Climate Change Adaptation

Adaptation Reporting Power (ARP3) Report

SES Water

29th November 2021

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Executive Summary

Our Climate Adaption Report

At SES Water, we recognise that climate change poses a significant challenge in achieving our desired outcomes for our customers and the environment. We supