch review of our 2021 risk scores. As part of our 2023 business plan submission we published a long term delivery strategy (LTDS) which includes two common reference scenarios for climate change. For our wastewater long term delivery strategy, we used our hydraulic computer models to predict the impacts of the more adverse, high climate change scenario (RCP 8.5).

Our actions to adapt to climate change

Our approach to climate change adaption is aligned with the proposed goal in *Climate change adaptation – a common framework* (UKWIR 2022), i.e. Adapt for the climate of 2050 and prepare for possible climates of 2100.

The principle of planning for a resilient future in both scenarios where 2 degrees and 4 degrees of warming have occurred; is part of our long term delivery strategy. There are various ways to manage climate-related risks to an acceptable level, including building physical assets or improving systems; managing water supply and river catchments; improving co-operation with other organisations; and encouraging helpful behaviour among users of our services. These in combination will help us to be more resilient to the gradual stresses of a warming world and the shocks that come in the form of extreme weather events.

It would not make sense for us to attempt to adapt to climate change in isolation. A good proportion of our adaptation work for drainage requires collaboration and partnership working, our water resource planning involves extensive consultation with other interests and our business continuity work relies on close working with other service providers. Section 5 of the report details adaptation actions across the full range of our functions. Building on and updating our 2021 report, our actions are categorised as established ways of working; additional or updated work during 2020-25; and planned actions and delivery for 2025-2035. We also summarise the main benefits of climate risk mitigation.

Other elements of adaptation

Section 6 outlines a range of technical, organisational, economic, and policy considerations that need to be taken into account in our adaptation work. These include:

- ***Interdependencies and multi-agency cooperation*** - our work with other organisations and people, especially on issues where there are shared responsibilities.
- ***Our corporate governance*** – our processes and organisational systems for management of risks, including those related to climate change.
- ***Thresholds*** – use of certain *weather events* as reference points or benchmarks for action or investment.
- ***Cost-benefit analysis*** – as an integral part of the business plans that we submit to Ofwat and the case made for investment.
- ***Barriers*** to adaptation including financial, regulatory and technical factors.
- ***Regulation*** as one driver for investment, and our advocacy for regulation that focuses primarily on social and environmental outcomes and is solution agnostic.
- ***Monitoring*** of climate change and the effects of adaptation work.
- ***Flexible adaptation*** – the need for adaptation to be flexible as new data emerges or risk assessments change.
- ***Climate change mitigation*** – our work to decarbonise our activities.

A series of technical appendices provide further detail in support of sections 1 to 6.

1. Wessex Water and our region

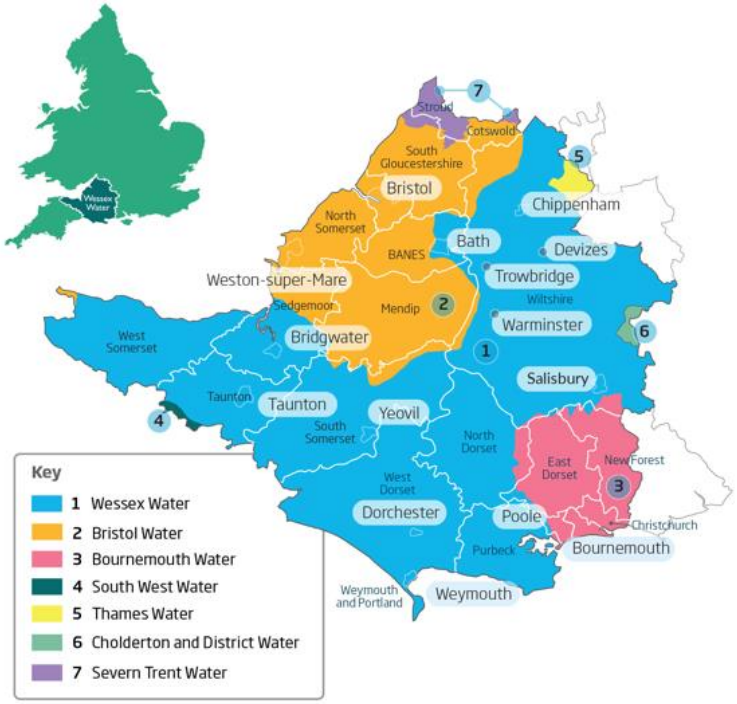
Our company and our region

Wessex Water is the regional water and sewage treatment business serving a 10,000 square kilometre area of the southwest of England, including Dorset, Somerset, Bristol, most of Wiltshire and parts of Gloucestershire and Hampshire. The company is a wholly-owned subsidiary of YTL Power International of Malaysia.

Our purpose is to support our customers' health and wellbeing, and enhance the environment and the diverse communities we serve. We aim to:

1. provide reliable, affordable services for all customers and communities
2. deliver a better environment for nature and people
3. be a great place to work
4. be a trusted, financially strong company.

We treat and supply	We take away and treat
Over 278 million litres of water a day to 1.4 million customers and 47,000 businesses	898 million litres of wastewater from 2.9 million customers and 62,000 businesses every day
We have	**We have**
253 water sources & water treatment centres 311 service reservoirs and water towers 12,116 km of water mains	35,089 kilometres of sewers 398 water recycling centres 2,159 sewage pumping stations



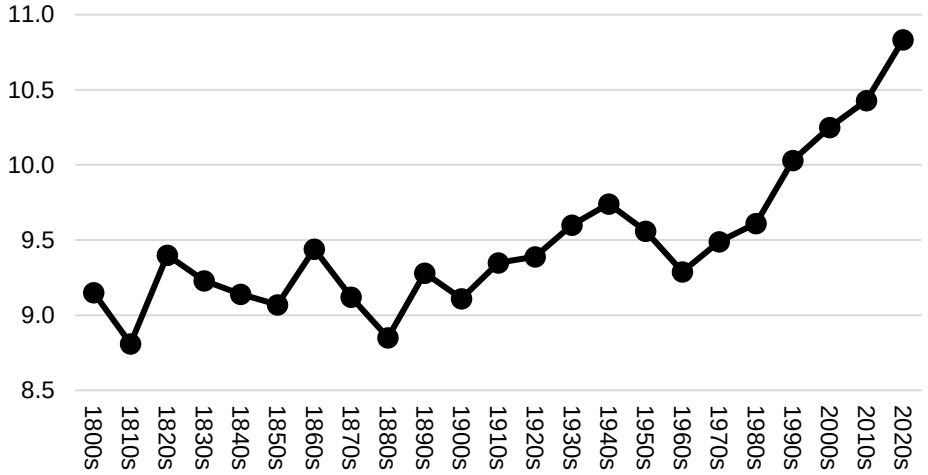
Wessex Water is one of the leading water and sewerage company for customer service and satisfaction, as judged by standards set by our regulators, and is committed to delivering the highest levels of customer service and environmental performance at a price that customers can afford. We continually seek new and innovative ways of working, while continuing to deliver a quality service and experience for our customers, our people and stakeholders. We are a long-term business that is committed to reducing our environmental impact. This includes our support for the Government's net zero by 2050 target; we are committed to achieving net zero operational emissions by 2030 and net zero total emissions by 2040. Alongside mitigation, we recognise the importance of preparing for climate change and having a business resilient to any potential impacts. Adaptation to a changing climate is integral both to our long-term vision and our business plan, and to subject-specific exercises such as our water resources planning process.

2. Our climate and extreme weather

Long-term trends
As our services and operations are affected by weather patterns, climate change needs to be accounted for in our long-term planning.

The warming trend since the end of the nineteenth century has been unequivocal. As the chart below shows, annual average temperatures in central England in the 2010s were approximately 1.4 degrees centigrade warmer than the 1880-99 'pre-industrial' period, compared with the 1.2 degrees rise in global average temperatures over the same period.

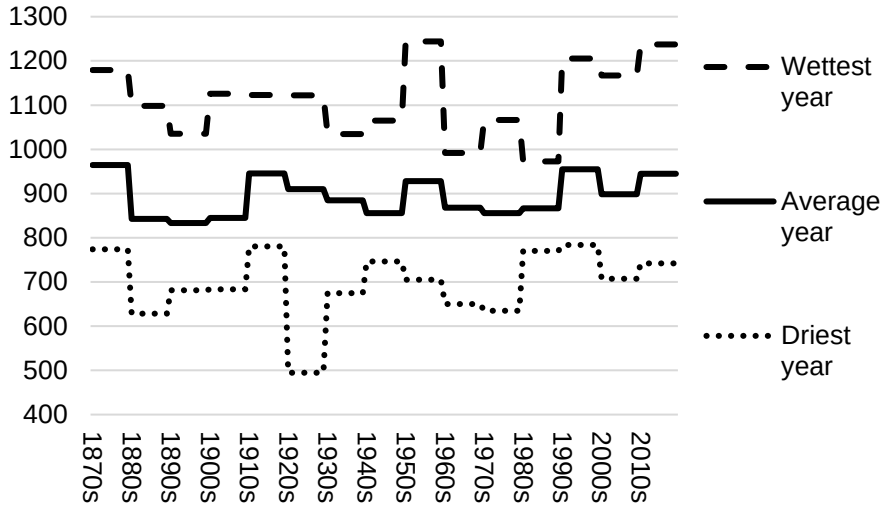
Central England (HadCET) annual average temperature*



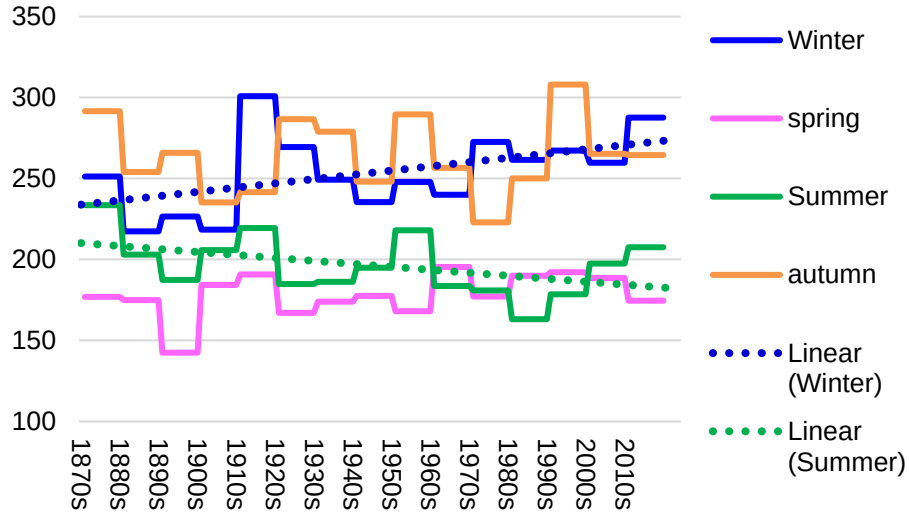
*This is the nearest continuous long-term temperature record to our region.

Monthly rainfall records, measured by the Environment Agency's gauges spread across our region, allow us to compare current weather with long term averages, and provide context for the projected effects of climate change. Annual average precipitation in our region is 900mm for 1871-2023 and 898mm for 1991-2020 (which can thought of as our current climate). The graphs to the right show annual and seasonal rainfall by decade since the 1910s, with further detail in appendix 2.

Annual precipitation (mm) by decade



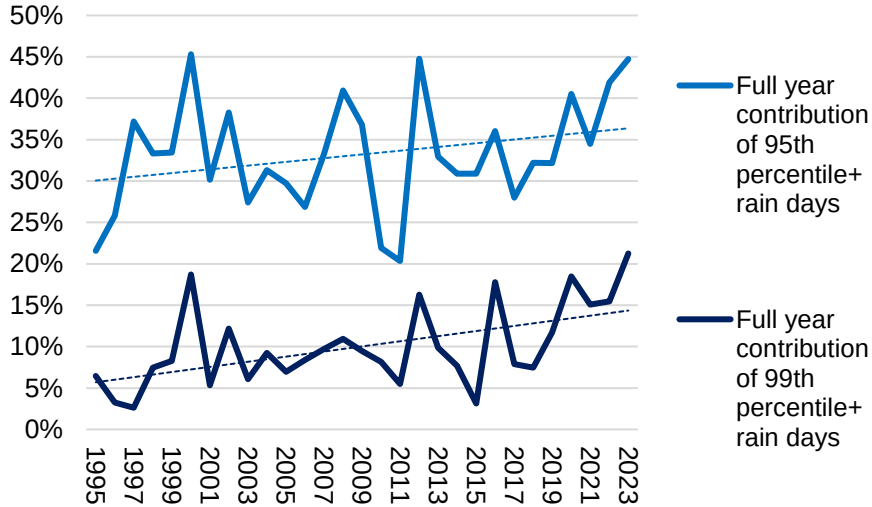
Seasonal average precipitation (mm), by decade



Extreme events – wet and dry

Water and wastewater services are adversely affected by extreme weather conditions, such as increasing rainfall intensity. The graph below shows this phenomenon; the percentage of total annual rainfall that happened on very wet or extremely wet days (i.e. exceeding the 95th and 99th percentiles respectively for daily rainfall) is steadily increasing.

Percentage of each year's total rain on days exceeding 11mm (95th percentile) and 19mm (99th percentile)



Since 1990 there have been five unusually wet winters (i.e. exceeding the 95th percentile for 1871-2023), compared with three such events during the previous 120 years. Spring and autumn seasons exceeding their 95th percentiles were also more numerous during 1990-2024 than in 1870-99, 1900-29, 1930-59, and 1960-89. Since the late 1980s there were numerous extremely wet and periods that tested our resilience. The prolonged rainfall of summer 2007 required widespread emergency response, including our assistance to Severn Trent Water under the mutual aid scheme. The heavy rainfall of 2012 included the wettest summer since 1879, followed a year later by the wettest three-month period on record from December 2013 to February 2014, with the flooding of the Somerset levels being the largest flood event in the area since records began in the 1600s.

Extreme wet events		Rainfall vs. average
Winter 1989-90	Heavy rainfall	188%
Winter 1994-95	Heavy rainfall	171%
Autumn 2000	Heavy rainfall, flooding	184%
Summer 2007	Heavy rainfall	160%
April 2012 to Winter 2012-13	Heavy rainfall	154%
Winter 2013-14	Heavy rainfall, flooding	200%
Autumn 2019 to winter 2019-20	Heavy rainfall	162%
October 2023 to September 2024	Wettest 12 month sequence for 1871-2024	153%

We experienced extensive operational impacts:

- Nitrate levels rose significantly in groundwater sources, with up to 23 sites taken out of supply until nitrate levels reduced.
- Some customers experienced restricted wastewater service - our response included pumping rainwater out of sewers which had been overwhelmed through groundwater infiltration; tankering away the contents of sewers at 46 locations and overpumping to watercourses at 12 locations to prevent internal property flooding. Saturated soil limited the capacity of on-farm storage of treated sludge cake.
- There was localised flooding of some operational sites.

Autumn 2019 to winter 2020 was the third wettest autumn to winter period since 1911. The accumulation of back-to-back events caused high ground water levels and saturated ground which meant that smaller rainfall events - as well as heavy rainfall - caused flooding. Despite the weather throughout this period, the vast majority of internal flooding incidents were due to sewers being partially blocked due to misuse rather than the sewer not having adequate hydraulic capacity. Most recently, October 2023 to September 2024 was the wettest 12 month period since our records began in 1871 with 1376mm of rainfall.

The above events are mainly those that occurred over a month or more. Our ability to track extremely wet rainfall at the daily or hourly scale is less advanced, and more acute events can be extremely localised and take place in short periods of time, we expect an increase over time as a warmer atmosphere can hold water vapour in larger quantities.

In terms of dry extremes, 1995 was (and remains) the driest summer since 1911 and the driest three-month period since 1938. Efforts to reduce leakage were stepped up following this event, leading to annual leakage targets overseen by Ofwat; leakage from our network has me than halved since then. While this and the eighteen months to March 2012 were classed as drought events, we have not imposed water use restrictions in our supply area since 1975-76, and this period remains the benchmark for our water resources planning.

Extreme dry events		Rainfall compared to average
Summer 1995	Drought	22%
October 2010 to March 2012	Environmental drought	75%
November 2021 to August 2022	Environmental drought	60%

Extreme events – temperature

The February to March 2018 ‘Beast from the East’ cold wave and the subsequent thaw caused widespread outbreaks of leaks and pipe bursts. While over 60,000 customers across England and Wales were without water for more than 12 hours, Wessex Water was the only company to have no customers experiencing water supply interruptions exceeding four hours. This was achieved through prior discussions with Bristol Water about potential impacts and bulk water transfer arrangements; use of our new water supply grid to move water to where it was needed most; and use of leak detection and pinpointing technology. We subsequently changed our adverse weather business continuity plan, including earlier notification of potential events before red weather warnings are issued. The 2018 heatwave led to changes in business continuity practices, including a direct link into national heat alerts and July 2022 saw the first red warning for extreme heat.

Extreme temperature events		Min / max temperatures*
Summer 2003	Heatwave	32.4 deg.C
Summer 2006	Heatwave	35 deg.C
Winter 2010	Cold snap	-15 deg.C
Feb-Mar 2018	Cold wave	-6.4 deg.C
Summer 2018	Heatwave	30.5 deg.C
Summer 2022	Heatwave	34.9 deg.C

*As recorded at RAF Yeovilton

3. Future climate change risk and adaption in the UK

Global, UK and regional climate change hazards

In 2021, the Intergovernmental Panel on Climate Change (IPCC) working group 1 produced its latest report on the physical science basis of our understanding of climate change. This is the most recent comprehensive overview of the scientific basis of climate change, potential impacts, and options for limiting concentrations of greenhouse gases in the atmosphere. Its headline conclusions include the following:

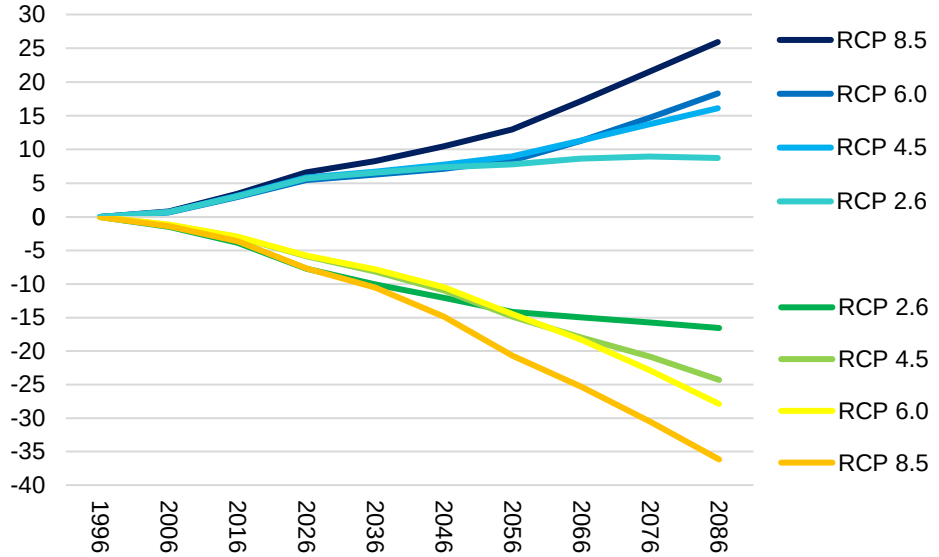
- "It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred."
- "The scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years."
- "Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since the Fifth Assessment Report (AR5)."
- "Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO2 and other greenhouse gas emissions occur in the coming decades."
- "Continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events."

UK Climate Projections

Like other water companies, we use UK Climate Projections to help assess climate risks and plan investment. The 2018 edition (UKCP18) shows how our climate may change according to emissions scenarios using the IPCC's representative concentration pathways (RCPs), different levels of probability; and several overlapping time periods to cover the 21st century.

The following chart and tables summarise projected rainfall changes across Somerset, Dorset and Wiltshire compared with 1981-2010. It is clear that across all scenarios and timescales, summers will be drier and winters will be wetter.

Winter and summer rainfall, projected % change



Projected % changes for winter (upper) and summer (lower) rainfall vs 1981-2010, average of Dorset, Somerset & Wiltshire, 50th percentile for probability (source: UKCP18, probabilistic, via UK Climate risk indicators at https://uk-cri.org/).

Winter and summer rainfall, projected % change

	2030-59	2050-79	2070-99
Summer (Jun-Aug) precipitation	-12 to -15%	-15 to -25%	-17 to -36%
Winter (Dec-Feb) precipitation	+7 to +10%	+9 to +17%	+9 to +26%
Summer average daily temperature	+1.7 to +2.3°C	+1.9 to +4.0°C	+2.1 to +6.0°C

This table shows the median outcome from the probabilistic models.
The ranges in each cell show the difference between RCP 2.6 (most benign emissions scenario) and RCP 8.5 (most adverse emissions scenario), and align with Ofwat's guidance in its November 2021 document "Long-term delivery strategies and common reference scenarios".

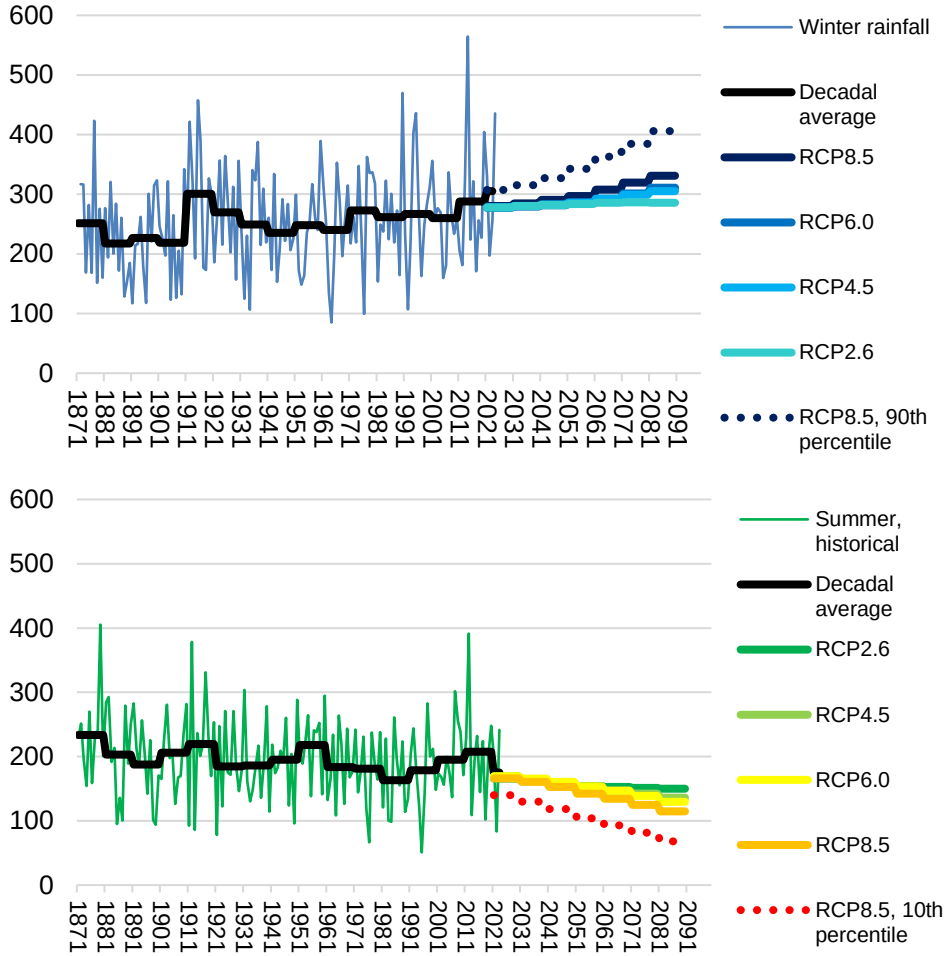
Least probable changes to future average years

	2030-59	2050-79	2070-99
Summer precipitation 10th percentile	-28 to -34%	-31 to -48%	-34 to -62%
Winter precipitation 90th percentile	+19 to +25%	+21 to +38%	+24 to +54%
Summer average daily temperature 90th percentile	+2.8 to +3.8°C	+3.2 to +6.3°C	+3.5 to +9.3°C

As above, the ranges in each cell show the difference between emission scenarios i.e. RCP 2.6 (most benign) and RCP 8.5 (most adverse)

Overlying trends, we experience a lot of variation from one year to the next, as illustrated in the following charts. Looking ahead, while changes to average conditions are important, the resilience of our services will continue to be affected more by extreme weather events of the sort noted previously. Moreover, as background warming takes place, weather events considered extreme or unusual by today's standards are likely to occur more frequently in future. Either way, our past experience of dealing with acute weather-related impacts means we can build them into our planning activities and company risk assessments.

Winter and summer rainfall (mm): historical (annual and decadal averages), and projected (decadal averages, from UKCP18)



The future trajectories shown are at the 50th percentile for probability.

UK Climate Change Risk Assessment (UKCCRA)

The third edition of the UKCCRA (CCRA3) was published in 2022, drawing on the updated independent assessment of climate change published by the Climate Change Committee (CCC) in summer 2021. The CCC assessment included some specific findings for the water sector:

- Water infrastructure, such as reservoirs, dams, pipelines, water treatment and recycling centres, are all at risk from the impacts of climate change, especially increases in the frequency and intensity of surface water and coastal flooding.
- Water infrastructure assets represent a key element of the UK infrastructure system and could affect, or be affected by, failures of other assets due to extreme weather, such as energy systems, transport and information and communications technology (ICT).
- There are also risks to buried infrastructure, such as water pipelines, with damage potentially becoming more frequent in future due to flooding and subsidence.
- More frequent flooding could impact water treatment facilities leading to potential reductions in water quality, in turn impacting upon health.
- Future projections of more frequent and intense dry periods lead to concerns around the availability of water supplies in future, especially in England and parts of Wales.
- Aquifers near the coast could be at greater risk from saltwater intrusion due to sea level rise, though the risk is thought to be low in places where aquifers are important water sources.

The UKCCRA includes an assessment of risks and opportunities that are graded according to the level of action needed, and potential costs / damages or opportunities. The table below shows those of the most relevance to the water sector, with gradings of future costs under two different warming scenarios:

			Future costs*		
			2050s, 2/4°C	2080s, 2°C	2080s, 4°C
More action needed	I1.	Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures	VH	VH	VH
	I2.	Risks to infrastructure services from river, surface water and groundwater flooding	H to VH	H to VH	VH
	H3a.	Risks to people, communities and buildings from river and surface flooding	VH	VH	VH
	I8.	Risks to public water supplies from reduced water availability	H	H	H
Further investigation	I3.	Risks to infrastructure services from coastal flooding and erosion	M	M	M
	I7.	Risks to subterranean and surface infrastructure from subsidence	M	M	M
	H10a.	Risks to health from water quality	H	H	H
	H10b.	Risks to health from water supply	?	?	?
	B3.	Risks to businesses from water scarcity	H	H	H
	N10.	Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	?	?	?

*Coding for costs: VH = very high, H = high, M = medium, ? = unknown

2023 National Adaptation Programme

The third National Adaptation Programme (NAP) was published in 2023, bringing together policies and actions to address the risks and opportunities arising from climate change identified in CCRA3.

Regarding the water sector, the NAP includes the following policy measures and action areas:

- Defra's strategic policy statement for Ofwat sets out our priorities for Ofwat and the water industry to continue to deliver a resilient and sustainable water supply. The Plan for Water sets out Defra's commitment to improve water efficiency and invest in water resource infrastructure that is resilient to climate change.
- Ofwat uses the regulatory framework to ensure water companies invest sufficiently to safeguard current and future access to safe and clean water. The methodology for the 2024 price review explicitly includes consideration of climate change.
- A range of measures will incentivise water companies to improve their performance, increase water efficiency and develop new water infrastructure, including incentives to improve their performance for water quality compliance, leakage and supply interruptions and delivery of outcomes and outputs.
- Supporting water companies to maintain supply to a nil deficit, implementing water efficiency measures focusing on sustainable drainage systems, leakage, per capita consumption, water efficiency projects and labelling, tighter water efficiency standards for new homes.
- Supporting companies to develop new water infrastructure including: increasing water capacity and driving water efficiency; advancing the Regulators' Alliance for Progressing Infrastructure Development's work to help water companies deliver water resources infrastructure at pace; publishing the National Policy Statement for water resources infrastructure to help streamline the planning consent process for significant water resources infrastructure.
- Inclusion in the Environment Agency's National Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026 of a clear objective for water companies to make their infrastructure resilient to flooding and coastal change between now and 2030.
- The requirement for water companies to produce Water Resources Management Plans (WRMPs) and drainage and wastewater management plans (DWMPs) every 5 years setting out how they will invest in infrastructure and technology to manage water supply and demand, and pressures and risks to the wastewater network - including the risks posed to both by climate change.
- 25-year delivery strategies that represent a move towards long-term strategic, regional planning to better enable government and the water industry to consider water balance at regional and national scale.
- Water company-level plans being informed by five regional water resources plans that foster collaboration between water companies and bring water companies together with other significant water users, e.g. agriculture and electricity generation, as well as to support thriving and biodiverse ecosystems.
- monitoring progress through regular reporting and holding water companies to account for delivering on their plans, including by taking enforcement action through Ofwat where necessary.

Further detail is provided in appendix 3 on proposed measures linked to the most relevant risks for the water sector in CCRA3. Our own approach and plans for these items are provided throughout this report.

4. Our main climate-related risks

Understanding climate risk

Providing water and wastewater services involves many risks related to climate change. Understanding and assessing these involves concepts that apply in risk management more widely, including:

- Hazards - events or trends that may cause loss of life, injury, health impacts or damage. These can be gradual (stresses) or more sudden (shocks), and those related to climate change include drought, heatwaves, intense rainfall and sea level rise.
- Exposure - the presence of things or people in places that could be adversely affected by hazards.
- Likelihood - the probability of a hazard occurring within a particular time period.
- Consequence - the severity of the impact if the hazard should occur.

Together, these give a picture of the sensitivity or vulnerability or organisations like ours, and the people and places that we serve, to both general changes that we expect to see or very specific issues.

Our climate risk assessments

We carry out climate risk assessments at various levels, as described in the following pages. In each case we consider:

- likelihood - the probability of impacts occurring over different timescales, as some effects of climate change might be unlikely in the next few years but likely in the long term.
- consequence or severity - applying the various aspects in our corporate risk assessment system including health and safety, public health, customer service, environmental impacts, reputation, legal and regulatory issues and financial or commercial consequences.

We use best available evidence and our current view of the best responses, incorporating good quality information from outside our company as well as the accumulated knowledge of our own staff. However, climate change projections and responses involve uncertainties including:

- the future return period of extreme weather events such as multi-season droughts, which are highly unpredictable;
- future emissions, concentrations of greenhouse gases in the atmosphere and the pace of climatic changes;
- the specific influence of climate change for issues such as flooding and water demand where there are many factors involved;
- the costs and benefits of adaptation options and the suitability of the measures we choose;
- the potential appearance of some entirely new issues.

Our understanding of risk has a dual focus. Firstly, we must understand how hazards can affect the reliability and quality of the services we provide to the people we serve. Secondly, we know that climate change will place greater stress on the wider environment, e.g. rivers and streams suffering more often during very warm or dry weather conditions. This in turn will likely lead to greater pressure on our activities e.g. reduced abstraction, or tighter end-of-pipe standards at water recycling centres.

The high-level climate change risk assessments presented in this report are based on the 2012 HR Wallingford / UKWIR climate risk tool produced for the UK water sector. The following tables show the hazards in its inventory that we judged in our 2021 assessment as posing medium to high risk i.e., those scoring 12 or more out of 25. The risk scores shown take account of the risk reduction measures that are already in place or planned. For the purpose of this 2024 report we have carried out a light touch review of our 2021 risk scores. Any changes are noted in the following sections. Of the significant climate-related risks shown in the following tables, it is clear that heat, drought and heavy rain are each important, and that each poses difficulties for both water supply and wastewater activities. Also, it is generally the case that the services we provide are more sensitive to extreme events, rather than gradual increases to average temperatures – although the latter increases the likelihood of the former.

Long term delivery strategy – climate-related impacts
As part of our 2023 business plan submission we published a long term delivery strategy (LTDS) which articulates the key investment areas we have identified as necessary to deliver ambitious outcomes and targets, between 2025-2050. It is based on known changes that are likely to impact us, and a set of common reference scenarios defined by the Office for Water Services (Ofwat) related to demand, technology, climate change and abstraction reductions.

The common reference scenarios for climate change are based on RCP 2.6 (benign scenario) and RCP 8.5 (adverse scenario). Consequently, these reference scenarios have been applied to the strategies for specific functions, mirroring their use in developing our water resources management plan and drainage and wastewater management plan.

Risks to customers, communities and the environment - overview
Regarding **water quantity**, the headline climate change effects of warmer and wetter winters and hotter and drier summers will affect supply system resilience to drought conditions. Long-lasting drought and acute heatwaves both affect demand, and droughts also reduce overall yields from groundwater and reservoirs, and lead to pressure to reduce abstraction to protect the freshwater environment due to the risk of low river flows.

Detailed climate risk assessments are carried out for our Water Resources Management Plans (WRMP), for which climate change scenario are an integral part. Firstly, it is factored into forecasts of available water supplies, where we consider the impact of changing rainfall, evaporation and temperature patterns and the impact that these may have on river flows, reservoirs, groundwater recharge and ultimately on deployable output. Secondly, it is considered in relation to impacts on water demand.

Our 2024 WRMP assessment shows that while available supplies are forecast to decline gradually over 2025-50, this is primarily because of increased demand relating to population and property growth and consumption change. Also, the main driver of deficit in our supply demand balance is due to significant licence change reductions required to protect the environment. Compared with these pressures, climate change impacts are minor, accounting for at most 1% of the supply-demand balance deficit that we forecast from 2035, and mostly attributed to impacts on surface reservoir storage. To reach this conclusion we considered the impact of climate change on the amount of water available for supplies (deployable output), based on the difference between the following scenarios:

- Low – median of the probabilistic RCP 2.6 distribution (equivalent of the LTDS benign scenario)
- Central – median of the probabilistic RCP 8.5 distribution (equivalent to the LTDS adverse scenario)
- High – mean of the median RCM RCP 8.5 distribution and GCM RCP 8.5 distribution.

Despite this assessment we are aware that longer, drier summers could result in significantly higher peaks in demand even if annual average per capita consumption is reduced through smart meter and water efficiency.

Distribution networks may be affected by wetter winters and drier summers, which may affect ground conditions and increase the risk of damage to underground structures. They may also be affected by extreme storm events that cause flood damage to above ground assets.

Climate-related risks for **water quality** come in the form of extreme wet conditions as well as warm or dry. Warmer summers are likely to bring reductions in quality due to biological activity. Our experience also shows that heavy rainfall – both in prolonged episodes or short, sharp spells – can result in contaminants being washed into reservoirs or groundwater sources. Past episodes have given rise to high levels of nitrates, as noted earlier in relation to extremely wet autumn and winter conditions. Overall, deterioration in raw water quality as a result of climate change and more extreme weather events, and catchment pollution from agro-chemicals (pesticides and nutrients) and turbidity represent a historic and changing threat to drinking water quality compliance.

Climate change impacts and risk scores (out of 25): water supply

Change / hazard		Effects on assets & services	2015 risk score	2021 risk score	**2024 risk score**
Higher temperatures	Quantity	Increased daily and peak demand leading to larger volumes requiring treatment & storage	12	20	20
	Quantity	Increased seasonal demand and risk of reduced or removed abstraction licences	9	16	16
	Quality	Discolouration and taste issues, increasing complaints / compliance risk	20	20	20
	Quality	More microbiological growth (algae, microorganisms), increasing treatment requirements	20	15	15
	Quality	Accelerated chlorine depletion leading to increased compliance risk	9	15	15
Drought	Quantity	Shorter groundwater recharge periods, leading to reduced yields in the summer	9	20	20
	Quantity	Lower reservoir yields, affecting security of supply	8	16	16
	Quantity	Increased demand increasing volumes needing treatment	12	15	15
	Quantity	Political pressure for prioritising essential water use, affecting security of supply	16	16	16
	Quantity	Lower groundwater yields / low river flows / changing habitat conditions, resulting in reduced or removed abstraction licences	16	16	16
	Quality	With more storms alongside, reducing raw water quality, increasing drinking water quality risk	20	16	16
	Quality	Deposition of sediment in raw water, which is remobilised after heavy rain	4	12	12
More intense / prolonged rainfall	Quality	Turbidity affecting quality of surface water or raw water quality of groundwater	20	15	15
	Quality	Runoff causing increased levels of sediment and suspended solids	20	15	15
	Quality	Soil erosion leading to siltation in reservoirs and lower raw water quality	9	12	12
	Quality	Increased risk of cryptosporidium affecting drinking water quality	20	12	12
Cold wave	Quantity	Extreme freeze thaw events leading to increased leakage and pipe bursts	16	12	12
Combinations	Quantity	Drought / heatwave increasing demand leading to increased treated volume requirement	12	20	20

Regarding **sewerage, sewage treatment and sludge**, there are significant uncertainties in our long term planning for the next 25 years including the impact of climate change on storm frequency and severity. Indeed, of the common reference scenarios considered in our long term delivery strategy the impacts of climate change have the largest level of uncertainty.

Overall, increasing storm intensity will increase flood risk and storm overflow volumes being discharged to the environment. Wetter winters will increase the risk of seasonal groundwater inundation leading to flood flooding, restricted toilet use and storm overflow discharge volumes and duration.

Climate change is also predicted to increase sea levels in the long term and tidal increase will increase the risk of flooding due to submerged discharges and could prevent storm overflows from discharging. This may require surface water outfalls or storm overflows discharges to be pumped in the future, whereas most currently discharge by gravity. We will undertake more assessments of the impact of sea level rise in preparing our 2029 business plan submission.

Our core plan for flooding and storm overflow improvements includes a 20% increase in design rainfall intensity for climate change. This allowance for climate change in the design and construction of solutions is the current best practice. For our long term delivery strategy, we have used our hydraulic computer models to predict the impacts of the more adverse, high climate change scenario (RCP 8.5). We calculate that 30% more properties would also be at risk of flooding in a storm, and an 8% increase in storm overflow discharge volumes, compared to the core scenario. This would require an increase in expenditure on storm overflows, hydraulic flooding and infiltration reduction to cover the more intense rainfall events that are forecast to occur over the winter.

For our water recycling centres, the more adverse climate scenario includes the following effects:

- Drier summers bringing a risk of much reduced river flows, prompting a tightening of discharge permits, possibly on a seasonal basis, which in turn would result in increase in the costs for phosphorus and nitrogen removal capital expenditure and operational costs.
- Longer drier summers punctuated by more extreme rainfall events could cause reduction in overall flows to be treated as more overflows would be in operation, resulting in further storm overflow improvements (e.g. attenuation or storage).
- an increase in resilience costs to cover rising sea levels and increased protection against flooding for our water recycling centres.
- an increase in odour and other nuisance costs due to a likely need to increase our odour control as temperatures increase in the summer.
- drier summers may necessitate more internal recirculation of flows within WRCs to maintain sufficient wetting rates of biological processes, leading to more opex.
- hotter weather brings risk of increased fugitive emissions of methane and potentially nitrous oxide.
- an increase in the number of barns required for bioresources and sludge storage as we approach 2050, again to mitigate the impact of more rainfall and wetter winters impacting our ability to spread sludge.
- Increasing storm intensity will affect biosolids landbank accessibility by increasing the risk and frequency of run-off and contaminant export to watercourses. Increasing flood risk for low-lying agricultural land may also remove some disposal sites from the landbank.

Notwithstanding the many uncertainties that we face, our core long term plan represents our best estimate of what is required by 2030 and has a line of sight for delivery by 2050.

Climate change impacts and risk scores (out of 25): sewerage, sewage treatment & sludge

Change / hazard	Effects on assets & services		2015 risk score	2021 risk score	**2024 risk score**
Higher temperatures	Sewerage	Increased septicity in sewerage, leading to corrosion, increased toxicity, odour complaints	9	12	12
	Treatment	Increasing odour and pest risks at water recycling centres and sludge sites, affecting local people	16	20	20
	Treatment	Increased seasonal demand (including from tourism), increasing volumes needing treatment	12	15	15
	Treatment	Increased odour complaints linked to water recycling centres	16	12	12
Drought	Sewerage	Low flows in sewers leading to sedimentation, increasing the risk of blockages leading to customer flooding; hydrogen sulphide and subsequent deterioration of sewerage assets; pollution incidents	6	16	16
	Sewerage	Lower flows in sewers leading to blockages, resulting in property flooding	12	16	16
	Sewerage & treatment	Settlement / sedimentation in sewers, leading to subsequent shock loads following rainfall, affecting treatment processes	16	16	16
	Treatment	Lower flows, leading to longer retention times in settlement tanks, resulting in increased septicity and odour problems	16	15	15
	Other	Lower river flows resulting in less dilution of effluent and increased risk of consent failure	12	12	12
More intense / prolonged rainfall	Sewerage	Increased storm water volumes overwhelming combined sewers and sewerage pumps, leading to flooding and more spills affecting watercourses	20	20	20
	Sewerage	Heavy rain and sewer blockages caused by customers' sewer misuse, leading to spills and / or sewer flooding	12	20	20
	Sewerage	More infiltration of groundwater into sewers, increasing flood risk	20	20	20
	Sewerage & treatment	Heavy rain leading to more spills affecting bathing waters	20	16	16
	Sewerage	Increased volumes to be pumped, accelerating asset deterioration and increasing power use	15	12	12
	Sewerage	Flooding of sewerage assets leading to potential failures	12	12	12
	Sludge	Increased risk of spoiling sludge stockpiles		15	15

Climate change impacts and risk scores (out of 25): all services

Change / hazard	Effects on assets & services		2015 risk score	2021 risk score	**2024 risk score**
Higher temperatures / drought	Quantity	Increased demand (including from tourism), increasing volumes needing treatment and storage requirements	12	16	16
More intense / prolonged rainfall	Other	Flooding of sites, leading to equipment outages, elevated safety risk	20	12	12
	Other	Increased public expectation for hard defences to prevent site flooding	16	8	**12**
	Other	Flooding and inundation affecting transport routes/access to assets	16	10	10
	Other	Asset flooding leading to submersion of electrical assets	8	12	12
	Other	Storm events affecting power supplies and damage to assets at sites	20	12	**15**

Greenhouse gas emissions reduction

Gradual climatic change and extreme weather will be a challenge as we work to decarbonise our operations and investment. Regarding operational emissions, we would potentially see more use of standby generators and pumping energy in response to extreme weather events; this will be mitigated as the electricity grid decarbonised and low carbon alternatives to diesel generators become more available over time. There could be higher wastewater process emissions with heatwave conditions, although the science is still developing in this area. Adverse weather (e.g. heatwaves and prolonged rainfall) would likely add to pressure to reduce or restrict use of biosolids in land outlets; the impact on our scope 1 or scope 3 emissions would depend on alternative uses of biosolids.

Regarding capital carbon: with more frequent extreme weather events there could be more pressure to reinforce our infrastructure through additional investment in capacity (e.g. storm water attenuation). In the absence of major decarbonisation in the construction materials supply chain this could lead to significant addition embodied carbon emissions.

Biodiversity

Biodiversity management approaches may become more reactive, shifting from preserving past/present conditions to accommodating new species and ecosystems, and facilitating transition to a new ecosystem state).

- A warmer climate with hotter, drier summers may be challenging for some species, and could increase the risk of new pest incursion and wildfire.
- Warmer and wetter winters may result in lower pest mortality and, through various pathways, cause changes in the composition and structure of habitats.

5. Our actions to adapt to climate change

Responding to climate-related risk
Our approach to climate change adaption is aligned with the proposed goal in *Climate change adaptation – a common framework* (UKWIR 2022), i.e. **Adapt for the climate of 2050; prepare for possible climates of 2100.** The principle of planning for a resilient future in both scenarios where 2 degrees and 4 degrees of warming have occurred; is part of our long term delivery strategy.

We aim to maintain high quality, reliable and secure services for our customers and to protect the natural environment in the face of disruptive challenges, and ensure the long-term viability of those services against a backdrop of strategic change and the changing external environment. It depends on critical natural resources, our assets and systems and fundamentally on our people and their skills and expertise in planning, developing, operating and maintaining the resources, assets and systems on which those services depend. As shown in the table to the right, there are various ways to manage climate-related risks to an acceptable level. These include building physical assets or improving systems; managing water supply and river catchments; improving co-operation with other organisations; and encouraging helpful behaviour among users of our services. Central to this is our successive programmes of major investment in our physical assets and systems, helping us accommodate changing volumes of water and sewage as well as changing customer expectations and regulatory requirements. These will help us to be more resilient to the gradual stresses of a warming world and the shocks that come in the form of extreme weather events. It would not make sense for us to attempt to adapt to climate change in isolation. For example, a good proportion of our adaptation work for drainage requires collaboration and partnership working with Lead Local Flood Authorities, other Flood Risk Management Authorities and stakeholders (including catchment partnerships, infrastructure and utility providers). Similarly, our water resource planning involves extensive consultation with other interests and our business continuity work relies on close working with other service providers.

Types of resilience: climate change adaptation examples
Based on *Keeping the Country Running: Natural Hazards and Infrastructure* (Cabinet Office, 2011)

Redundancy: backup installations or spare capacity that enable operations to be modified in the event of disruptions • Maintaining water supply-demand surpluses • Ensuring that communities have back-up water sources • Adding storage in sewers and at water recycling centres • Reciprocal arrangements with neighbouring water companies • Allowance for outages, standby units for critical plant.
Resistance: preventing damage or disruption, by providing strength or protection to resist a hazard or its primary impact • Flood defences • Changing land use to cope with weather extremes • Ensuring design standards are appropriate.
Reliability: infrastructure that can operate under a range of conditions, limiting damage or loss from an event • Routine maintenance • Refurbishment / replacement of assets.
Recovery / response: fast and effective response to, and recovery from, disruptive events. • Early warning systems, telemetry, real-time monitoring • Emergency planning, business continuity.

Over time, extreme weather events might highlight vulnerabilities of which we were previously not aware, and alternative adaptation methods might become available. For these reasons, our adaptation measures will themselves need to be flexible and able to change. The following pages set out specific types of actions related to climate resilience, for our main areas of delivery. These include established ways of working; additional methods that have been introduced more recently, and further work anticipated over the next ten years.

Water supply: quantity, sustainable abstraction

Higher temperatures in the summer months can lead to an increased daily and peak demand and larger volumes of water requiring treatment and storage. Dry conditions can present a range of local implications from the impacts of abstraction where droughts lead to shorter groundwater recharge periods, resulting in reduced yields. Consequently, we face the potential need to reduce water abstraction licences in order to protect river ecology, at the same time as meeting demand. Combined with changing weather patterns due to climate change, maintaining a positive supply-demand balance will be challenging.

Current: established ways of working

- Drought plans that set out how we manage water resources during extended periods of dry weather.
- 25 year Water Resources Management Plans, incorporating climate change scenarios in their assessment of available water sources and customer demand, which in turn informs our business plans for future investment.
- Maintaining a stable risk profile for dams and impounding reservoirs.
- Reactive mains repair or replacement, such as bursts caused by ground movement from severe cold weather (freeze thaw cycle) or long hot summers (ground shrinkage).
- Reducing leakage through a range of techniques for detection, pinpointing and rapid repair.
- Encouragement of efficient use of water through promoting metering and other measures amongst customers.
- Our integrated water supply grid, completed in 2018, reduced the number of customers reliant on a single source; allowed us to reduce abstraction as required by the Environment Agency to improve flows in some rivers; and creates a network that is more resilient during unforeseen events.

Current: additional or updated work during 2020-25

- We updated our drought plan in 2022.
- We our draft 2024 Water Resources Management Plan has been published, including use of the latest available climate change scenarios.
- Further reductions of leakage and supply interruptions through a combination of mains replacements and smarter network operation.
- Further reductions of customer demand through our water efficiency engagement programme.

Future: planned actions and delivery for 2025-2035

- Continuation of established activities to protect and manage water sources and treatment facilities.
- Updating our Water Resources Management plan for 2029 publication.
- Updating our Drought Plan for final publication in 2026.
- Further environmental investigations in 2025-30 to inform final decisions on sustainable abstraction licence reduction from 2035.
- Planning and development of Strategic Resource Options in collaboration with the West Country Water Resources Group, to ensure we are appropriately prepared if these are needed to meet long-term resource needs.
- Adopting new and innovative technologies to enhance the operation of our network, including real time monitoring of water volumes in the distribution network; reducing leakage by a further 10%.
- Continued engagement with customers to meet water efficiency targets, including roll out of smart meters to 40% of our household and non-household properties by 2030, and 95% by 2035.
- Our long-term plan is to have zero interruptions of more than three hours. We will continue to replace older mains which will reduce the number of bursts and therefore the likelihood of supply interruptions. Prioritisation of water mains bursts will take into account various factors such as interruptions, leakage, mains bursts and water quality.

Risk mitigation benefits

- Drought plans and historical water resources planning help limit the impacts of dry weather periods.
- Reducing demand through water efficiency promotion.
- Maintaining supply-demand balance surplus.
- Reduced disruptions to supply.
- Increasing ecosystem resilience by reducing abstraction.

Water supply – quality

With the impacts of climate change resulting in a shift in weather patterns, water sources will be vulnerable to extreme rainfall which could increase contamination by sediment, pesticides and nutrients, leading to additional treatment requirements. This can happen by leaching into groundwater or runoff into reservoirs. Higher temperatures increase the risk of algal blooms, discolouration and taste issues, resulting in increased compliance challenges and customer complaints. Periods of dry weather followed by heavy rain events can result in reduced raw water quality, also requiring increased treatment to maintain excellent drinking water quality.

Current: established ways of working

- Source to tap risk assessments and Drinking Water Safety Plans as the main route for prioritising investment to maintain drinking water quality.
- Online water quality monitoring and regular sampling of the water we supply means that sources can be taken offline if a risk to water quality is identified.
- Catchment management: working with land users to reduce contamination of raw water sources by fertiliser and pesticides. This can increase the resilience of our sources in the face of more extreme rainfall events and limits further deterioration in raw water quality. This approach is also more sustainable and can improve the natural resilience of the ecosystem at least cost.
- Investing in water treatment centres where necessary (e.g. to deal with deteriorating source water quality), to ensure they are resilient and available at all times.
- Switching sources or blending water from different nearby sources in the event of shorter-lived problems.
- The integrated supply grid enables alternative water supplies to be delivered to areas that are currently supplied by sources at risk of breaching the nitrate limit, reducing the need for additional treatment.

Current: additional or updated work during 2020-25

- Extending catchment management methods to protect water sources in relation to nitrates and pesticides.
- Water treatment improvements at a range of sites.

Future: planned actions and delivery for 2025-2035

- Upgrading 10 of our water treatment centres
- Ongoing action against rising nitrates and pesticides in the raw water at our sources, with enhanced catchment management practices at a further 10 high risk nitrate sites
- Reducing contacts about water colour / appearance: we will continue to replace mains in areas that give rise to elevated numbers of contacts.
- A dedicated team for identifying and prioritising appropriate interventions to reduce customer contacts.
- Continued monitoring of progress against our water quality related performance commitments e.g. water quality compliance customer contacts about water quality, lead communication service pipes replaced.

Risk mitigation benefits

- Reduced risk to quality from water mains
- Water safety plans provide source-to-tap management system.
- An auditable database of actions and risk scores; prioritising investment and operational interventions.
- Catchment management contributes to maintaining compliance and deferring additional water treatment for nitrates and pesticides.
- Compliance maintained at >99.95%.

Sewerage

Heavy rain and storm events present a significant risk to sewerage and surface water management. Increased storm water volumes from heavy rainfall events can overwhelm combined sewers and sewerage pumps leading to flooding and / or spills from storm overflows, affecting watercourses and bathing waters. The issue of sewer blockages due to sewer misuse by customers remains an ongoing challenge and combined with more intense and prolonged rainfall events, it adds to the high risk of spills or sewer flooding. Additionally, heavy rainfall can lead to infiltration of groundwater into sewers, and prolonged dry conditions can cause sedimentation in sewers, which can affect treatment processes due to shock loads following rainfall.

Current: established ways of working

- Emergency tankering and over-pumping during intense and prolonged rainfall events, to protect properties from flooding internally.
- Reducing infiltration of groundwater e.g. by lining sewers.
- Maintaining sewer capacity and condition through inspections, jetting, tree root cutting, relining, and raising public awareness about what can cause blockages in sewers, 89% of which are caused by sewer misuse.
- Using Artificial intelligence software to analyse spill monitoring data at storm overflows (SOs) to identify potential blockages and better understand the frequency of their operation during heavy rain; investment where there is a link between SOs and river or coastal water quality.
- Investing proactively in sewerage capacity where cost-beneficial, including schemes that improve capacity across the region.
- Separating surface water from combined systems to create space in the combined sewers and reduce overflow volumes. Promotion of integrated urban drainage management and sustainable urban drainage systems.
- Use of sewer models to assess the impacts of growth, urban creep and climate change on the risks of flooding and pollution.
- Close work with local authorities and the Environment Agency, e.g. sharing asset data and hydraulic models to help development plans for surface water management and infiltration reduction.

Current: additional or updated work during 2020-25

- Publication of our Drainage and Wastewater Management Plan (DWMP) including modelling climate change impacts on rainfall; assessing performance of ~200 catchments; developing long-term sustainable and traditional solutions to deliver resilient drainage and wastewater infrastructure.
- working with stakeholders to develop partnership schemes to deliver integrated flood risk management improvements where there are synergies between flooding, SOs and/or water quality.
- Promoting integrated, sustainable urban drainage system control.
- installing over 3000 new in-sewer monitors and using artificial intelligence to highlight problems in the sewer network, alongside active system control.

Future: planned actions and delivery for 2025-2035

- Delivery of future cycle DWMPs including more stakeholder engagement.
- More jetting of sewers, sewer surveys, customer engagement, additional monitoring and analytics to reduce the number of pollution incidents.
- Hydraulic improvements at 143 overflows (by 2030) to reduce storm spills with more improvements planned by 2035.
- Water quality monitoring of our outfalls.
- Additional flow monitoring at pumping station emergency overflows.
- Large scale deployment of network monitoring including in tanks, syphons, flow control chambers and pollution hot-spots.
- More separation of surface water at source (such as rainfall harvesting, water butts, ponds, swales, and new or improved wetland areas).

Risk mitigation benefits

- Reduced risk of sewer flooding for properties (internally and externally), and avoidance of restricted toilet use.
- Reducing overflows from combined sewers and overwhelmed water recycling centres.
- Reduction in flood risk and pollution incident risk due to clearance of blockages in sewers.

Sewage treatment

We anticipate that warmer temperatures will increase the risk of odour and pests at sludge sites and water recycling centres, having a resulting impact on residents and businesses in the local area. Periods of prolonged dry conditions can also present challenges; for example, lower flows within the system could lead to longer retention times in settlement tanks, which can result in increased septicity and odour problems. Sea level rises compounded with more frequent storms (and hence storm surges), could require changes to outfall structures and /or discharge arrangements, such as new or increased pumping.

Current: established ways of working and actions

- Detailed odour management plans, enabling operational improvements and good housekeeping.
- Monitor the performance of our odour control plants and carry out maintenance and improvement work as and when required.
- Upgrading treatment processes to maintain capacity and meet environmental quality standards, increasing the resilience of the watercourses into which treated effluent is discharged.
- Continuous maintenance to ensure compliance with discharge permits.
- Catchment permitting for phosphorus reductions as a method of more flexible management of water recycling.

Current: additional or updated work during 2020-25

- Flood protection at one of our major water recycling centres.
- Delivering the Water Industry Strategic Environment Requirements, including 100% compliance with environmental permit conditions
- Improvements to river and bathing water quality via our AMP7 Water Industry National Environment Programme (WINEP) investments.

Future: planned actions and delivery for 2025-2035

- Providing additional capacity across water recycling centres that are overloaded, or aligning with enhancement schemes where flow and permit limits are being tightened.
- Enhancements at water recycling centres including removal of a further 1,500 tonnes of phosphorus and nitrogen through sewage treatment improvements.
- Further implementation of catchment-based permitting, which reduces costs and increases flexibility.
- 500 water quality monitors at high priority sites by 2030, with the remaining 1,400 to be in place by 2035.

Risk mitigation benefits

- Maintaining compliance with end-of-pipe standards
- Improving the resilience of river and coastal ecosystems

Sludge management

We anticipate that warmer temperatures will increase the risk of odour and pests at sludge treatment centres, having a resulting impact on residents and businesses in the local area. Periods of prolonged dry conditions can result in septicity in sludge and present challenges in sludge treatment due to increased risk of odour and release of methane. Periods of prolonged wet weather can pose multiple challenges for the management of biosolids (treated sludge); for example, prolonged wet weather can restrict access to landbank and cause sludge stockpiles to reliquefy and pollute nearby waterbodies.

Current: established ways of working and actions

- Forecasting sludge production and the need for additional capacity.
- Managing sewage sludge - including stockpiles on farmland - so as not to cause pollution to land, surface water or groundwater.
- Maintenance and upgrades of anaerobic digesters to provide additional capacity and resilience.
- Offsite storage of biosolids, prior to delivery to landbank locations

Current: additional or updated work during 2020-25

- Additional storage of sludge cake at Taunton and Wimborne St Giles to mitigate against slumping of stockpiles during wet weather.
- Major maintenance and upgrades of anaerobic digesters at Poole to provide additional capacity and resilience.
- Investigation of advanced thermal conversion technologies which will provide alternatives disposal outlets for sludge other than recovery to agriculture.

Future: planned actions and delivery for 2025-2035

- Major maintenance and upgrades of anaerobic digesters at Avonmouth, Trowbridge and Berry Hill to provide additional capacity and resilience.
- Provision of additional biosolids storage capacity at Avonmouth and our Northern region to improve the resilience of our biosolids management.
- Ongoing upgrades of all sludge treatment centres to ensure compliance with the Industrial Emissions Directive.
- Reviewing implications arising from changes to sludge quantity and quality resulting from increased chemical dosing for additional phosphorus removal from sewage effluent.
- Reviewing implications, and making improvements and wholesale changes as appropriate, on sludge treatment and disposal to manage the risk of potential reduction in future landbank availability.
- Acceleration of innovation in advanced thermal conversion to identify viable solutions that can be deployed in the next 5-10 years.

Risk mitigation benefits

- Retaining the ability to reuse sludge cake on farmland as an alternative to artificial fertiliser.

Flooding of sites, coastal squeeze

Prolonged and intense rainfall events can affect our operational sites and assets directly through flooding from rivers or runoff. Risks include impacts on power supplies, submersion of electrical assets and transport routes or site access being impaired.

Current: established ways of working and actions

- Reviewing flood risks at our operational sites
- Improvements at specific sites that are at a higher risk of flooding e.g. installation of bunding; flap valves; alarms; drainage improvements; replacing above-ground pump motors with dry well submersibles; raising electrical equipment above possible flood levels.
- Assessing the impact of shoreline management plans on our sites.
- Ensuring all new (critical) electrical plant and equipment is above the 1 in 200-year flood plain level.

Current: additional or updated work during 2020-25

- Building a perimeter flood wall / bund around Portbury Wharf water recycling centre (in 2022), where the current sea bank is at increasing risk of overtopping during spring high tides, exacerbated by climate change.
- Assessing critical pumping stations capacity at sites that are now frequently experiencing conditions e.g. Storms/tidal surge that limit capability of pumping stations to discharge.

Future: planned actions and delivery for 2025-2035

- Ongoing review of medium to long term flood risk, with appropriate action to be taken at sites where risks will become unacceptable.
- Ongoing review of status of shoreline management plans which may result in a re-assessment of risk at affected sites.

Risk mitigation benefits

- Reduced consequence of site flooding, e.g. maintaining security of water supplies and continuity of sewage treatment during flood events
- Avoidance of coastal flooding of operational assets.

Wider environmental work

We expect to see a range of pressures on the natural environment of our region arising from climate change. Less summer rainfall could affect the levels and movement of groundwater and the size and shape of groundwater catchments, affecting flows in rivers and streams that are fed by aquifers. Heatwaves will contribute to algal blooms in lakes, rivers and estuaries, resulting in lower oxygen levels and ecosystem damage. More intense rainfall could lead to more contaminants leaching into groundwater, or being washed directly into surface water. Meanwhile, climate change could result in conditions becoming more suitable to alternative crops but also different parasites and pests, leading to a change in the pesticides used. We also expect further migration into the region of non-native species, including some that are invasive and damaging to existing biodiversity.

Current: established ways of working and actions

- Our Biodiversity Action Plan contributes to regional and national initiatives and projects for biodiversity delivery to include building resilience to, mitigation and adaptation to adverse anthropological impacts on biodiversity including climate change.
- Hosting or supporting catchment partnerships, which oversee projects that deliver a range of benefits and increase environmental resilience.
- Use of catchment management to improve water quality in rivers and estuaries.

Current: additional or updated work during 2020-25

- Developing market-based methods for environmental delivery and the use of nature-based solutions
- Increasing the use of local volunteers to monitor watercourses, identify possible pollution incidents and report them to us for further investigation.
- Application of artificial intelligence for monitoring river and coastal water quality
- Supporting four projects through our Biodiversity Action Plan Partners Programme during 2020-2025

Future: planned actions and delivery for 2025-2035

- Promotion of outcomes-based environmental regulation
- Proposals for at least 36 nature-based solutions to tackle storm overflows
- Habitat improvement and creation on our land and catchments (including 15ha of restored land, 10km of new hedgerow and 50ha of woodland improvement) by 2030.
- Four partner projects supported through our Biodiversity Action Plan Partners Programme 2025-2030
- Sustainable nutrient reductions through Catchment Nutrient Balancing with land managers in Somerset and Dorset
- Investigation of peatland resource and management / restoration options
- 5 major partnership projects on the rivers Stour, Frome, Cam & Wellow, Chew and Hampshire Avon to improve water quality, support sustainable land management, catchment monitoring with citizen science and nature recovery. The Dorset Frome Headwaters project is centred on climate change resilience in chalk streams.
- Expansion of market-based approaches to environmental improvements and promotion of nature-based solutions
- An ongoing portfolio of work under our biodiversity action plan
- A range of measures to achieve net zero operational emissions.

Risk mitigation benefits

Improving the resilience of the environment in our region through a range of interventions.

Business continuity

We are reliant on services provided by others and some issues involve shared responsibility with others who are affected by extreme weather or a changing climate. This means that there is a risk of cascading failures where climate-related problems experienced by other service providers affect us, or vice versa.

Current: established ways of working and actions

- Business continuity arrangements and emergency planning procedures in each business areas
- Following Cabinet Office good practice guidance for integrated emergency management, with three response levels: operational, tactical, strategic
- Active participation in responses to incidents involving multiple agencies, where our involvement is required and contributes to external debriefing. Participation with local resilience forums.
- Using weather forecast and weather warnings from the Met Office, enabling advance planning for coming weather e.g. ensuring additional resources are available; rearranging non-essential planned works.
- Adverse Weather Continuity Plans - reviewing our overall preparedness, ensuring appropriate stocks of rock salt and grit, 4x4 vehicles.
- Back-up electricity generators: 114 for water supply sites, 251 for wastewater sites.
- An Emergency Planning Tactical Group with leads from across the business, to respond to a range of emergency issues. By taking an integrated view it can address concurrent risks and cascading failures.
- Staff risk assessments across the organisation, which includes provisions for working in adverse weather (GRA141).

Current: additional or updated work during 2020-25

- Ongoing updating of business continuity arrangements
- Storm incident planning report and site power outage dashboard.

Future: planned actions and delivery for 2025-2035

- Regular review of business continuity arrangements developed by the various business areas.
- Continual learning from exercises and incidents.

Risk mitigation benefits

- Ensuring that we can respond to unforeseen, acute situations such as extreme weather events – as well as gradual stresses.
- Maintenance of services to customers and communities
- Reducing adverse impacts on our people, physical assets and systems during acute events
- Better co-ordination with other organisations, including providers of essential services on which we depend.

Public engagement

Stakeholder dialogue with customers, local communities, businesses, interest groups and others is critical for maintaining resilient water and wastewater systems and services.

Current: established ways of working and actions

- Promoting a range of water saving behaviours to customers through official communication channels (i.e., social media and customer magazine) and at public events
- Home Check: technicians installing water saving devices and providing tailored advice in customer homes.
- Schools' education service that informs pupils about water and wastewater issues through classroom sessions, assemblies and site visits
- Localised community-based engagement projects to increase participation.
- Distribution of free water saving devices packs to customer homes
- Raising awareness about blockages and pollution incidents causes by wet wipes and cooking oil and fat in sewers. Data analysis to identify sewer blockage 'hot spots' where targeted customer engagement could be beneficial.

Current: additional or updated work during 2020-25

- Enhancing our Home Check service to target households that use the most water and providing leaking toilet fixes.
- The launch of GetWaterFit – a digital water use calculator tool – to help customers understand their usage, compare it with other households like theirs, receive tailored behavioural nudges and order free water saving devices.
- Building our understanding of customer behaviours including a novel project looking into garden water use behaviours that will be used to shape future campaigns.
- We worked with schools and businesses to support water demand reductions.
- Funding local sustainability community projects, including those to save water and divert rainwater, through the Wessex Water Foundation Environment Fund
- Reduced water abstraction as a result of demand management e.g. water efficiency promotion
- Our Community Connectors project involved engagement with people and communities on the local water environment and multiple issues linked to the sustainability of the water system.
- Development of apps for informing the public about water quality at recreational sites, and a detailed real-time portal for reporting sewer overflow operation.

Future: planned actions for 2025-2035

- Incorporating behavioural science into communications materials to encourage pro-environmental actions – including increasing the uptake of metering and reducing wet wipes.
- Increasingly targeted campaigns in sewer blockage hotspots including door-knocking to advise when an issue occurs, coupled with the launch of a new blockage reduction free pack of devices to encourage customers to think about what they flush and pour down the sink, plus engagement through letters and social media.
- Exploration of collaborative working with water retailers to drive non-household demand reductions.
- We aim to continue to meet demand without restrictions in the event of a drought that matches 1975-76.

6. Other elements of adaptation

The success of our adaptation work will be judged on our ability to continually meet the many expectations of our diverse stakeholders, while the stresses and shocks of climate change take effect. Consequently, planning for climate change is not an optional add-on but is embedded in our work, for example:

- it is an explicit part of our risk management framework.
- it is integral to technical work such as water resource planning and sewer design standards.
- we employ technical specialists who are able to translate climate risk into practice.
- we participate in UKWIR projects that incorporate UKCP18 projections and consider various potential impacts in depth.

However, it is not simply the case that evidence and modelling leads seamlessly to investment and other adaptation work. There are a range of technical, organisational, economic, and policy considerations that need to be taken into account.

Interdependencies, co-operation, and risk of cascading failures

It would not make sense for us to attempt to adapt to climate change in isolation. We are reliant on services provided by others and some issues involve shared responsibility with others who are affected by extreme weather or a changing climate. Examples include:

- surface water management, involving liaison with councils, Internal Drainage Boards and the Highways Agency and emergency response.
- the water sector's protocol for sharing resources and its mutual aid scheme through which companies co-operate during emergencies.
- customers, who have important roles to play in terms of using water wisely (especially during prolonged dry weather) and not causing blockages by flushing wet wipes or pouring way cooking oil and fat – and the media in helping us to raise awareness of these points.
- community groups and individuals that are able to keep an eye on their local water environment and inform us of problems with water supplies or sewerage.
- work with land users, especially for protecting drinking water sources that are vulnerable to a combination of farm inputs (e.g. nitrates and pesticides) and heavy rain.
- dialogue with government and our regulators in relation to both our day-to-day activities and longer-term planning.
- our own use of other utilities, in particular electricity and telecommunications. Their reliability is very important to us and interdependencies between utilities have been very evident during past extreme weather events. Information on power outages comes directly into our control room to ensure a managed response from the centre.

Under the Civil Contingencies Act we are designated as category 2 responders, although we work closely with category 1 responder agencies via three local resilience forums (LRF). These provide a structure for agencies to work together on planning and in tactical and strategic response to incidents, using facilities such as dedicated teleconferencing to share information and warnings and agree external messaging.

We have been doing more in recent years to ensure that we can cope with acute events, especially where there is a risk of cascading failures across a number of utilities or aspects of critical infrastructure. Our work on interdependencies is developing further under the review of the critical national infrastructure that we rely on, linked to the Security and Emergency Measures Direction. This has been informed by our experience of COVID-19 and concurrent disruptive events.

Close co-operation is well established for emergency response practices; it is important that there are good working relationships with local authorities, emergency services and business partners such as suppliers and contractors, who may themselves be affected by intense weather events. We are an active member of the three Local Resilience Forum groups operating in our region (Avon & Somerset; Wiltshire & Swindon; and Bournemouth, Dorset & Poole), with representation at executive and business management group level. Wessex Water sits on the LRFs'

adverse weather groups, which cover plans for responding to events such as flooding and heatwaves. The water sector itself has a protocol for sharing resources and a mutual aid scheme through which companies co-operate during emergencies.

Further information is provided in appendix 4, Our approach to resilience.

Our corporate governance
As noted elsewhere, we have a clearly documented process for management of risk, including climate-related risks. The Board agree the risk appetite and tolerance statements that provide the 'guardrails' for the business to make decisions. Metrics are identified to check that the level of risk taken is appropriate and there is a procedure for risk escalation. We have a clear risk management hierarchy which includes the Board of Directors, Audit and Risk Committee, Executive Leadership Team (chaired by Chief Executive), Risk Management Group (chaired by Director of Risk and Investment), risk and investment team, business risk owners, and internal audit and compliance functions. Strategic oversight is also provided by the Environment and Public Value Board Committee.

Thresholds
We use certain *weather events* such as the 1975-76 drought and 1 in 30-year storms as reference points or benchmarks for action or investment. However, we have not identified specific threshold points in the *climate* itself, such as average annual or seasonal temperature or rainfall above which particular impacts move up from one level of risk to another. Nevertheless, the water sector should in future consider the implications of the global or UK climate passing particular points and the effects of this on its activities.

Cost-benefit analysis
Cost benefit analysis is integral to the five-year business plans that we submit to Ofwat. We set out the costs that we estimate for delivering outputs and clearly explain the benefits that we expect to be gained as a result. The principal benefit provided by measures with an explicit climate change driver to date has been reduction of the risk of disruption from operational sites being flooded. The benefits of other 'complimentary adaptation' work mainly involve reduced disruption or nuisance to customers; maintaining operational flexibility (such as the number of water sources that we can use); limiting adverse impacts on the environment during drought or heavy rainfall, and generally maintaining our ability to provide expected standards of service in the face of more extreme weather events.

Barriers
The main barriers to climate change adaptation are financial, regulatory and technical. Examples include:

- the upfront cost of capital-intensive engineered measures;
- uncertainty and the limits of existing knowledge;
- delayed action due to complexity (particularly where agencies with varied funding arrangements and cycles are involved);
- insufficiently clarity over responsibilities where there is more than one potential lead organisation;
- potential unintended consequences of adaptation measures such as changes in movement of excess water.

These issues can be addressed in part by improved evidence or risk assessments that indicate the highest priorities for action funding and closer co-operation between interdependent organisations to identify cost savings and risk reduction measures. Changes in economic regulation of the water sector also offer the potential for a wider suite of measures to be pursued.

Regulation
Since 2011 there have been some changes in the water sector that are relevant to climate change adaptation. Firstly, the 2014 Water Act gave Ofwat and the Defra Secretary of State a duty to secure resilience of water supply and sewerage systems in the face of environmental pressures, population growth and changes in consumer behaviour. This provides policy context for thinking on, and investment for, climate change adaptation. Secondly, the 2014 periodic review of prices saw two notable developments. One was the emphasis on beneficial outcomes for

customers and environment (one of which for Wessex Water is ‘resilient services’) as opposed to ‘outputs’ in the form of a list of activities to be undertaken by water companies. The other is the emphasis on total expenditure, with solutions chosen based on their wholelife cost. This was intended in part to equalise the incentives for less capital-intensive solutions (such as catchment management, sustainable urban drainage systems, or behavioural measures) and conventional investment in larger physical assets. The implication for work related to climate change adaptation is there will likely be more emphasis on ‘flexible adaptation’ and a more diverse blend of measures overall.

However, regulation in the water sector is not yet providing the space or incentives to choose solutions that deliver the biggest environmental benefit at the lowest societal costs. Indeed, investment tends to be dominated still by capital intensive methods focused on single issues. Meanwhile, uncertainties about the timing and extent of climate change impacts limits the regulatory appetite for investment except where the benefit of acting very clearly outweighs costs. Moreover, the prospect of investment to reduce the sectors carbon footprint while also adapting to climate impacts threatens to place upward pressure on bills, at a time when household budgets are stretched.

One potential way to address these challenges is to place even greater emphasis on outcomes, and we are advocates of an approach termed outcomes based environmental regulation (OBER). OBER involves setting outcomes-based targets that allow companies to choose solutions that deliver the biggest environmental benefits (across a range of dimensions) at the lowest costs. It therefore unlocks the inefficiency with the current approach to environmental regulation. OBER is a flexible approach that can first be introduced in the water sector to learn important lessons and could then be rolled out more widely. Successfully implementing OBER requires a number of conditions to be met such as a strong monitoring framework, enabling partnerships, listening and engaging with communities and creating appropriate incentives in the economic regulation of water companies.

Monitoring

It is important to monitor the gradual impacts of climate change and evaluate the success of our adaptation. For water supply, we review forecasts of source yields (include the effects of climate change) at least once every five years as part of the business plan and water resources management plan processes. For sewerage and sewage treatment, we review the performance of our assets during more extreme rainfall events and assess causes and possible alleviation of new flooding. We are also installing event duration monitors at storm overflows to record the frequency and duration of spill events; this in turn will help us to assess any deterioration in the performance of these assets.

Flexible adaptation

Our adaptation plan and work are not fixed in perpetuity. Adaptation must be flexible as new data emerges or risk assessments change. This is partly enabled by the cyclical nature of some of our asset planning exercises which involve revisiting current climate change projections. Work to deal with flood risk also responds to recent weather events, local floods and the effectiveness of surface water management plans. We also look for opportunities to trial innovative approaches that might improve our resilience, and through initiatives such as Wessex Water Marketplace, to be open to a wider range of solution providers.

Climate change mitigation

By 2030, we aim to achieve net zero operational carbon emissions. These are our annual emissions linked to our energy use and transport, plus other greenhouse gases that are emitted from sewage and sludge treatment processes. However, our goal does not end there. We also aim to achieve net zero total carbon emissions by 2040 at the latest. This includes our operational emissions outlined above, plus emissions linked to construction materials, and consumables such as treatment chemicals.

Background reductions in the UKs carbon footprint, such as the growth in renewable energy generation, will mean that our energy and transport emissions will fall by around one third from our current position. We

therefore need to take concerted action between now and 2030. We will do this through a range of readily-available options including:

- emissions avoidance measures, such as reducing water use and leakage; increasing the use of lower carbon transport; and promoting nature-based solutions that avoid energy use.
- optimisation measures, such as energy efficiency work and systems for monitoring and controlling nitrous oxide from sewage treatment.
- renewable energy – increasing the amount of biogas that we generate from anaerobic digestion and pursuing opportunities for wind and solar power, either as generators or as the end-user.

These measures will be necessary but not sufficient to achieve our goal of net zero carbon. We will need to pursue more innovative options involving emerging science and technology, such as turning sewage sludge into biochar, as well as extending the use of nature-based solutions.

Alongside, we are very conscious that efforts to improve climate change resilience could lead to carbon-intensive adaptation methods – particularly those involving the construction of additional physical storage of water and wastewater. We must work closely with others to pursue low carbon alternatives where possible, or lower carbon construction methods where larger physical infrastructure is the only feasible approach.

PART 2 SUPPORTING INFORMATION

Appendix 1 Historical precipitation

Appendix 2 UK climate projections

Appendix 3 UK climate risk assessment and National Adaptation Programme

Appendix 4 Our approach to resilience

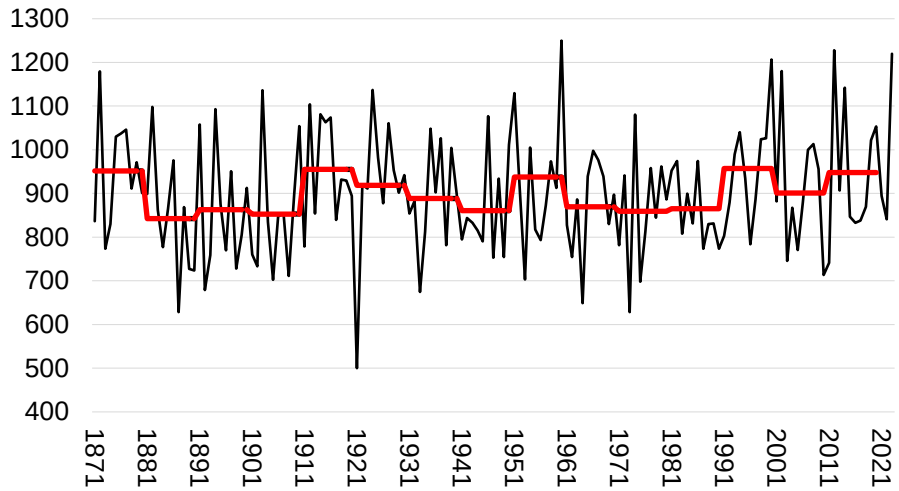
Appendix 5 Water, wastewater and other functions: responding to climate change risks (additional information).

Appendix 6 UKWIR climate change adaptation projects

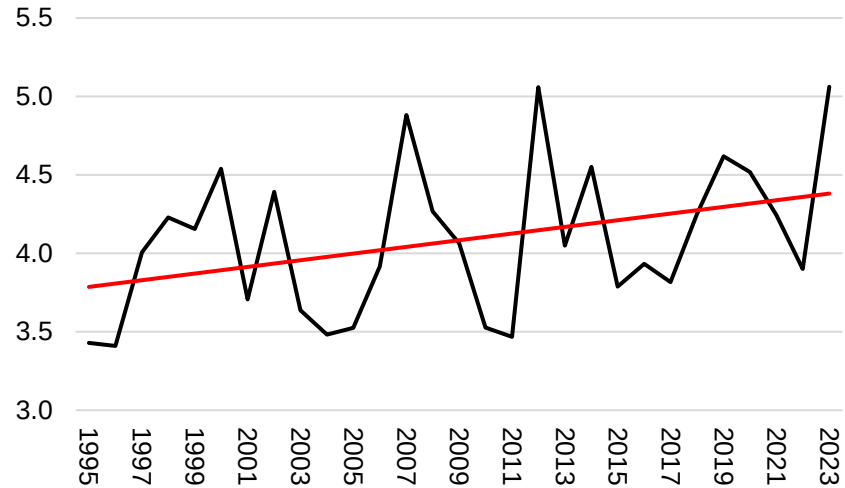
Appendix 1: Historical precipitation

The following charts show historical precipitation from rain gauges spread across our region that are maintained by the Environment Agency.

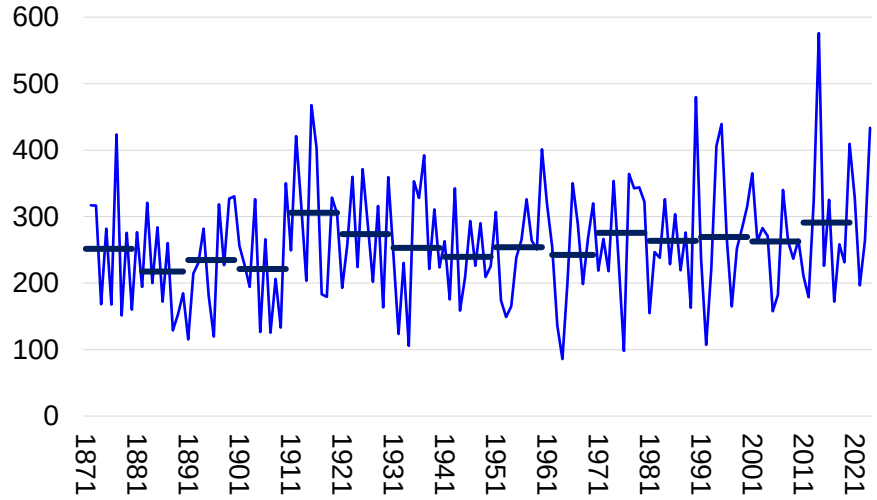
Precipitation (mm): annual & average for each decade (red)



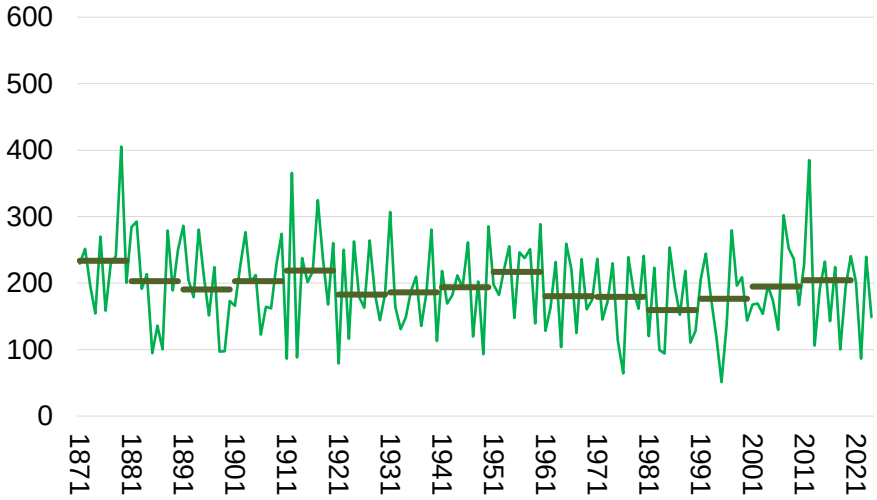
Average rainfall (mm) on rain days: annual & linear trend (red)

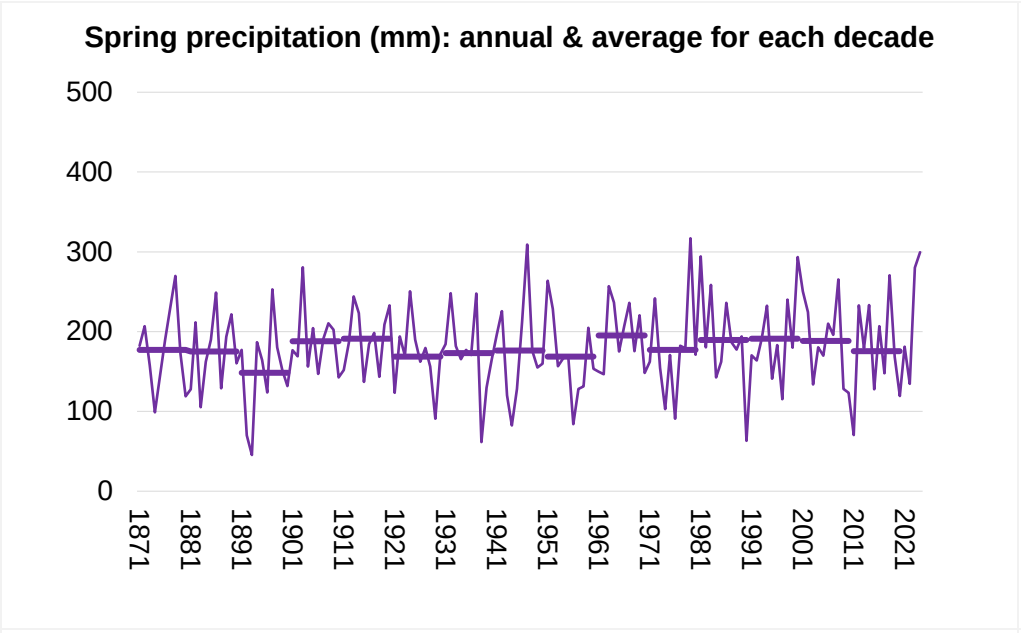


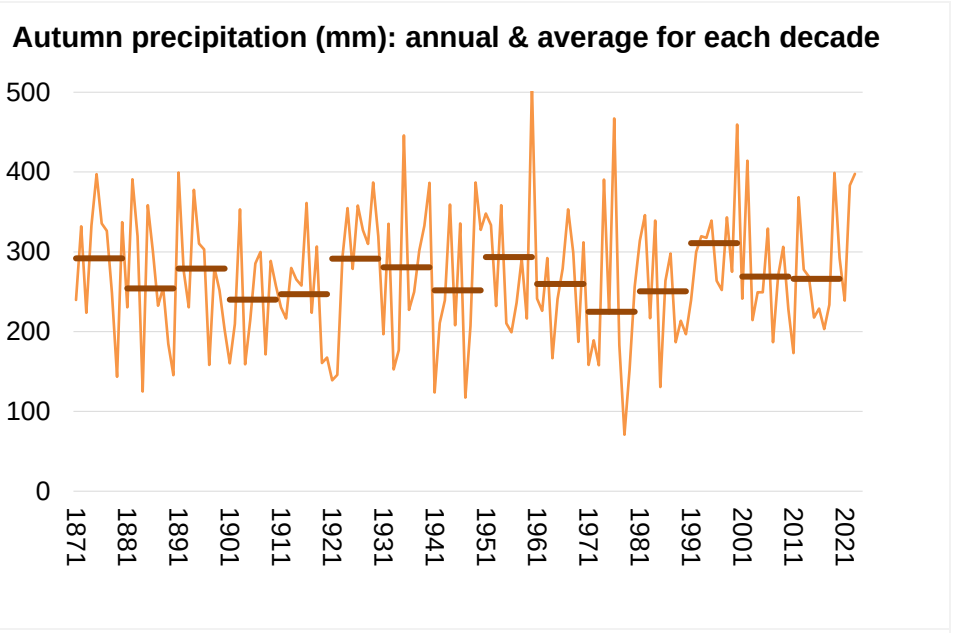
Winter precipitation (mm): annual & average for each decade

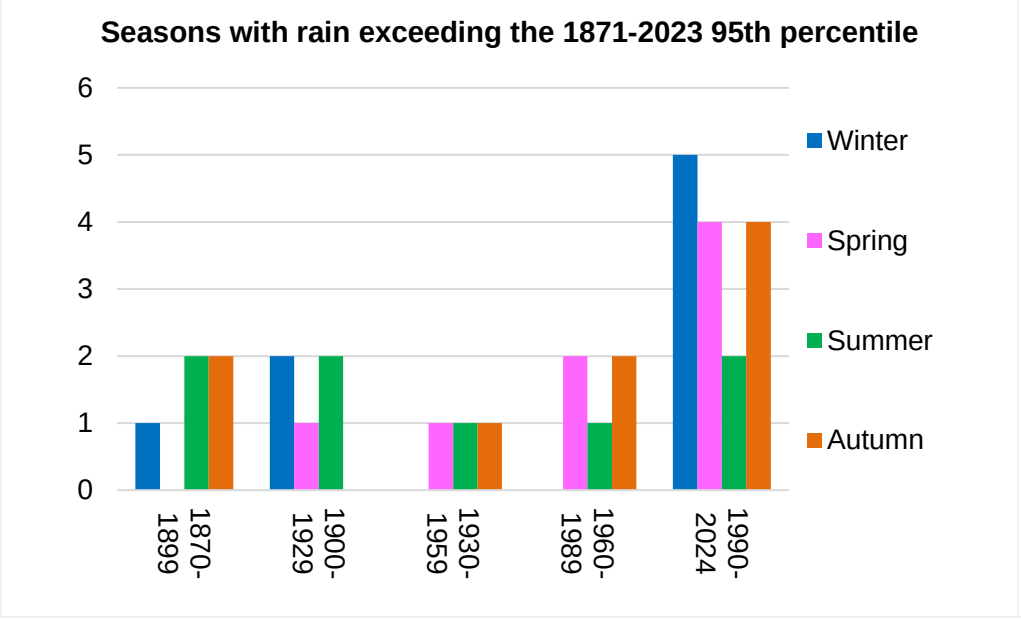


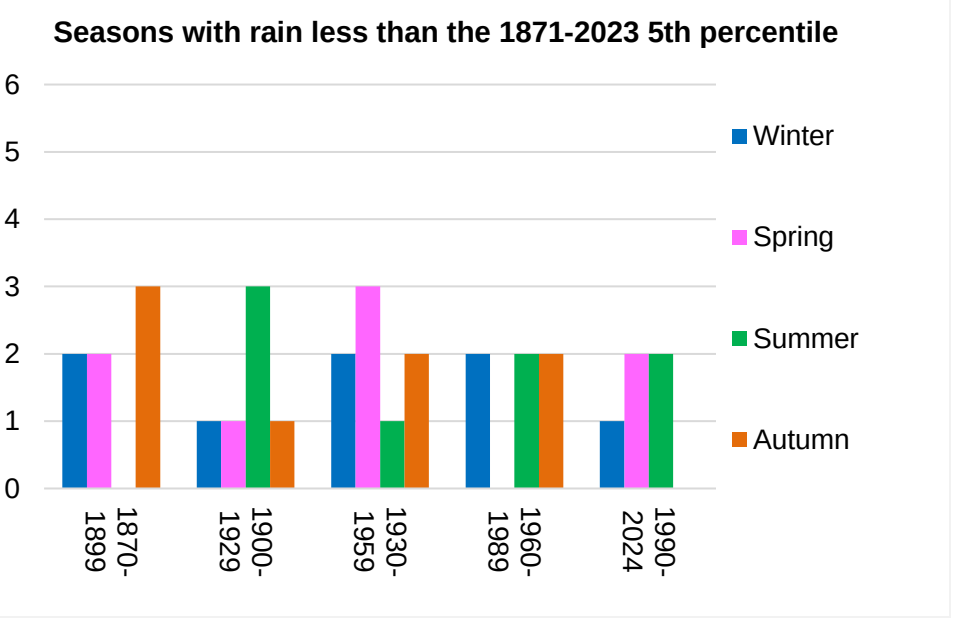
Summer precipitation (mm): annual & average for each decade




Spring precipitation (mm): annual & average for each decade
500
400
300
200
100
0
1871
1881
1891
1901
1911
1921
1931
1941
1951
1961
1971
1981
1991
2001
2011
2021


Autumn precipitation (mm): annual & average for each decade
500
400
300
200
100
0
1871
1881
1891
1901
1911
1921
1931
1941
1951
1961
1971
1981
1991
2001
2011
2021


Seasons with rain exceeding the 1871-2023 95th percentile
6
5
4
3
2
1
0
1870-1899
1900-1929
1930-1959
1960-1989
1990-2024
Winter
Spring
Summer
Autumn


Seasons with rain less than the 1871-2023 5th percentile
6
5
4
3
2
1
0
1870-1899
1900-1929
1930-1959
1960-1989
1990-2024
Winter
Spring
Summer
Autumn

Appendix 2: Climate projections and forecasts

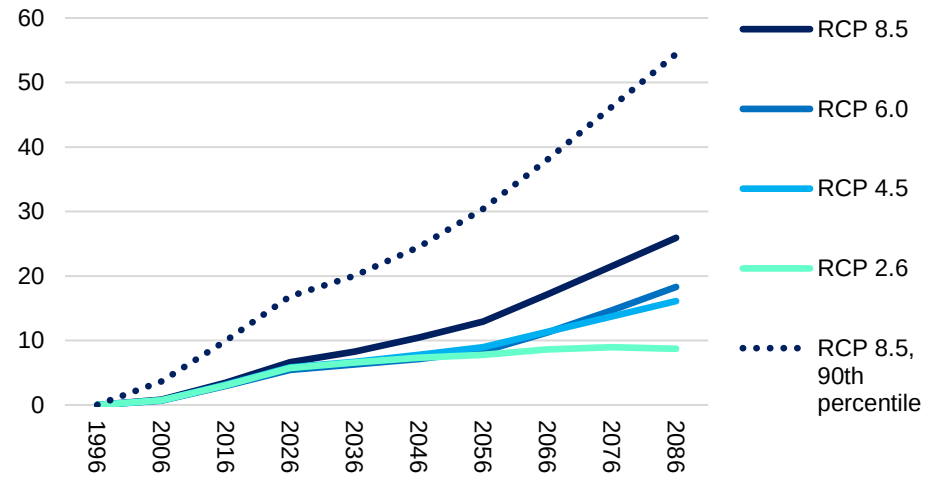
UKCP18 projections for the Wessex Water region: for an average year under four emissions scenarios, compared to 1981-2010

	LESS LIKELY 10% probability that the outcome is less than the value shown				CENTRAL CASE 50th percentile (the central estimate across all models)				LESS LIKELY 90% probability that the outcome is less than the value shown			
	RCP 2.6	**RCP 4.5**	**RCP 6.0**	**RCP 8.5**	**RCP 2.6**	**RCP 4.5**	**RCP 6.0**	**RCP 8.5**	**RCP 2.6**	**RCP 4.5**	**RCP 6.0**	**RCP 8.5**
Summer rain % change												
2020-2049	-25	-24	-23	-28	-10	-8	-8	-11	5	7	7	6
2030-2059	-28	-28	-27	-34	-12	-11	-10	-15	3	5	5	3
2040-2069	-30	-33	-33	-42	-14	-15	-14	-21	1	3	2	0
2050-2079	-31	-37	-37	-48	-15	-18	-18	-25	1	0	-1	-4
2060-2089	-32	-40	-42	-55	-16	-21	-23	-31	0	-3	-4	-7
2070-2099	-34	-45	-49	-62	-17	-24	-28	-36	1	-4	-6	-9
Winter rain % change												
2020-2049	-3	-3	-3	-2	7	7	6	8	17	17	17	20
2030-2059	-3	-3	-3	-2	7	8	7	10	19	20	19	25
2040-2069	-3	-3	-3	-1	8	9	8	13	20	23	22	30
2050-2079	-2	-3	-3	0	9	11	11	17	21	27	28	38
2060-2089	-2	-1	-1	1	9	14	15	22	22	31	34	46
2070-2099	-4	0	0	3	9	16	18	26	24	35	39	54
Summer maximum temperature deg.C warming												
2020-2049	0.6	0.3	0.2	0.5	1.5	1.3	1.2	1.7	2.5	2.3	2.2	2.8
2030-2059	0.6	0.5	0.4	0.8	1.7	1.6	1.5	2.3	2.8	2.9	2.7	3.8
2040-2069	0.7	0.7	0.6	1.2	1.9	2.1	2.0	3.1	3.0	3.6	3.5	4.9
2050-2079	0.7	0.9	0.9	1.7	1.9	2.5	2.6	4.0	3.2	4.4	4.5	6.3
2060-2089	0.8	1.2	1.3	2.2	2.0	3.1	3.4	5.0	3.3	5.2	5.6	7.8
2070-2099	0.8	1.4	1.7	2.8	2.1	3.7	4.3	6.0	3.5	6.0	6.8	9.3

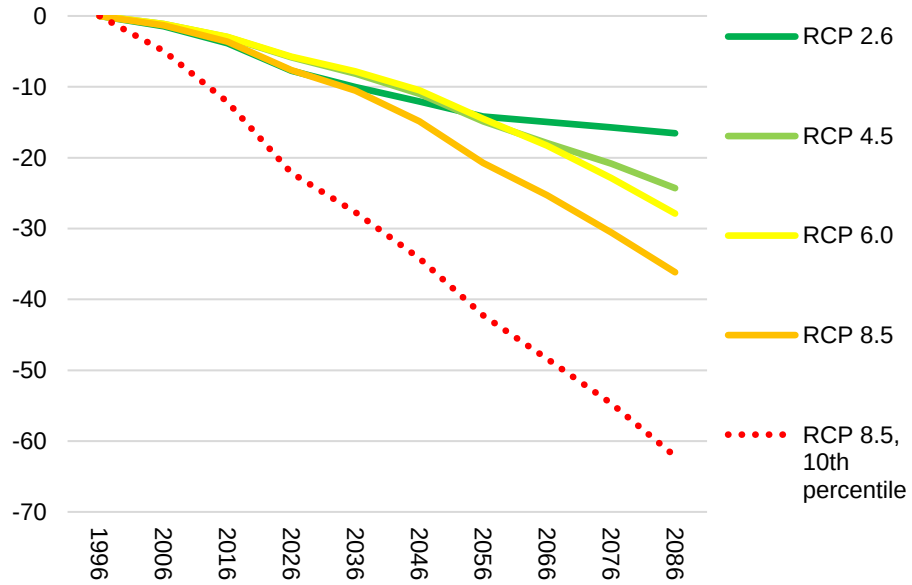
Figures shown are the average of projections for Dorset, Somerset and Wiltshire, via Climate Risk Indicators (uk-cri.org)

Projected % change vs 1961-90
(50th centile for probability and worst-case scenarios)

Winter

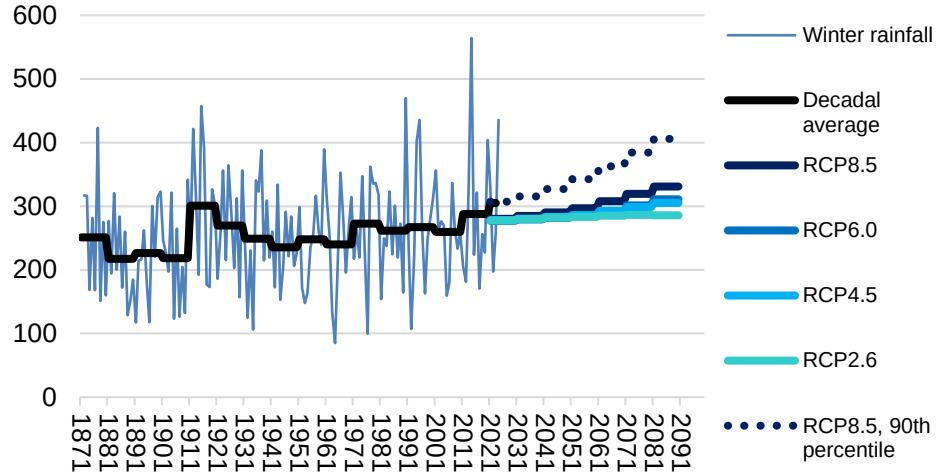


Summer

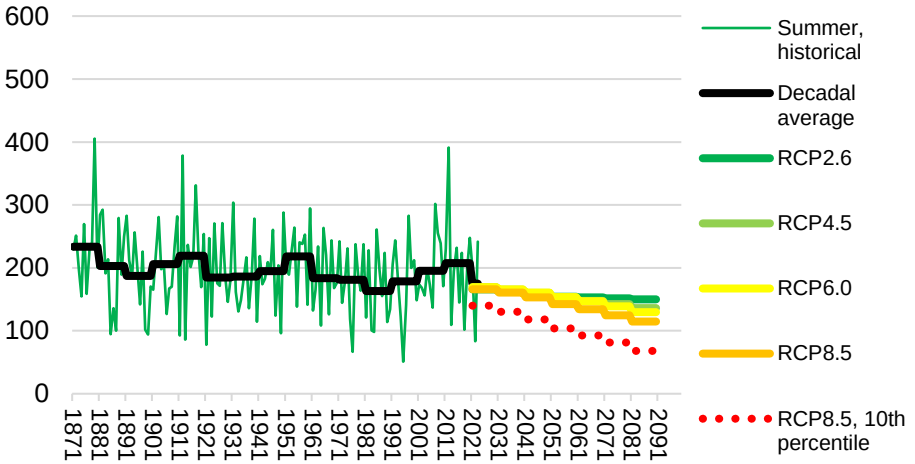


Winter and summer rainfall (mm): historical (annual, decadal averages), and projected (UKCP18 applied to 1981-2010 average)

Winter



Summer

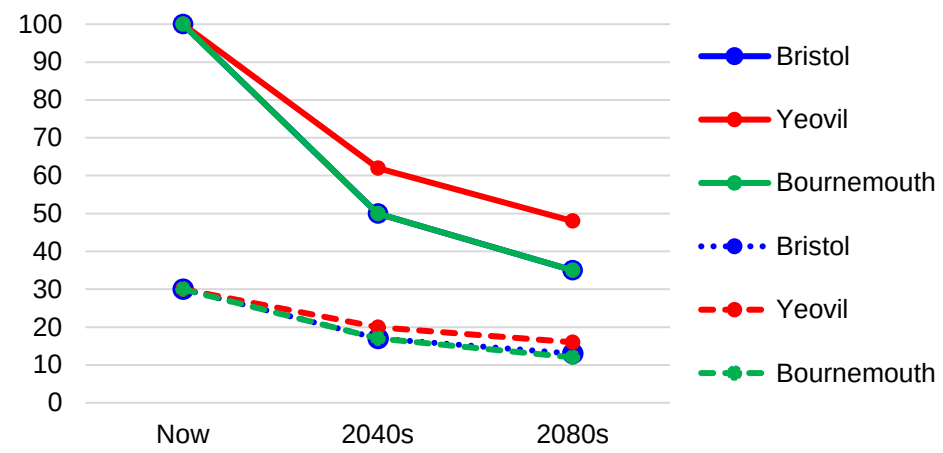


RCP profiles are the 50th percentile unless indicated

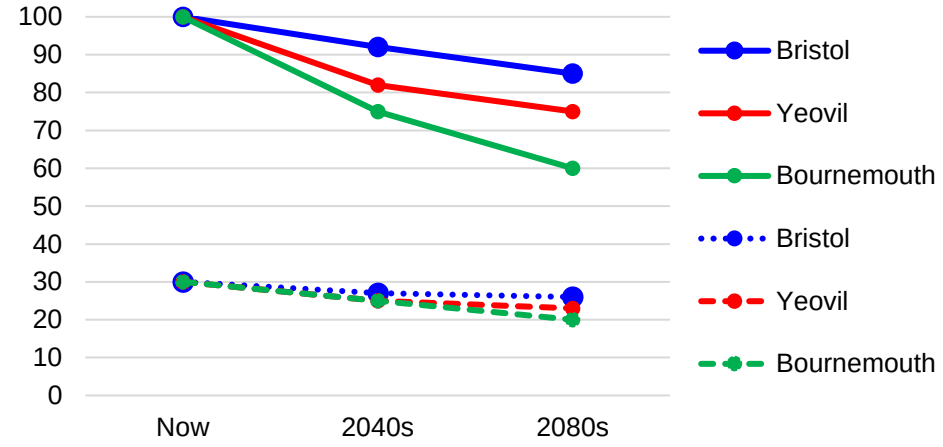
Changing occurrence of major storms (Met Office for Ofwat, 2010)

	Storms of the intensity currently expected to occur once every…	by the 2040s, will be expected to occur once every…	and by the 2080s, will be expected to occur once every…
Winter storms			
Bristol	10 years	6 years	5 years
	30 years	17 years	13 years
	100 years	50 years	35 years
Yeovil	10 years	7 years	5 years
	30 years	20 years	16 years
	100 years	62 years	48 years
Bournemouth	10 years	7 years	5 years
	30 years	17 years	12 years
	100 years	50 years	35 years
Summer storms			
Bristol	10 years	9 years	8 years
	30 years	27 years	26 years
	100 years	92 years	85 years
Yeovil	10 years	9 years	8 years
	30 years	25 years	23 years
	100 years	82 years	75 years
Bournemouth	10 years	8 years	7 years
	30 years	25 years	20 years
	100 years	75 years	60 years

Winter storms (Y axis = return period in years)



Summer storms (Y axis = return period in years)



Source: Met Office (2010) Changes in the frequency of extreme rainfall events for selected towns and cities (report for Ofwat)

Coastal impacts

UKCP18 Key Findings

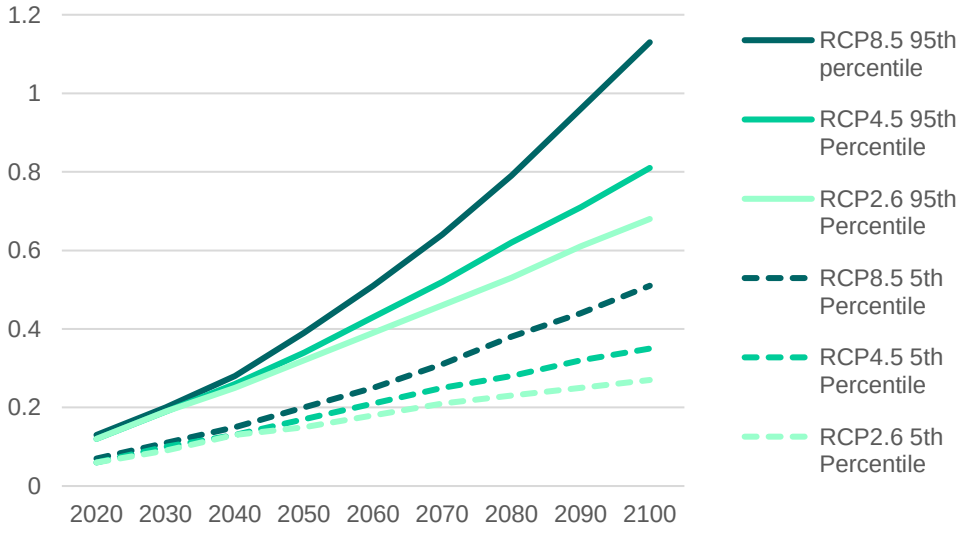
UK coastal flood risk is expected to increase over the 21st century and beyond under all climate change scenarios. Mean sea level (MSL) rise is the dominant factor and varies by location and climate change scenario. Storm surge and wave changes are up to ~10% of the MSL signal, but larger changes cannot be ruled out. Future ice loss from Antarctica remains a major uncertainty, particularly for post-2100 time horizons.

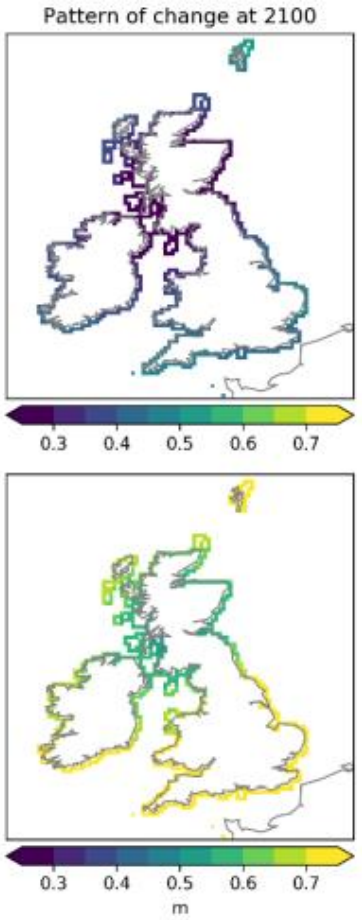
Projected sea level change (m) at Cardiff

a) 2100 relative to 1981-2000 average 5th and 9th probability percentile

	5th	95th
RCP2.6	0.27	0.68
RCP4.5	0.35	0.81
RCP8.5	0.51	1.13

b) Decadal profile





Source: UKCP18 Marine Projections report via https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/summaries/headline-findings

Appendix 3. UK Climate Risk Assessment and National Adaptation Programme

The Climate Change Committee's 2021 evidence report on climate change risk

The Government's first two assessment of the risks and opportunities for the UK of the current and predicted impact of climate change were published in 2012 and 2017. They drew primarily on independent evidence reports produced by the Climate Change Committee's Adaptation Sub-Committee. The 2021 Advice Report is the Adaptation Committee's statutory advice to Governments on priorities for forthcoming national adaptation plans and wider action. The headline points include the following:

- The gap between the level of risk we face and the level of adaptation underway has widened. Adaptation action has failed to keep pace with the worsening reality of climate risk.
- The UK has the capacity and the resources to respond effectively to these risks, but it has not yet done so. Acting now will be cheaper than waiting to deal with the consequences. Government must lead that action.
- The Committee identifies eight risk areas that require the most urgent attention in the next two years.
    1. Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards.
    2. Risks to soil health from increased flooding and drought
    3. Risks to natural carbon stores and sequestration from multiple hazards, leading to increased emissions
    4. Risks to crops, livestock and commercial trees from multiple climate hazards
    5. Risks to supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks
    6. Risks to people and the economy from climate-related failure of the power system
    7. Risks to human health, wellbeing and productivity from increased exposure to heat in homes and other buildings
    8. Multiple risks to the UK from climate change impacts overseas
- These were selected on the basis of the urgency of additional action, the gap in UK adaptation planning, the opportunity to integrate adaptation into forthcoming policy commitments and the need to avoid locking in poor planning, especially as we recover from the COVID-19 pandemic.

The 2021 evidence report provides a set of key messages for the water sector:

- Water infrastructure, such as reservoirs, dams, pipelines, water treatment and recycling centres plants and sewage treatment plants, are all at risk from the impacts of climate change, especially increases in the frequency and intensity of surface water and coastal flooding.
- Water infrastructure assets represent a key element of the UK infrastructure system and could affect, or be affected by, failures of other assets due to extreme weather, such as energy systems, transport and information and communications technology (ICT)
- There are risks to buried infrastructure, such as water pipelines, with damage potentially becoming more frequent in future due to flooding and subsidence.
- More frequent flooding could also impact on water treatment facilities leading to potential reductions in water quality, in turn impacting upon health.
- Future projections of more frequent and intense dry periods lead to concerns around the availability of public water supplies in future, especially in England and parts of Wales. Private water supplies are also at risk.
- Aquifers near the coast could be at greater risk from saltwater intrusion due to sea level rise, though the risk is thought to be low in places where aquifers are important water sources.

Additionally, low summer river flows and increases in river water temperature, leading to algal blooms and habitat degradation, is assigned a high-risk rating for 2080.

The table below shows the individual risks and opportunities highlighted in the 2017 and 2021 evidence reports which are most relevant to our activities, and their inclusion in the 2023 UK Climate Change Risk Assessment.

	2017 evidence report	2021 evidence report	2023 UKCCRA
Risks of cascading infrastructure failures across interdependent networks	In1. More action needed	More action needed	I1. More action needed
Risks to infrastructure from river, surface/groundwater flooding	In2. More action needed	More action needed	I2. More action needed
Risks to infrastructure from coastal flooding & erosion	In3. More action needed	Further investigation	I3. Further investigation
Risks of sewer flooding due to heavy rainfall	In4. More action needed		
Risks to bridges and pipelines from high river flows / erosion	In5. Research priority		
Subsidence risks to buried / surface infrastructure	In8. Watching brief	Further investigation	I7. Further investigation
Risks to public water supplies from drought and low river flows	In9. More action needed	Sustain current action	I8. More action needed
Benefits for infrastructure from reduced extreme cold events	In14. Sustain current action		
Risks to health from poor water quality	PB13. Sustain current action	Further investigation	H10a. Further investigation
Risk of household water supply interruptions	PB14. Sustain current action	Further investigation	
Risks to people, communities and buildings from river and surface flooding			H3. More action needed
Risks to business sites from flooding	Bu1. More action needed		
Risks to business operations from water scarcity	Bu3. Sustain current action		B3. Further investigation
Risks to agriculture & wildlife from water scarcity & flooding	Ne6. More action needed		
Saltwater intrusion risks to aquifers, farmland & habitats	Ne11. Sustain current action	Maintain watching brief	N10. Further investigation

Legend	Natural environment and natural assets	Infrastructure	People and the built environment	Business and industry

2022 UK Climate Change Risk Assessment

The third edition of the UKCCRA (CCRA3) was published by the government in 2022, drawing on the updated independent assessment of climate change published by the Climate Change Committee (CCC) in summer 2021. The UKCCRA includes an assessment of risks and opportunities that are graded according to the level of action needed, and potential costs / damages or opportunities. The following are those of the most relevance to the water sector:

More action needed	I1. Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures I2. Risks to infrastructure services from river, surface water and groundwater flooding H3a. Risks to people, communities and buildings from river and surface flooding I8. Risks to public water supplies from reduced water availability
Further investigation	I3. Risks to infrastructure services from coastal flooding and erosion I7. Risks to subterranean and surface infrastructure from subsidence H10a. Risks to health from water quality H10b. Risks to health from water supply B3. Risks to businesses from water scarcity N10. Risks to aquifers and agricultural land from sea level rise, saltwater intrusion

National adaptation programme, 2023 (NAP3)

Following CCRA3, NAP3 explains the government's plans to adapt to climate change over the next 5 years from 2023 to 2028, including protecting the natural environment; supporting business in adapting to climate change; adapting infrastructure; protecting buildings and their surroundings; protecting public health and communities; and mitigating international impacts on the UK. Actions related to water companies include the following:

I1. Risks to infrastructure networks from cascading failures

7. Defra will provide guidance to respondents to improve sector-level reporting on climate risks, including on infrastructure sector interdependencies and cascading failures, through the fourth round of ARP in 2024

I2. Risks to infrastructure services from river, surface water and groundwater flooding

I3. Risks to infrastructure services from coastal flooding and erosion

1. Ofwat will take a long-term view of the requirements for investment in water infrastructure and consider climate change as part of the methodology for the Price Review 2024, to ensure that water companies can invest in the resilience of their infrastructure.
2. Water companies will follow the National Flood and Coastal Erosion Risk Management (FCERM) Strategy for England, which includes an objective for water companies to develop plans for their infrastructure to be resilient to flooding and coastal change between now and 2030.
4. The Environment Agency will report on the flood risk management performance of risk management authorities (including water companies) annually as part of their duties under the Flood and Water Management Act 2010.

5. Water companies will invest £400 million via 18 schemes in new infrastructure to improve water resilience by increasing water capacity and driving water efficiency, with projects started before April 2025 and completed by 2030.
6. Water companies will publish drainage and wastewater management plans in summer 2023, which will identify mitigations for the flood risk both from and to their sewage assets for the period 2023 to 2028.

I7. Risks to subterranean and surface infrastructure from subsidence

Water companies will address leakage and drought and invest in infrastructure where necessary to reduce the risk that subsidence poses to their operations.

1. Ofwat will take a long-term view of the requirements for investment in water infrastructure and consider climate change as part of the methodology for the Price Review 2024, to ensure that water companies can invest in the resilience of their infrastructure.
3. Defra will require water companies to reduce leakage rates by 37% by 2038 and 50% by 2050, which will reduce the risk of subsidence. Ofwat will monitor progress on leakage rates throughout the NAP3 period and beyond.
4. Defra will invite water companies to report on the climate risks they face and the work they are doing to mitigate these risks under the ARP in the Climate Change Act 2008, with the fourth round of reports due in 2024.
5. Defra will require water companies to produce water resources management plans setting out how they will secure a resilient and secure water supply for a minimum of 25 years. The next iteration of plans will be produced by 2025 and reviewed annually by regulators. Companies must provide technical annexes that detail how they have assessed the risk to their infrastructure.
6. Water companies will produce drought plans every 5 years setting out how they will monitor water availability, the triggers for drought measures, and supply and demand mitigation actions. This will reduce the risk of subsidence posed by dry soils. These drought plans will inform other aspects of water industry planning, including the next round of water resources management plans in 2024.

I8. Risks to public water supplies from reduced water availability

1. Ofwat will take a long-term view of the requirements for investment in water infrastructure and consider climate change as part of the methodology for the Price Review 2024, to ensure that water companies can invest in the resilience of their infrastructure.
2. Defra will require water companies to produce water resources management plans setting out how they will secure a resilient and secure water supply for a minimum of 25 years. The next iteration of plans will be produced by 2025 and reviewed annually by regulators. They detail companies' commitments to build new infrastructure, reduce demand and highlight where they will invest in technology to mitigate the risk posed by climate change.
3. Water companies will work with other sectors to produce collaborative regional water resources management plans for the first time in 2023. These detail how companies in each regional zone will work together with other major water stakeholders to ensure security of water supply over a minimum 25-year timeframe.
4. The government will work with regulators to assess the statutory water resources management plans which companies will submit in 2024. It will ensure water companies manage supply and demand to a nil deficit, taking account of climate change.
5. Water companies will produce drought plans every 5 years setting out how they will monitor water availability, the triggers for drought measures, and supply and demand mitigation actions. These drought plans will inform other aspects of water industry planning, including the next round of water resources management plans in 2024.
6. Defra, the Environment Agency and Ofwat will drive the development of new infrastructure projects where necessary to manage the risk. Large-scale water supply water infrastructure projects are currently being submitted through a RAPID accelerated process led by the Environment Agency, Ofwat and the Drinking Water Inspectorate. This project is currently considering 17 water infrastructure projects for funding, and projects will be ready for

construction in the next Price Review period (by 2030). Defra will designate the national policy statement for water resources infrastructure to improve planning decisions.
7. Defra will require water companies to reduce leakage rates by 37% by 2038, with interim targets in 2027 and 2031.
8. Defra and Ofwat will work with companies to reduce water demand, with a target to reduce the use of public water supply by 20% by 2038.

N10. Risks to aquifers and agricultural land from sea level rise, saltwater intrusion

1. Defra will continue to assess evidence gaps and review water companies' current good practice for managing saline intrusion risk to aquifers to provide clarification on exposure and vulnerability. The next iteration of water resources management plans will be in 2029.
2. Defra will continue to review guidance to companies on what should be included in water company plans every 5 years, ensuring that water companies complete water resources management plans with zero water deficit to mitigate the risk to water supply in the event of sea level rise and saltwater intrusion.
3. Defra will continue to work with regional resource groups, at catchment level, to understand local environmental risks and develop sustainable solutions. These include new winter rainfall storage reservoirs and licence holders, with a new regional management plan produced every 5 years.
4. The Environment Agency will continue modifying abstraction licences where there are environmental concerns. The Environment Agency will be able to modify licences without compensation to strengthen sustainable abstraction policies from 2028.

H10. Risks to water quality and household water supplies

1. Defra will continue to support the Drinking Water Inspectorate (DWI) in its oversight and enforcement role through the NAP3 implementation period to 2028 and beyond, utilising the Water Supply (Water Quality) Regulations 2016.
2. Defra will support the Environment Agency and Ofwat in ensuring water companies deliver the targets set out in the government's Storm Overflow Reduction Plan, which are to improve storm overflows in or near bathing waters by 2035, and in all locations by 2050. Defra asked water and sewerage companies to integrate their storm overflow commitments into their Drainage and Wastewater Management Plans and water resource management planning.
3. Defra will continue to enforce the Bathing Water Regulations 2013 through the NAP3 implementation period to 2028 and beyond to monitor designated bathing waters for faecal pollution during the bathing water season from 15 May to 31 September each year. Through this, the Environment Agency, local authorities and sewage undertakers will take necessary action if there are any health risks identified.
4. Defra will review water companies Drought Plans every five years. The next review will be in 2026. Drought Plans set out how water companies will monitor water availability, and triggers which indicates supply and demand actions for water.
5. Defra will implement the actions set out in the Plan for Water in order to achieve the statutory water demand target to mitigate the impacts of climate change on water supplies by 2037/38.

B3. Risks to businesses from water scarcity

5. Defra will require water companies to produce water resources management plans setting out how they will secure a resilient and secure water supply for a minimum of 25 years. The next iteration of plans will be produced by 2025 and reviewed annually by regulators. They detail companies' commitments to build new infrastructure, reduce demand and highlight where they will invest in technology to mitigate the risk posed by climate change.
6. Water companies will work with other sectors to produce collaborative regional water resources management plans for the first time in 2023. These detail how companies in each regional zone will work together with other major water stakeholders to ensure security of water supply over a minimum 25-year timeframe.

7. Water companies will produce drought plans every 5 years setting out how they will monitor water availability, the triggers for drought measures, and supply and demand mitigation actions. These drought plans will inform other aspects of water industry planning, including the next round of water resources management plans in 2024.
8. Defra will require water companies to reduce leakage rates by 37% by 2038, with interim targets in 2027 and 2031.
9. Defra and Ofwat will work with companies to reduce water demand, with a target to reduce the use of public water supply by 20% by 2038.

Wessex Water: examples of response to UKCCRA 3 and the 2023 National Adaptation Programme

UK CCRA3 risks	National Adaptation Programme 3 Proposed / required responses	WW controls and actions (examples)	Metrics/ reporting (examples)	Further information in this report
Water supply				
I8. Risks to public water supplies from reduced water availability B3. Risks to businesses from water scarcity	• Production of water resources management plans; work with other sectors to produce collaborative regional water resources management plans • Managing supply and demand to a nil deficit, taking account of climate change. • Review of water companies Drought Plans every five years. • Large-scale water supply water infrastructure projects via RAPID • Reduce leakage rates by 37% by 2038 and 50% by 2050 • Reducing water demand, with a target to reduce the use of public water supply by 20% by 2038 • Investment (via 18 schemes) in new infrastructure during 2025-30 to improve water resilience by increasing water capacity and driving water efficiency	• Drought planning • Water resource planning to address long term change • Dialogue with regulators on abstraction • Abstraction reduction at sensitive sites • Integrated supply grid to allow transfers within the region • Networks management to maintain resilience • Publication of plans, following detailed analysis of risk and stakeholder engagement • Promotion of water efficiency	• Water supply restrictions • Compliance with abstraction licences • Water restrictions • Avoided water use from water efficiency measures	Appendix 5: water resources; wider environment; Water supply - quantity
H10. Risks to water quality and household water supplies	• Defra support for the Drinking Water Inspectorate (DWI); the Water Supply (Water Quality) Regulations 2016. • Review of water companies Drought Plans every five years. • Defra implementation of actions in the Plan for Water in order to achieve the statutory water demand target	• Continuous monitoring of water supplies • Source to tap risk assessments; water safety plans • Investment in infrastructure and systems to limit the number of customers reliant on a single source • Rezoning in the event of failing samples • Catchment management to protect drinking water sources • Blending water supplies when required • Additional treatment where necessary to keep risk to a satisfactory level • Network monitoring, leakage detection • Intra-regional water movements via the integrated supply grid during extreme weather event • Water resource planning to address long term change • Replacement of older water mains • Completion of integrated supply grid	• Water quality compliance; Events Risk Index; water quality customer contacts • Water supply interruptions • Leaks repaired within 24 hours	Appendix 5 Water supply - quality

N10. Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	• Mitigating the risk to water supply from sea level rise and saltwater intrusion. • Modifying abstraction licences where there are environmental concerns	• Assessed as a low risk item.		
Wastewater				
H10. Risks to water quality	• Deliver the targets set out in the government's Storm Overflow Reduction Plan; integrate their storm overflow commitments into their Drainage and Wastewater Management Plans and water resource management planning. • Bathing waters – to take necessary action if there are any health risks identified	• Drainage and wastewater management plans • Infiltration reduction plans • Modelling sewer catchments, topographic mapping; rainfall modelling. • Monitoring networks and overflows • Work with lead local flood authorities on surface water management • Promoting sustainable drainage methods • Property level protection • Sewer sealing to reduce groundwater infiltration • Sewer maintenance e.g. jetting • Improvements at individual storm overflows (SOs) • Sewer separation where possible and effective • Behavioural engagement to reduce sewer blockages • Monitoring recreational water quality and impacts; providing public information	• Internal flooding per 10,000 connected properties • External flooding per 10,000 connected properties • Properties at risk of sewer flooding • Sewer flood risk score	Appendix 5 Sewerage and surface water management
Flooding				
I2: Risks to infrastructure services from river, surface water and groundwater flooding I3: Risks to infrastructure services from coastal flooding and erosion	• Publication of drainage and wastewater management plans • Development of plans (between now and 2030) for infrastructure to be resilient to flooding and coastal change	• Adapting maintenance plans • Water supplies: ability to rezone; blend water sources; move water via our integrated grid • Response and recovery plans • Site flood risk assessments; designation of sites needing defences / alterations; monitoring of vulnerability of sites and assets • Water supplies: rezoning; blending; transfers via our integrated grid • Investments in bunding, flap valves, alarms and drainage improvements at high-risk sites; moving electrical equipment above flood levels • Coastal – assessed as low risk	• Various resilience metrics	Appendix 5: flooding of operational sites and assets

Cross-cutting				
I1.Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures	• Defra guidance to improve sector-level reporting on climate risks, including on infrastructure sector interdependencies and cascading failures	• Following Cabinet Office good practice guidance for integrated emergency management • Emergency Tactical Planning Group • Incident management procedures • Involvement in Local resilience forums • Back-up generators • Continual review of business continuity arrangements • Emergency planning; emergency simulation exercises	• Water supply interruptions	Appendix 4: our approach to resilience Appendix 5: Business continuity and cascading failures
I7.Risks to subterranean and surface infrastructure from subsidence	• Water companies will address leakage and drought and invest in infrastructure where necessary to reduce the risk that subsidence poses to their operations. • Ofwat to consider climate change as part of the 2024 Price Review • Water companies to reduce leakage rates by 37% by 2038 and 50% by 2050, which will reduce the risk of subsidence. • Water companies to produce water resources management plans assessment of risk to infrastructure. • Water companies to produce drought plans including supply and demand mitigation actions; this will reduce the risk of subsidence posed by dry soils	• Proactive network monitoring inspections • Reactive responses, e.g. maintenance in the event of sewer collapses • Drought planning • Water resource planning to address long term change • Networks management to maintain resilience	• Leakage • Sewer collapses per 1,000km	Appendix 5 Water supply – quantity; sewerage

The following were included in the UK Climate Change Risk Assessment 2017 Evidence Report from the Climate Change Committee, but were not included in the subsequent UKCCRA2, nor the 2021 and 2022 equivalents.

MORE ACTION NEEDED

	WW controls and actions (examples)	Metrics / reporting (examples)
In4: Risks of sewer and surface water flooding due to heavy rainfall	• Drainage and wastewater management plans • Infiltration reduction plans • Modelling sewer catchments • Topographic mapping; rainfall modelling. • Monitoring networks and overflows • Work with lead local flood authorities on surface water management • Promoting sustainable drainage methods • Property level protection • Sewer sealing to reduce groundwater infiltration • Sewer maintenance e.g. jetting • Improvements at individual storm overflows (SOs) • Behavioural engagement to reduce sewer blockages • Sewer separation where possible and effective	• Internal flooding per 10,000 connected properties • External flooding per 10,000 connected properties • Properties at risk of sewer flooding • Sewer flood risk score

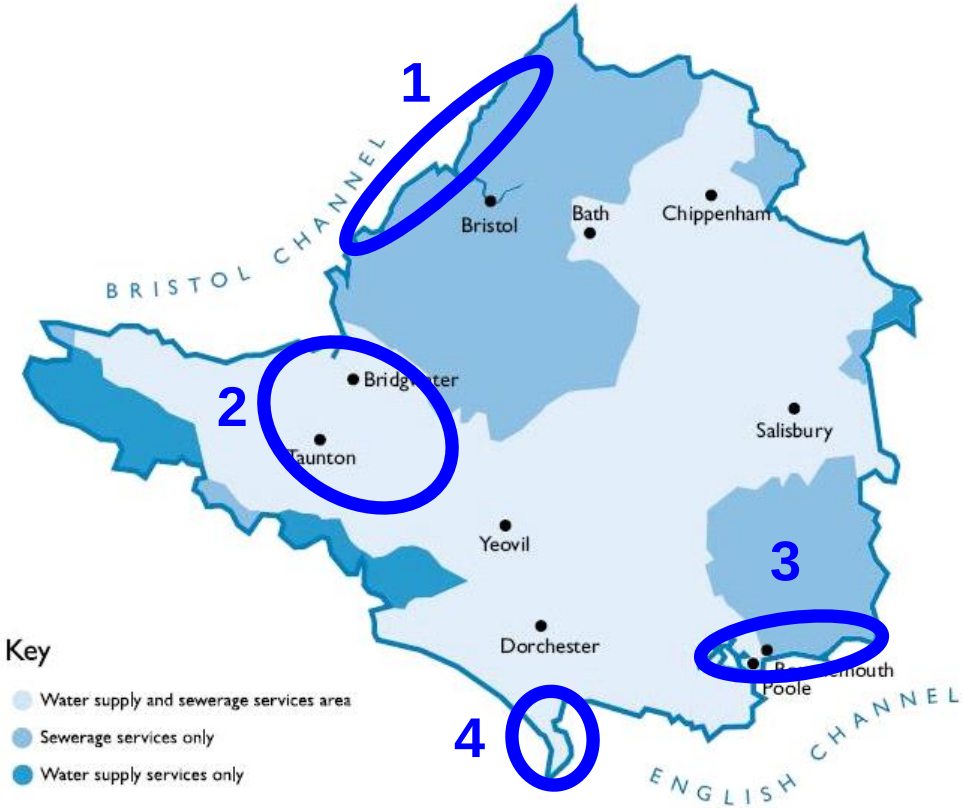
RESEARCH PRIORITY

In5: Risks to bridges and pipelines from high river flows and bank erosion	• Water supply rezoning	• Water supply interruptions

SUSTAIN CURRENT ACTION

In14: Potential benefits to water, transport, digital and energy infrastructure from reduced frequency of extreme cold events	• Levels of benefit not assessed • Extreme weather business continuity arrangements • Response to future cold wave events informed by learning points from the 2018 ‘Beast from the East’. • No action linked to reduced frequency	• Water supply interruptions

South West Regional Flood Risk Appraisal (2007): regionally significant flood risk areas



	Groundwater	Fluvial	Tidal	Coastal
1		▪	▪	▪
2			▪	▪
3	▪	▪	▪	▪
4			▪	▪

Appendix 4: Our approach to resilience

The world is changing faster than ever before. Uncertainty from shocks and stresses challenge our ability to deliver a good quality service, both now and in the future. Therefore, we have a focus on improving the resilience of our systems, to support us to deliver our long-term vision.

We define resilience as the ability to cope with and recover from, disruption and anticipate trends and variability in order to maintain services for people and protect the natural environment now and in the future. When we consider resilience, we consider three types of resilience, as set out in our original resilience action plan:

- **Operational** - The ability of an organisation's infrastructure, and the skills to run that infrastructure, to avoid, cope with and recover from disruption in its performance.
- **Financial** - The ability of an organisation's governance, accountability and assurance processes to help avoid, cope with and recover from disruption and to anticipate trends and variability in all aspects of risk to the delivery of services.
- **Corporate** - The extent to which an organisation's financial arrangements enable it to avoid, cope with and recover from disruption.

Providing a resilient service to our customers is a critical part of our operational activities and supports the delivery of our purpose. It is a fundamental capability that is engrained into our business and can be evidenced through our historical actions such as our implementation of the Water Supply Grid and our response to the Beast from the East.

Shocks, stresses and future uncertainties challenge our ability to deliver a resilient service, and we recognise that to create a resilient system we need to adequately understand, assess and quantify our risk. Our integrated systems-based approach to risk and resilience provides a clear line of sight from risk through to delivery of ambitions, objectives and outcomes. We have several systems and tools which we use to enable resilience.

We consider resilience as a key part of how we can deliver our Strategic Direction Statement which describes our long-term vision and ambition in delivering the eight outcomes that customers, communities and stakeholders have told us are their priorities, through to 2050.

We recognise that our operating conditions are ever changing. Since the publication of the initial resilience action plan, the COVID-19 pandemic as well as the lived experience of a changing climate have provided an impetus to focus on longer-term risks. There have been numerous extreme weather events since 2020 which we can expect to see occurring more frequently because of climate change. There has also been a significant shift in public views towards the environment and the role of water companies in managing this.

We have processes in place to identify, assess and act in response to shocks and stresses to ensure customers continue to receive the right services. We consider planning for both short term shocks and long-term stresses as equally important.

Our risk and resilience framework sets out our approach and describes how we are continuing to embed a systems-based approach to resilience. Our overall approach to resilience is divided into two sections:

- Identifying the objectives and defining the context
- six resilience steps: identify, assess, evaluate, plan response, implement responses, monitor and evaluate.

Our 2020 resilience action plan can be found at wwsl-resilience-action-plan-2020.pdf

Our resilience approach for 2025-30 can be found at WSX37 – Resilience, risk management and decision frameworks

Business continuity, interdependencies and cascading failures

During 2015-20 we reviewed and updated business continuity arrangements, including strengthening our working relationships with local resilience forums. We developed an Emergency Tactical Planning Group with leads from across the business, to respond to a range of emergency issues. This enables a more integrated view which increases our ability to address concurrent risks and cascading failures. We also implemented staff risk assessments across the organisation for working in adverse weather.

This came into play during the 'Beast from the East' cold wave event in 2018, although much of the response was logistical. We allocated additional resources to manage the expected increase in workload; we carried out proactive communication with customers through social media on preparations that can be made in the home for freezing weather; and we also used our integrated supply grid to move water to locations suffering most from pipe bursts. The net effect was that none of our customers were without water for more than 3 hours during the event.

Future work will be centred on regular review of business continuity arrangements developed by the various business areas, as well as developing the partnership arrangements with other organisations as set out below.

Interdependencies

It would not make sense for us to attempt to adapt to climate change in isolation. UK infrastructure - energy, transport, information and communications technology (ICT), water and wastewater - is highly interconnected and interdependent. We are reliant on services provided by others, in particular electricity and telecommunications, and some issues involve shared responsibility with others who are affected by extreme weather or a changing climate. Failures of one type due to extreme weather will have rapid knock-on effects for the others.

Overall, the multi-agency nature of climate risk is very evident to us. Examples include:

- surface water management, involving liaison with councils, Internal Drainage Boards and the Highways Agency and emergency response.
- the water sector's protocol for sharing resources and its mutual aid scheme through which companies co-operate during emergencies.
- customers, who have important roles to play in terms of using water wisely (especially during prolonged dry weather) and not causing blockages by flushing wet wipes or pouring way cooking oil and fat – and the media in helping us to raise awareness of these points.
- community groups and individuals that are able to keep an eye on their local water environment and inform us of problems with water supplies or sewerage.
- work with land users, especially for protecting drinking water sources that are vulnerable to a combination of farm inputs (e.g. nitrates and pesticides) and heavy rain.
- dialogue with government and our regulators in relation to both our day-to-day activities and longer-term planning.
- our own use of other utilities, in particular electricity and telecommunications. Their reliability is very important to us and interdependencies between utilities have been very evident during past extreme weather events. Information on power outages comes directly into our control room to ensure a managed response from the centre.

The 2021 independent assessment of climate change risk outlined its view of key risks for other infrastructure sectors, including the following key messages shown in the table on the following page. Due to these interdependencies, we have contingency measures in place, such as our numerous standby power generators which can be deployed at short notice. This includes both permanent generators as key locations and smaller generators which can be moved from one location to another.

We have been doing more in recent years to ensure that we can cope with acute events, especially where there is a risk of cascading failures across a number of utilities or aspects of critical infrastructure. We continue to review and update business continuity arrangements and work in partnership with other agencies.

2021 independent assessment of climate change risk: key risks for other infrastructure sectors

Energy	***Telecoms and ICT***	***Transport***
• All energy-related infrastructure is at risk from the impacts of climate change, especially due to the changing frequency and intensity of surface water and coastal flooding. • High and low temperatures, snow and ice, high winds and lightning can all cause disruption to the energy network. The future risks from wind and lightning are more uncertain than for other hazards. • There are also risks to buried infrastructure such as gas pipelines, with damage potentially becoming more frequent in future due to flooding (affecting bridges that carry pipelines) and subsidence. • The potential for reduced water availability in future could reduce output of thermal power generators and potentially biomass and gas power output.	• There is increasing available evidence of the impacts of weather-related events on ICT and telecoms, including damage to assets, power failures, and poorer performance due to heavy rainfall or temperature extremes and fluctuations. • The risk of telecoms and ICT infrastructure being directly affected by flooding is lower than the risk to other infrastructure types such as energy assets, but disruption caused by flooding of the latter could indirectly cause telecoms and ICT outages. High temperatures are of greater concern.	• Transport regularly faces climate challenges from flooding, heat, erosion, subsidence and extreme weather. As the climate continues to change, the severity of these risks is projected to increase. • The interconnected nature of infrastructure systems means that impacts on transport networks can quickly disrupt other areas, for example by preventing the operation or repair of other critical infrastructure assets. • Impacts on other infrastructure sectors can cascade into transport failures.

Under the Civil Contingencies Act we are designated as category 2 responders, although we work closely with category 1 responder agencies via three local resilience forums (LRF). These provide a structure for agencies to work together on planning and in tactical and strategic response to incidents, using facilities such as dedicated teleconferencing to share information and warnings and agree external messaging. Our work on interdependencies is developing further under the review of the critical national infrastructure that we rely on, linked to the Security and Emergency Measures Direction. This has been informed by our experience of COVID-19 and concurrent disruptive events.

Close co-operation is well established for emergency response practices; it is important that there are good working relationships with local authorities, emergency services and business partners such as suppliers and contractors, who may themselves be affected by intense weather events. We are an active member of the three Local Resilience Forum groups operating in our region (Avon & Somerset; Wiltshire & Swindon; and Bournemouth, Dorset & Poole), with representation at executive and business management group level. Wessex Water sits on the LRFs' adverse weather groups, which cover plans for responding to events such as flooding and heatwaves. The water sector itself has a protocol for sharing resources and a mutual aid scheme through which companies co-operate during emergencies.

Customers' needs and expectations are a critical concern, and we routinely keep track of how these are evolving. We will be expected to provide excellent service regardless of weather conditions and also to make allowance for climate change in our planning. We need to effectively communicate our approach to dealing with climate stresses and shocks and need the goodwill of our customers and the help of the media to have the greatest chance of successful adaptation. We continue to build links with land users, particularly through our catchment management work. This is needed especially for protecting drinking water sources that are vulnerable to a combination of farm inputs (e.g. nitrates and pesticides) and heavy rain. Communication to understand each

others' activities and needs is important for maintaining the resilience of individual water sources and maintaining security of supply. Co-operative working relationships with government and our regulators are also essential for our day-to-day activities and longer-term planning alike. This is equally true for climate change – we need to explain our understanding of likely impacts in our region and produce well-reasoned cases for investment where we believe it is necessary.

Appendix 5: Water, wastewater and other functions: responding to climate change risks (additional information).

Water supply quantity

Our overall diagnosis

The investments we have previously made in our strategic network infrastructure have created a resilient water supply system. Households and businesses in the Wessex Water region have enjoyed supplies without restriction for more than 40 years. Despite periods of dry weather in the recent historical record, notably in 1991, 1995, 2003, 2012, and the dry hot summer of 2018, we have not had to impose restrictions on customer water use, apply for drought permits or drought orders for 48 years, since 1976.

Water resource management planning

Our 2024 Water Resources Management Plan (WRMP) indicates a number of pressures to the amount of water available to meet demand over the next 40 years, including climate change, population growth, and the need to give more water back to the environment, for example, to protect chalk streams.

Regarding climate change pressures, detailed climate risk assessments are carried out for our WRMP, for which climate change scenarios are an integral part. Firstly, climate change is factored into forecasts of available water supplies, where we consider the impact of changing rainfall, evaporation and temperature patterns and the impact that these may have on river flows, reservoirs, groundwater recharge and ultimately on deployable output. Secondly, it is considered in relation to impacts on water demand.

Our 2024 WRMP assessment shows that while available supplies are forecast to decline gradually over 2025-50, this is primarily as a result of increased demand relating to population and property growth and consumption change. Also, the main driver of deficit in our supply demand balance is as a result of significant licence change reductions required to protect the environment. Compared with these pressures, climate change impacts are minor, accounting for at most 1% of the supply-demand balance deficit that we forecast from 2035, and mostly attributed to impacts on surface reservoir storage. To reach this conclusion we considered the impact of climate change on the amount of water available for supplies (deployable output), based on the difference between the following scenarios:

- Low – median of the probabilistic RCP 2.6 distribution (equivalent of the LTDS benign scenario)
- Central – median of the probabilistic RCP 8.5 distribution (equivalent to the LTDS adverse scenario)
- High – mean of the median RCM RCP 8.5 distribution and GCM RCP 8.5 distribution.

Modelling suggests climate change will have a relatively small negative impact on deployable output, mostly attributed to impacts on surface reservoir storage. However, longer, drier summers could result in significantly higher peaks in demand even if annual average per capita consumption is reduced through smart metering and water efficiency.

Distribution networks may be affected by wetter winters and drier summers, which may affect ground conditions and increase the risk of damage to underground structures. They may also be affected by extreme storm events that cause flood damage to above ground assets.

We will continue to work with our customers and local communities so that together, we can reduce the water we take from the environment, improve the resilience of our services and support areas of the west country where water scarcity is a growing problem. We'll also continue to work with partners at a catchment level to help safeguard the resilience of the ecosystems that provide us with our raw water supplies.

Our 2024 WRMP sets out how we will meet demand and protect the environment through to 2080, consistent with the West Country Water Resources Group (WCWRG) regional plan. It provides a detailed description of the resource assessment and optioneering processes used to characterise plausible future scenarios, forecast their impact, and determine the optimum operational response required to ensure we

deliver a best value plan while achieving the goals defined in our Strategic Direction Statement and satisfying statutory obligations.
We are building water resource resilience to climate change and population growth through a combination of demand side and supply side initiatives.

Integrated grid
We completed the development of a more integrated water supply grid in 2017/18, which allows us to deal with a number of water volume issues simultaneously:

- It has improved the security of supply to customers, allowing us to meet our customers' demand for water and providing full connectivity of demand and resources throughout our water supply area. Specifically, it means that the number of customers reliant on a single source has been reduced.
- It complements existing bulk supply agreements with neighbouring water companies.
- It allows us to accommodate abstraction licence reductions required by the Environment Agency to improve flows in some rivers and protect their ecology. The reductions required total 33.5 megalitres / day in daily abstraction licence limits across eight sources. It also helps us to substitute for smaller sources that have been abandoned due to cryptosporidium risk.
- It enables surplus water to be used in the event of outages, such as those caused by the Beast from the East,

While the main drivers for this scheme were *not* directly related to climate change, it improves our resilience against the main climate change pressure categories outlined above. As a result, our supply network is better able to cope with extreme weather events.

Reducing leakage
Reducing leakage is an important part of our efforts to maintain a healthy surplus of available water supplies compared to demand, including during hot and dry weather conditions. We have halved leakage since 1994-95, and consistently met our leakage target up to 2022-23 despite severe weather, maintaining one of the largest reductions amongst our peers. We aim to reduce leakage by 10% (from our 2024-25 forecast) by 2030 and halve leakage by 2050 from a 2017-18 starting point. Our reactive work centres on finding and fixing more leaks more promptly using a suite of techniques. Alongside, we are developing predictive capabilities; using increasingly sophisticated analytical technology, fed by the growing number of data points in our network (including smart meters), we will increasingly seek to forecast and prepare ahead for leaks.

There are a number of factors that influence mains repairs and replacement, such as the age and material of pipes. Extreme weather impacts can play a part in the number of bursts which can be caused by severe cold weather, with the freeze thaw cycle causing ground movement. Through both improved prioritisation and an increase in the rate of replacement we plan to keep this large asset group in a stable condition and maintain and improve our current performance.

We will continue to replace older mains which, in the long term, will reduce the number of bursts and therefore the likelihood of supply interruption events. Prioritisation of water mains bursts will take into account the various potential drivers such as interruptions, leakage, mains bursts and water quality. We are adopting new and innovative technologies to enhance the operation of our network to deliver excellent service to our customers and our long-term plan is to have zero interruptions of more than three hours.

Managing demand
We will continue to help customers manage household demand by promoting metering and water efficiency through behavioural engagement. We have an ambitious strategy to reduce water wastage and unnecessary water usage. This will set us on the path to achieving government expectations to halve leakage and reduce personal consumption to 110 litres per person per day by 2050, and the new Environment Act target to achieve a 20% reduction in distribution input per capita by 2037-38. Reducing demand is the lowest cost and potentially the quickest-to-deliver option to ensure security of supply, given water resource development schemes have a minimum ten-year lead time.

Behavioural measures such as encouraging greater water efficiency will be important for coping with extreme weather events. Our water efficiency strategy actively seeks to help customers use water wisely and avoid waste through a range of education, information and device measures, while showing the links between weather, climate, water resource availability and the environment.

The centrepiece of our plan to support demand reduction is an £86m roll out of smart meters to 40% of our household and non-household properties by 2030, and 95% by 2035. The priority areas for smart metering will be in our most water stressed region – the Hampshire Avon and areas connected to it via our water grid.

We also plan to double the number of water efficiency visits we currently conduct, and extend them to non-household customers, focusing on domestic type usage (for instance, fixing leaky loos and supplying water efficient devices for taps and showers). We restarted our non-household programme in 2022, beginning with schools, and will scale this up in 2025-30, cognisant that around 30% of the water we put into supply is consumed in the commercial sector. We plan to visit 84,000 properties by 2030. We already target the highest users with these visits but will be able to do so more quickly and accurately with smart meter data.

Supply-side schemes
Our water supply grid is already enabling us to transfer water to where it is needed most and to reduce the need for river abstraction in sensitive areas. In AMP8, we will design and develop new in-area transfers to increase our options, including to move water around to offset abstraction licence reductions. Investigations under our Water Industry National Environment Programme (WINEP) will provide more granular information on the volume of licence changes needed by 2035. We'll work with our neighbouring water companies to investigate supply side options to meet remaining deficits. The flagship projects we are collaborating on are:

- Poole to River Stour transfer – we will transfer highly treated effluent from our Poole Water Recycling Centre via a pipeline and a wetland to the River Stour, for subsequent abstraction by Bournemouth Water.
- Mendip Quarry reservoir – we have identified several quarries in the Mendip Hills that could be repurposed as a reservoir once they are decommissioned. The reservoir would be fed by a combination of groundwater and surface water from an enhanced River Avon abstraction licence. We are one of several companies that could potentially benefit from a subsequent transfer.
- Cheddar Two reservoir – the construction of a second reservoir at Cheddar, which Bristol Water would fill from the Cheddar Springs and the River Axe and treat before transferring it to a service reservoir in the east of our region.

Water Resources Management Plan
Drought Plan | Wessex Water

Water supply - quality

Deterioration in raw water quality as a result of climate change and more extreme weather events, and catchment pollution from agro-chemicals (pesticides and nutrients) and turbidity represent a historic and changing threat to drinking water quality compliance in the Wessex Water region.

Water Safety Plans
Following their introduction in 2006, water safety plans are firmly embedded as a central tool for managing water supply risk. Our water safety plans comprise a detailed site-by-site risk assessment. For each supply system these cover the four stages from source to tap (catchment, treatment, distribution and customer);; risk scoring of hazards and mitigation actions for each hazardous event. As a legal requirement we have a plan for every source and their routes to customers' taps. The resulting water safety plans are not static documents, as knowledge is constantly evolving about hazards and risks. Thus, we will continue to develop and maintain our water safety plans.

Catchment management
We have an active programme of catchment management - by working with land users, we can tackle problems at source to limit deterioration of raw water rather than removing contamination through additional treatment. This approach is considered to be viable where there are clear risks to drinking water quality and reasonable certainty of the timescales involved to address the problem. At the end of AMP7 the rate of increase

in nitrate levels has been slowed at a number of sources to the extent that nitrate is no longer seen as a water quality risk at these sources. However, the high nitrate levels seen as a result of the extremely wet conditions in 2012 and winter 2013-14, and more recently in 2023/2024 with exceptionally high groundwater levels, have shown that catchment management does not eliminate risk altogether, nor the need for comprehensive treatment processes. The difficulties associated with the catchment approach are highlighted by ten sites whose nitrate levels continue to rise despite five to ten years of catchment work. At these sites we are proposing enhanced catchment approaches in 2025-30 in an effort to stabilise these trends before treatment is required.

The metaldehyde risk was greatly reduced through catchment intervention prior to the outright ban in March 2022. Metaldehyde no longer constitutes a significant risk to supply resilience. However, there are other persistent pesticides such as bentazone that continue to threaten drinking water quality. Ongoing work with farmers in our catchments (including pesticide amnesties) is helping to reduce the risk. Catchment actions will be continued in AMP8 are likely able to help the resilience of our sources in the face of more extreme rainfall events and can limit further deterioration in raw water quality. Nonetheless, we have extended this approach to rivers and estuaries as well as drinking water sources, leading multi-agency collaborations in the Bristol Avon and Frome & Piddle / Poole Harbour catchments.

During 2020 - 25, we used catchment management methods to protect water sources at nineteen sites in relation to nitrates and three sites in relation to pesticides; In addition, the catchment approach was used to offset nitrate in the Poole Harbour catchment and phosphorus in the Stour, Tone and Parrett catchments. This work has been extended through our pioneering work on market-based methods for environmental delivery.

Monitoring sources
Our extensive sampling allows continuous monitoring of the quality of water supplied from our sources. This means that sources can be taken offline if needed in the event of a failed sample or a material threat to quality. In future years we can expect to see monitoring technologies improve, allowing more rapid analysis of water quality, as well as real time monitoring of water volumes in the distribution network. We also have a dedicated team for identifying and prioritising appropriate interventions to reduce customer contacts related to water quality.

Integrated grid
In addition to the water quantity benefits offered by our new integrated water supply grid, it enables alternative water supplies to be delivered to areas that are currently supplied by sources at risk of breaching the nitrate limit in drinking water. Together with catchment management, this delays the need for construction of additional resource development, although this will be kept under review in the light of potential future reductions to the amount of what that we are permitted to abstract at certain sites.

Reservoir desilting
We intend to maintain a stable risk profile for our dams and impounding reservoirs, principally to ensure on-going compliance with the Reservoirs Act 1975. Sedimentation in reservoirs can eventually affect raw water quality, as can dredging or desilting work that can mobilise sediment into the water column. The main activity at present is routine scouring, which involves opening a pipe at the base of a reservoir dam, resulting in the release of fast flowing water and sediment with it. We will also assess the sediment trapping ability of the inflow wetland area constructed at Durleigh Reservoir.

Enhanced treatment
Our preferred course of action for tackling sub-standard raw water is not additional treatment. Instead, we aim to manage the issue at source if possible, for example through catchment management, which can have a significantly lower whole-life cost than additional treatment. Also, there is the option to switch sources or blend-in suitable water from nearby in the event of shorter-lived problems such as elevated nitrates caused by wet weather.

During 2015-20 we carried out a major rebuild of our Durleigh water treatment centre to deal with deteriorating water quality, where various upstream issues were causing problems for a range of quality parameters

in the reservoir. In 2025-30 we will invest in upgrading 10 of our water treatment centres. This is driven by the twin goals of increasing resilience and safeguarding water quality. We will address single points of failure to increase our flexibility in maintaining supply, particularly at treatment centres that supply major populations.

Sewerage and surface water management

Climate-related pressures – past and future

Links between climate change and our wastewater services has been clearly recognised for several years. A 2011 study by Mott MacDonald for Ofwat concluded that climate change is likely to increase flooding volumes by 27% up to 2040 and our mid-climate change scenario suggests a 20% uplift in rainfall intensity. Overall, UK climate projections point to weather events that were viewed historically as 'extreme' occurring more frequently.

The last 15 years have demonstrated the effects of extreme rainfall within the context of a changing climate. For example, 2012 saw prolonged downpours caused by convective rainfall, and the high groundwater levels led to 50,000 properties in Dorset and Wiltshire being at risk of groundwater flooding. The Centre for Ecology & Hydrology stating that there was no close modern precedent for the extraordinary switch in river flows during spring 2012. The saturated ground meant permeable areas responded as if they were impermeable and the consequential number of flooding incidents from the sewer network reached an all-time high. We saw exceptionally high groundwater levels and extensive fluvial, pluvial, groundwater and sewer flooding, plus restricted toilet use in some cases for several months. There was a sharp increase in recorded sewer flooding incidents and the number of properties at risk of flooding.

Sewer flooding attributable to insufficient sewerage capacity occurs during wet weather. Flash floods can occur during intense rainfall or during times of prolonged rainfall due to high groundwater table entering the sewers. While prolonged flooding tends to occur during winter months, intense rainfall can occur anywhere, e.g. the village of Chard experienced a 1 in 24-year event in May 2021, a 1 in 34-year event in June 2021 and another significant event in October 2021. These events are a reminder of how variable and extreme weather patterns can be, and as noted earlier can lead to a big increase in flooding incidents and restricted service for some customers.

The water industry has been investigating the effects of climate change for over a decade, over which time weather patterns appear to have shifted. Recently, the ConVex project (http://research.ncl.ac.uk/convex/) focused on improving prediction of convectional rainfall patterns. The UKWIR project *Planning for the mean or planning for the extreme* used the UKCP09 and ConVex data to consider how climate change will affect rainfall intensities and hence flood risk. Predictions show that with an uplift in rainfall of 30% by 2030 in our region, annual flooding volumes would potentially double. As such, today's extremes could become the futures mean.

Looking ahead, our long term delivery strategy uses two climate change scenarios, based on RCP 2.6 and RCP 8.5. With the more benign scenario we would expect expenditure on storm overflows and hydraulic flooding to fall due to lower levels of rainfall than anticipated. We also forecast that less sludge storage would be needed to 2035, as lower rainfall would likely see less restrictions on sludge spreading and therefore lower levels of storage needed. Under the adverse scenario, with the global temperature increasing towards 4 deg.C, we will see increased rainfall intensities. We predict storm overflows would increase by 7.6% by 2050. Consequently, as the adaptive plan is triggered, we would see higher expenditure on a number of areas due to increased rainfall; notably on storm overflows, hydraulic flooding and infiltration reduction, water recycling centre resilience to cover rising sea levels and other flooding, odour control costs, nitrogen and phosphorus schemes and bioresources due to a need for more sludge storage.

Maintaining resilience – planning

We have a duty "to provide, improve and extend a system of public sewers to ensure that our area is and continues to be effectually drained" (Section 94 Water Industry Act 1991). The sewerage network is required to cope with high volumes associated with prolonged or intense rainfall. Our sewers have generally been designed to provide a 1 in 20-year level

of protection against flooding. With a risk-based approach we aim to enhance protection where the impact of any flooding is the greatest.

Our long-term core sewerage plan is designed to achieve the following:

- Storm overflows discharge reduction plan (SODRP) compliance
- Continuous monitoring of water quality from AMP8 (subject to confirmed final guidance from Defra)
- Halving the number of sewer flooding incidents by 2050
- Zero pollution incidents by 2050
- Deploying nature-based solutions or sustainable solutions where they represent best value.

We aim to maintain a stable level of total flooding risk, including external area flooding. Measuring total flooding risk – including external as well as internal flooding risk – is feasible now that we have been collecting external flooding risk data for nearly 15 years. We will continue to focus investment primarily on locations of highest risk and also consequence because flooding inside people's homes and businesses is a high priority from our customer research.

There are significant uncertainties in long term planning for sewerage assets and operations in the next 25 years, which we have accommodated into our planning via the use of adaptive pathways developed in accordance with Ofwat guidance. The impact of climate change on storm frequency and severity is one of the key areas of uncertainty. Nevertheless, with climate change increasing flows and loads through our network and at our water recycling centres (alongside urban creep and new development), we must invest to provide stable levels of service to our customers and the environment.

Drainage and Wastewater Management Plans

In 2022 we published our first Drainage and Wastewater Management Plan (DWMP). As an equivalent to Water Resources Management Plans, the DWMP demonstrates our long-term plans for sewerage investment, including three main levels:

- level 1: at the water company regional area
- level 2: strategic planning areas based on river basin catchments (four areas in Wessex Water), which are relevant for catchment partnerships
- level 3: drainage strategies for water recycling centre (WRC) catchments.

Our first DWMP looks at existing risks as well as assessing the potential impact of climate change, growth and urban creep. It uses a risk-based assessment of the hydraulic capacity of sewer networks and WRCs. For WRCs and significant pumping stations, sites at high risk of flooding are identified and high-level measures to reduce flood risk have been proposed in our business plan for 2025-30.

Assessment of hydraulic capacity risks are carried out where significant impacts of growth, urban creep and climate change are predicted and solutions to reduce flood risk are expected to be complicated. Options for flood risk and storm overflow improvements have been developed for all significant 'escape of sewage' risks. Adaptive pathways have been considered for 'complex' catchments. Over time, the pace and intensity of climate changes may become more or less clear, extreme weather events might highlight vulnerabilities of which we were previously not aware, and alternative adaptation methods might become available. For these reasons, our adaptation measures will themselves need to be flexible and able to change.

We have models for more than 90% of our foul and combined sewerage system, and plan to complete modelling of our sewer network, and surface water drainage. Our DWMP website hosts a long-term sewerage capacity graphical information portal to allow customers and stakeholders to see our long-term Drainage Strategies.

Maintaining resilience – investment and other responses

Implementation of DWMPs will come through:

- traditional solutions, e.g. storage
- more sustainable approaches involving physical assets e.g. separating rainwater and foul sewerage
- working with stakeholders to develop partnership schemes to deliver integrated flood risk management.

In the past we have invested proactively in sewerage capacity where cost-beneficial. Overall, we have maintained a stable level of total flooding

risk, including external area flooding and addressed smaller non-specific investment needs as they materialised during the period.

During 2020 – 2025 we continue to invest proactively in sewerage capacity. In 2021 as part of our DWMP, we used 200 hydraulic computer models and carried out circa. 420,000 model runs assessing the impact of growth, urban creep and climate change on the risks of flooding and pollution. We completed circa. 400 pumping station and overflow surveys and 3,000 manhole surveys and have been progressing 170 storm overflow investigations.

Major investment has already been made to reduce the risk of flooding of properties from sewage and to reduce the impact of overflows from combined sewers into watercourses. Investment can either occur before flows increase (but with a risk that the investment is premature or even unnecessary), or after - which risks customers suffering sewer flooding. We aim to invest appropriately to ensure our service levels remain one of the highest in the industry whilst delivering required capacity as efficiently as possible.

We will continue to work with local lead flood authorities and other stakeholders to identify joint schemes that provide value for money, sustainable solutions to reduce flooding.

Dealing with groundwater infiltration

Infiltration of groundwater into private drains and public sewers can be a significant problem in our area due to geology and the prevalence of high water tables following wet weather. This can lead to restricted toilet use, premature spilling of storm overflows to the environment and hydraulically overloaded water recycling centres. As well as the very wet winters of 2012/13 and 2013/14, the winters of 2019/20 and 2020/22 were also problematic for infiltration inundation, and we had to tanker the contents of sewers to other catchments at locations and over-pump to watercourses at a few locations in order to protect properties from flooding internally.

While infiltration was historically tackled using gel injection at joints, our preferred approach is now epoxy resin lining which, although more expensive, is more successful in the long run. Alongside, infiltration reduction plans are developed with the aim of reducing discharges to the environment. We work with the Environment Agency to agree where such plans need to be delivered and help lead local flood authorities to use their powers to enforce private drain maintenance where we can demonstrate that infiltration into these pipes and manholes is affecting downstream capacity. We learned from the floods of 2014 and prepared local emergency plans for over 50 catchments, so we are better prepared for extreme wet winter conditions. We also work at a national level to raise the profile of groundwater inundation and promote best practice.

Sewer maintenance

Sewers are designed to accommodate flows during wet and dry conditions; however, overflows leading to pollution incidents can occur, usually due to blockages rather than the sewerage itself being too small. We use various measures including inspections, relining, jetting, root cutting, and raising public awareness about what can cause blockages in sewers as the large majority of blockages are caused by sewer misuse. We collect data when sewer blockages occur to identify ‘hot spots’ where targeted customer engagement could be beneficial.

Surface water management

Constructing larger combined sewers is not necessarily the best long-term solution for increasing sewerage capacity. In the longer term, we believe separating rainwater from foul water at source will be essential to stop combined sewers being overwhelmed. We start with two principles: that rainwater should be treated as a valuable resource and used as near to where it falls as possible; and that it should be returned to the environment as close as possible to where it landed.

Therefore, our approach to providing adequate sewerage capacity is not limited to traditional “larger sewer construction”, but includes a suite of delivery options including Sustainable Urban Drainage Systems (SUDS), surface water separation schemes, and real-time control of the network. We will continue to look for sustainable solutions using an integrated urban drainage management (IUDM) approach as well as promoting sustainable urban drainage systems and using active system control to ensure adequate capacity is provided. The first two approaches will

require partnership working with other risk management authorities. IUDM can also improve water quality and so we will continue applying IUDM techniques in Weston-super-Mare, Highbridge and Bridgwater.

In 2016 we constructed a separation scheme which removes flow from a watercourse that was entering our combined sewer. A new surface water pumping station was built to lift flow into a new above ground storage area. We worked closely with the local council to oversize a pond that they were constructing so we had somewhere to pump the water into. There has also been industry activity to promote sustainable solutions, such as Water UK's Surface Water Separation Project and SusDrain, run by CIRIA.

We work closely with the 10 Lead Local Flood Authorities (LLFAs) in our area; co-operation and joint working are important for delivering our strategy to address flooding incidents and flood risk. We share asset data and hydraulic models with LLFAs and their consultants to assist in the development of their Surface Water Management Plans.

Improvements at individual storm overflows

Storm Overflows (SOs) act as relief valves for the sewerage network during times of heavy rain to prevent property flooding. They are designed to pass forward polluting loads so that when they do discharge, they do not significantly impact the environment. However, occasionally they operate incorrectly – most often due to downstream blockages - leading to pollution incidents. We have been installing spill monitors at SOs to better understand the frequency of their operation and are improving 13 frequent spilling overflows by 2025 plus 3 coastal sites where there is a link between SOs and coastal water quality. In 2025-30, we will increase our current level of investment in reducing storm spills to waterways to over £6m a month, £400m over the five-year period. This will reduce spill frequency by over 80% at the 128 overflows at which we will implement a scheme. We will prioritise nature-based solutions wherever possible. For around a third, we will use low carbon, nature-rich wetland treatments. For most of the rest, we will need to use storage and treatment solutions to meet the required standards in the specified time.

Smart sewers and data

Enhanced wastewater network monitoring will be key to our resilience. We have already seen huge benefit from the rollout of Storm Harvester sensor technology to 1,300 monitors installed throughout our sewer network, and the application of intelligent analytics to enhance asset monitoring and anomaly detection. This has helped us identify problems early and we have seen a significant reduction in pollutions caused by blockages around storm overflow monitoring assets. By 2030, we will install 12,000 more devices in a large-scale deployment of network monitoring including in tanks, syphons, flow control chambers and pollution hot-spots. This will give better coverage to detect issues, as well as enable us to implement more condition-based maintenance across the sewerage network. We are also considering using Storm Harvester to monitor water recycling centre storm tank compliance and to provide pump analysis of sewerage pumping stations. Increasingly, we also plan to create smart systems which link up our treatment and network intelligence, enabling all of our assets to work more effectively together. We will begin with a trial catchment, harnessing and combining Storm Harvester and CCTV information with external sources such as weather data and AI. Potentially then we could manage flows throughout the network – for instance, draining down a catchment to increase capacity ahead of a storm. Ultimately, we intend to replicate the centralised 'control room' approach we use on the clean water side of our business to the wastewater side, layered with predictive and analytical tools.

Behavioural engagement

We are building the reach of our campaigns against the misuse of sewers that cause blockages by encouraging the correct disposal of wet wipes and fats, oils and grease. Customer and community engagement, such as sewer misuse campaigns for the public in blockage hotspots has become part of our Pollution Incident Reduction Plan, alongside asset renewal and maintenance activities.

Our water citizenship project in Chippenham in 2018 involved engagement with people and communities on the local water environment and multiple issues linked to the sustainability of the water system. In Chippenham we have also recruited 200 Rain Saver households and enhanced our water efficiency home check and fix service to also include

the installation of a water butt and, where possible, a means of keeping the rainwater collected out of the sewerage system altogether – for instance, a rain garden or permeable soaker hose which distributes the water collected around the garden.

Drainage and Wastewater Management Plan | Wessex Water
Storm Overflows Improvement Plan | Wessex Water
Infiltration Reduction Plans | Wessex Water
Pollution Incident Reduction Plan | Wessex Water

Water recycling and sludge

Sewage treatment - improvements to meet tighter standards
The quality of rivers and streams can be placed under greater stress during very warm or dry weather conditions. With lower flows there is less dilution of effluent, and warmer water holds less dissolved oxygen and is more prone to algal blooms. A warmer climate could see these conditions happening more often, which in turn could mean pressure for tighter end-of-pipe standards at water recycling centres. We have already seen a significant increase in extreme weather events – in particular, hotter summers and storms. This has increased the number of alarms that we need to respond to, to ensure the effective operation of our sites.

Under an adverse climate scenario, our long term delivery strategy envisages increased spend on odour and resilience with hotter weather. Drier summers will risk much reduced river flow prompting a tightening of discharge permits, possibly on a seasonal basis, and increased spend on chemical treatment to reduce phosphorus and nitrogen I effluent. Longer drier summers but with more extreme stormy rainfall could cause reduction in overall flows to be treated as more overflows would be in operation, however this would generally be mitigated through storm overflow improvements (e.g. attenuation or storage). Drier summers may lead to the requirement for more internal recirculation of flows within WRCs to maintain sufficient wetting rates of biological processes.

Our current extensive programme of work across all the catchments in our region includes new / additional nutrient or ammonia removal, trials of novel treatment technologies, catchment-based consenting and environmental investigations. This is driven by the general condition of watercourses and legislation such as the Water Framework Directive. To date, warmer weather or climate change have not explicitly been cited as contributory reasons for our investment, but it is a factor that could have an influence in the medium to long term – especially as an additional burden for rivers with struggling ecosystems.

During 2015-20 our work included the development of catchment permitting for phosphorus reductions as a method of more flexible management of water recycling, as well as improvements to river and bathing water quality more widely, including through transferring flows from smaller water recycling centres for treatment at larger sites. We achieved a fall in the number of odour complaints related to our wastewater assets.

We are currently providing additional capacity across water recycling centres that are overloaded, or aligning with enhancement schemes where flow and permit limits are being tightened. We are delivering enhancements at water recycling centres including removal of a further c.300 tonnes of phosphorus per year by 2025 - through sewage treatment improvements and catchment interventions.

During 2025-30, a significant portion of our spending, £900m, will be used to reduce nutrient levels – chiefly phosphorus but also nitrogen – in our treated wastewater discharges. We will have to use traditional treatment solutions for the most part, because these provide the certainty of outcome demanded by legislation. Wherever possible, we will incorporate catchment and nature-based solutions such as reed beds. We have worked with Defra, the Environment Agency, and Natural England to pioneer innovative permitting that would allow nutrients to be balanced at catchment scale. This reduces costs and increases flexibility. In all, our investment will prevent 1,400 tonnes of phosphorus and nitrogen from entering rivers and seas by 2030.

Akin to the smart sewers work noted above, we are using digital approaches to inform stakeholders about the operation of our assets and to provide useful data in near real time. We will be publishing contextualised maps of our storm overflow monitoring data and layering in water quality data from hourly monitoring of dissolved oxygen, pH,

turbidity, ammonia and temperature upstream and downstream of our wastewater assets when that becomes available. We expect to install nearly 500 water quality monitors at our high priority sites by 2030, with the remaining 1,400 to be in place by 2035.

Bioresources

As we have limited capacity for storing treated sludge cake (biosolids), it is normally transferred directly from our bioresource centres (BCs) to on-farm storage areas. In exceptionally wet weather, soils in many parts of our region can become saturated, which limits the capacity of on-farm storage for sludge cake.

Wetter winters will limit opportunities for biosolids recycling to the landbank, due to waterlogging and flooding of disposal sites increasing the need for temporary storage. Increasing storm intensity will affect landbank accessibility by increasing the risk and frequency of run-off and contaminant export to watercourses. Increasing flood risk for low-lying agricultural land may also remove some disposal sites from the landbank.

Having assessed the need and costs for providing additional biosolids storage we have built two barns for winter storage of sludge cake to mitigate against slumping of stockpiles during wet weather.

Tighter environmental regulations, the growth in biosolids volumes, and more extreme weather patterns caused by climate change suggest that by 2035, there may be insufficient land available to receive all of our output. There is heightened public interest in and concern about micro pollutants such as microplastics in biosolids. These enter the sewer system through a variety of routes, including from road run off and when we wash our clothes. Current wastewater treatment processes were not designed to remove micro plastics or ‘forever’ chemicals such as PFAS. Potentially this concern could mount to the point that water companies are no longer allowed to spread sludge on land at all. Given the significant uncertainty in this area we will mitigate our risk by maintaining our current strategy until there is more clarity about the future national strategy. In the medium term this will include building seven additional biosolids storage barns to further improve the resilience of our biosolids recycling activity.

We are also investigating advanced thermal version technologies which have not been tested at scale in a UK wastewater setting yet; a successful trial will help to future proof our bioresources disposal routes and provide multiple benefits, including treating micro contaminants; safeguarding against high emissions incineration; and creating high value new products such as biochar, hydrogen or ammonia – some of which could help the sector achieve its net zero goals.

Odour control / mitigation and pests

Our Environmental Odour Policy is based on the Institute of Air Quality Management’s (IAQM) guidance document, EA H4 Odour Management guidance as well as DEFRA’s code of practice for odour control and management. By developing a system of detailed odour management plans we have been able to implement operational improvements and general good housekeeping which has resulted in a fall in the number of odour complaints related to our wastewater assets. We will continue to monitor the performance of our odour control plants and carry out maintenance and improvement works as and when required.

With a changing climate and potential increase in warmer, drier conditions, we anticipate an increase in fly nuisance as well as an increased presence of non-native invasive species. Our approach to fly management is based on guidance on nuisance from insects and flies from Defra and the Environment Agency. By developing a system of detailed fly management plans, we have been able to implement operational improvements and general good housekeeping, which keeps complaints as low as possible. It is clear that no best practice technique will completely remove all fly larvae and flies from trickling filter beds at water recycling centres, and that not every approach may be suitable for every site. Either way we will continue to monitor sensitive sites as levels of flies and species type may change as a result of climate change.

Flooding of operational sites and assets

Flood risk at water supply sites

Following the flooding in Gloucestershire in July 2007 which shut down a major water treatment centre for an extended period leaving thousands of customers without water, at the 2009 periodic review of prices we recognised the need to carry out flood risk assessments for our water treatment and recycling sewage centres and major pumping stations. Furthermore the Pitt Review published in June 2008 highlighted the need for enhanced resilience of critical assets to flooding. Ofwat's 2008 guidance, Service Risk Framework (SRF) for Flood Hazards, included a five-stage process summarised overleaf.

Our subsequent assessment using this methodology led to an initial long list of 24 sites that was narrowed down to two that we deemed to be at genuine risk of flooding. Our proposals for improvements at the two sites were approved by Ofwat for investment during 2010-15. As the previous assessments were very comprehensive and still applicable it was deemed that no further assessment work is required during 2020-2025.

Flood risk assessment and improvement for wastewater sites

During 2010-15 we replaced above-ground pump motors with dry well submersibles and raised electrical equipment above predicted possible flood levels at a sewage pumping station that serves a medium-sized town. Then, in the light of the exceptional wet weather of 2012 to 2014 we reviewed flood risks at our water recycling centres and records of five fluvial flooding events at one particular site, leading to work to identify and make more resilient critical electrical plant and equipment. This was also to align with our internal design standard which requires all new (critical) electrical plant and equipment to be above the 1 in 200-year flood plain level and/or with appropriate recovery/mitigation measures. More recently, as part of our DWMP Resilience Assessment, a multifaceted project assessing the resilience of our operational sewerage business was undertaken including;

- For fluvial and coastal flood risk - 125 water recycling centres & sewage pumping stations assessed with 50 site surveys and modelling completed.
- Coastal erosion risk - 64 sites and circa 2000 lengths of sewer network identified within 20m of mean high tide and risk assessed. Highest risk sites (~1%) surveyed and appraised.
- The current Shoreline Management Plan (SMP) policy has been reviewed to understand the risk of coastal processes on our assets. We will keep the status of these sites under regular review and respond to any developments or revisions to policies.
- Communications and power resilience - reviewing the provision and risk within our existing asset base.
- Business resilience documentation & processes assessments.

In 2022-23, in anticipation of high astronomical tides and the greater impact of climate change, the decision was taken to invest in enhancing the flood defences at a coastal water recycling centre. Several options were considered with the most effective being a local sea defence around the perimeter of the WRC only. Consequently, a sea wall was constructed around the WRC, at a height of 9.5mOD (16mCD), being the 1 in 200-year flood level (National Planning Policy Framework design flood), plus allowance for 30 years' climate change and 300mm freeboard.

Flood risk assessment and response: five stage process.

Risk screening	• Frequency and extent of flooding • Identify assets • Assets ‘at risk’: the analysis identified water treatment centres that lie within the flood plain or within 50m of it.
Risk analysis	• Flood characteristics • Vulnerability analysis • Modelling - site-specific flood risk assessments concluded that only two were considered to be vulnerable to significant flooding
Impact of flooding	• The sources of flooding and the impact on the site were assessed
Risk analysis	• The two sites at risk of flooding are critical sites and therefore extended asset failure would cause severe impact to service on the customers
Risk management	• Interventions and risk mitigation: for each site we developed a scope of works for flood protection and flood resilience • Cost benefit analysis: the analysis showed that the projects were cost beneficial

Wider environmental protection

Overview

In addition to our work to limit the amount of water we abstract and to manage and improve effluent discharges, we carry out a range of activities that contribute to the resilience of the environment of our region. Climate change impacts are not always a stated reason for this work; however, it is one of many pressures on the natural environment that underpins our efforts.

Biodiversity action plan

Our biodiversity action plan (BAP) was the first corporate initiative of its kind to be based on the UK biodiversity action plan (UK BAP). It draws on a long tradition of wildlife conservation work within Wessex Water but has continually adapted to meet the many challenges of conserving and enhancing biodiversity within our region. Our plan has six key themes to support our aim to double our contribution to biodiversity over the next 25 years:

- Supporting partnership through our partners programme, which provides funding for projects carried out by wildlife and catchment organisations across our region
- minimising the environmental impact of our activities, for example by assessing, avoiding, mitigating or offsetting impacts from the construction of new or expanded assets
- managing our own land to conserve and enhance biodiversity
- our catchment biodiversity work, which aims to find both wildlife and water quality solutions to problems in our catchments which are cost-effective and sustainable
    - Increasing our use of nature-based solutions, including 36 new wetlands to improve storm overflows
    - Increasing our tree planting.

We are actively involved with many of the local conservation groups and organisations across our region, including the Local Nature Partnerships, Environmental Records Centres, Catchment Partnerships and wildlife groups.

Changing temperature and water availability may affect the health and survival of species, their number, geographic range, and the condition of the areas they occupy. As a result, biodiversity management approaches may become more reactive, shifting from preserving past or present conditions to accommodating new species and ecosystems, and facilitating transition to a new ecosystem state. A warmer climate with hotter, drier summers may be challenging for some species (particularly in our rivers and streams) and could increase the risk of new pest incursion and wildfire. Warmer and wetter winters may result in lower pest mortality and, through various pathways, cause changes in the composition and structure of habitats.

The proposed package of options in our business plan for 2025-30 can help to mitigate scenario variables over the long-term. For example, amended conservation strategies together with the implementation of specific management options, will improve ecological resilience to climate change.

Biodiversity Action Plan | Wessex Water

Catchment partnerships
We work in partnership with organisations and individuals across our region to protect and restore the water environment as a part of the catchment-based approach. This is a way of working at a river catchment scale to improve the water environment for wildlife and people. By working together, the catchment partnerships aim to share local knowledge and expertise; identify the local challenges; and deliver cost effective solutions with multiple benefits. There are five catchment partnerships in the Wessex Water region; Bristol Avon, Hampshire Avon, Somerset and under Dorset, West Dorset, Poole Harbour and the Stour. We work with all the catchment partnerships in the region and co-host the Bristol Avon, and Poole Harbour/Stour with external partners.

Environmental investigations
We believe our investment should be based on sound science - by gathering data through our scientific investigations we can better understand how our business affects the environment before trialling solutions. Findings from our investigations are reported to the Environment Agency, Natural England and other stakeholders and then feed into subsequent business plan. Our planned programme over 2025-2030covers numerous diverse topics including monitoring and investigations into bathing water quality; assessment of the impacts of our abstractions; nutrient impacts on sensitive surface water and groundwater areas; the outcomes of creating or restoring functional wetlands; water quality impacts and options on designated sites; invasive non-native species; eel passes; peatland management; and implementing actions to support WFD status.

Catchment markets
We have taken a lead in the development of catchment markets as a way to demonstrate how high-integrity markets can reduce the costs of nature-based solutions and optimise the multiple environmental services they provide, including carbon sequestration. This will create an attractive economic opportunity for farmers and land managers to use land to plant trees, establish new wetlands and create more biodiverse field systems, building the resilience of our catchments.

These changes in land use create direct benefits for biodiversity, climate resilience and pollution control. They also avoid the carbon impacts of the grey infrastructure solutions that they replace. Modelling of solutions bought in our first catchment market around Poole Harbour, where nature-based projects have been used to avoid infrastructure upgrades and increased chemical usage at Dorchester wastewater treatment works, saving embodied carbon in the process. Larger scale catchment markets have since been developed in the Bristol Avon catchment and Somerset.

Greenhouse gas emissions
By 2030, we aim to achieve net zero operational carbon emissions (i.e. annual emissions linked to our energy use and transport, plus other greenhouse gases that are emitted from sewage and sludge treatment processes); and net zero total carbon emissions by 2040 at the latest. The latter includes our operational emissions, plus those linked to construction materials, and consumables such as treatment chemicals. We have a strong track record of carbon management work including:

- avoiding energy use and emissions generation across company activities, e.g., developing nature-based solutions, innovative infrastructure repair, and reducing the volumes we pump and treat through leakage prevention.
- using energy, where required, efficiently by monitoring and using smart controls on equipment.
- pioneering work to generate energy from sewage sludge and food waste as we switch our energy use toward renewable sources.

Background reductions in the UKs carbon footprint, such as the growth in renewable energy generation, will mean that our energy and transport emissions will fall by around one third from our current position. We therefore need to take concerted action between now and 2030. We will do this through a range of readily-available options including:

- emissions avoidance measures, such as reducing water use and leakage; increasing the use of lower carbon transport; and promoting nature-based solutions that avoid energy use.
- optimisation measures, such as energy efficiency work and systems for monitoring and controlling nitrous oxide from sewage treatment.
- renewable energy – increasing the amount of biogas that we generate from anaerobic digestion and pursuing opportunities for wind and solar power, either as generators or as the end-user.

However, reductions in background emissions and the most readily-available options will not be sufficient to achieve our goal of net zero carbon. We will need to pursue more innovative options involving emerging science and technology, such as turning sewage sludge into biochar, as well as promoting nature-based solutions. While these methods are not yet well-established, we are assessing their maturity and availability and will take part in trials where appropriate. We must also address embodied carbon emissions from construction and from the supply chains of goods and services that we use. We are developing a whole-life total carbon approach - which must be central to our decision-making processes - that will necessarily mean challenging assumptions about the best ways to carry out investment for customers, communities, and the water environment.

The physical impacts of climate change could have a number of upward pressures on our greenhouse gas emissions. For example:

- Fuels: we would potentially need to use standby generators more in response to extreme weather events
- Wastewater process emissions: potential increases with heatwave conditions, although the science is still developing in this area.
- Energy use and generation: heatwaves, dry conditions and prolonged wet weather all have an upward impact on pumping energy i.e. to meet peak water demand and convey storm water.
- Embodied carbon: with more frequent extreme weather events there could be more pressure to reinforce our infrastructure through additional investment in capacity (e.g. storm water attenuation). In the absence of major decarbonisation in the construction materials supply chain this could lead to significant addition embodied carbon emissions.

Relevant performance commitments

	2023-24 performance	2024-25 target
Water supply		
Compliance with abstraction licences	98%	
Water quality compliance (CRI) (score)	0.93	0
Water quality event risk index (ERI) (score)	23.678	12.800
Water supply interruptions (mm:ss per property per year)	05:35	05:00
Water per capita consumption (% reduction)	-0.8	-0.9
Volume of water saved by efficiency engagement (megalitres per day)	4.9	5
Water supply - unplanned outage (%)	1.53	2.34
Water mains repairs (no. per 1,000 km)	127.3	152.4
Risk of severe restrictions in a drought (%)	0	0
Restrictions on water use (hosepipe bans) (number)	0	0
Wastewater		
Internal sewer flooding (incidents per 10,000 sewer connections)	1.56	1.34
Risk of sewer flooding in a storm (%)	7.98	8.37
Customer property sewer flooding (external) (incidents per 10,000 connections)	18.52	15.68
Treatment works compliance (%)	99.0	100
Other		
Greenhouse gas emissions (KtCO2e)	105	101

Appendix 6. UK Water Industry Research climate change adaptation projects

2010-11

Water treatment and climate change
An assessment of the impact of climate change on catchment water quality and environmental conditions and the implications that may have for water quality, treatment and treatment processes, optimisation / rationalisation strategies, source protection (quantity and quality) with a view to developing a framework for “no / low regrets”, sustainable asset strategies in the context of developing carbon constraints.

Wastewater treatment and climate change
Transposing the potential effects of climate change into robustly defined impacts on wastewater treatment processes and services, and designing an appropriate response to those impacts for government, the industry, and its regulators.

2011-12

Impact on climate change on asset management planning
The impact of climate change will affect companies’ investment plans. Maintaining the asset performance and customer service will be an issue if like for like replacement continues.

Impact of climate change on source yields
With the Environment Agency, a project to develop the detailed methodologies required for water resources and business plans to produce a methodology that can be used to assess the impact of climate change on source yields.

2012-13

Practical methodologies for monitoring and responding to the impacts of Climate Change on industry treatment processes.
Providing a mechanism by which critical climate sensitive treatment process thresholds may be established, monitored and assessed; and to provide an evidence base from which adaptation actions may be taken that will be justifiable to regulators and other stakeholders.

Updating the UK Water Industry Adaptation Framework
Updating and enhancing the UK water industry adaptation framework, and associated guidance.

2014-15

Rainfall intensity for sewer design
Examined predicted changes in the type of UK rainfall important for sewer design using climate simulations and climate analogues (international locations with current climates similar to the ones predicted for the UK). It recommended uplift factors for current design storms for use in predicting future sewer flooding patterns; examined international sewerage design and stormwater management approaches; and provided guidance on appropriate provision for climate change in any new sewer systems or near-term infrastructure enhancements. Stage 2 (2017) used a new Met Office 1.5km climate length model simulation of the United Kingdom, with a view to resolving convective processes that produce the heavy rain seen in all seasons which affects the functioning of urban drainage systems.

Planning for the mean or planning for the extreme
Established a stronger understanding of the quantitative links between weather – in particular extreme weather events - and a broad range of performance issues, based on present day and historic data.

2017

Drought Vulnerability Framework
Provides a framework of methodologies to enable water companies to better understand the vulnerabilities of their water resource zones to drought. It builds on the concept of the Drought Response Surface (DRS) originally derived for the Environment Agency 'Understanding the Performance of Water Supply Systems during Mild to Extreme Droughts' study.

Resilience – performance measures, costs and stakeholder communication
Focusses on the service provided by the water supply and wastewater sectors and how aspects of resilience of that service could feed into Periodic Review 2019. The work also draws on the parallel work of the Water and Wastewater Resilience Action Group (WWRAG).

2018

Climate change modelling and the Water Resources Management Plans
Demonstrated how new climate change evidence can be considered in a proportionate, targeted and system specific manner. Included an online tool to enable practitioners to quickly evaluate new climate change evidence and identify any scenarios for subsequent analysis, and to rapidly evaluate how the UKCP18 projections compare to the UKCP09 projections in the context of their system's vulnerabilities. It also examined current methods for scaling climate change impacts through the WRMP planning period and recommended their review in advance of WRMP 2024 to better reflect the likely non-linearities of system response to climate exposure.

2019

WRMP 2019 methods – risk-based planning
As part of the UKWIR WRMP 2019 Methods Programme, the Risk Based Methods Project was commissioned to provide practitioners with a new set of tools with which they can evaluate supply, demand and investment risks and incorporate them into the WRMP decision making process.

2020

Developing management strategies for increasingly frequent algal blooms in source waters
Assesses the potential for prediction, the implications of climate change, and potential for better management, through a process of literature review, data collation and analysis, and the investigation of predictive methods. A literature review provided the background for the development of an approach and tools. Data collected from the steering group were analysed and a predictive tool was developed.

Modelling a dynamic and uncertain future – preparing SAGIS for changes in climate, PR24, RBMP Cycle 3 and Brexit
A project to improve confidence in model-based asset planning and decision making by enhancing SAGIS-SIMCAT through scoping studies, research, investigations, and the development of new tools and data to improve the robustness of the modelling system.

2021

Integrating UKCP18 with UKWIR tools and guidance: review of existing methods
Identified past UKWIR research which need to be updated following the publication of UKCP18 projections and recommended a programme for those updates. Included a review of UKCP18 projections in the context of water resource planning and drought and surface water management and change in extreme and seasonal rainfall; and a review of existing methods and tools that could be affected by the new projections.

2022

Climate change rainfall for use in sewerage design - design storm profiles, antecedent conditions, RED-UP tool update and seasonality impact

Development of an updated version of the RED-UP tool, a time series perturbation tool that allows historic rainfall data to be perturbed to be representative of future climate. RED-UP was originally developed in the 2017 UKWIR project, Rainfall Intensity for the Design of Sewerage Systems, involving members of the current contractor team. This project also examined other hydrological aspects related to the use of rainfall: the profile of the Flood Studies Report (FSR) design storm, antecedent wetness allowances and the Areal Reduction Factor have been analysed.

Climate change adaptation - a common framework

To date there has not been a common approach to assessing climate hazards, with different scenarios and timescales, due to different regulation, legislation and guidance across nations and different parts of the sector. Consequently, different parts of England, the rest of the UK and Ireland are assessing risk based on different climate futures. This project involved development of a shared climate adaptation goal and framework to support greater consistency, focused mainly on physical climate risk.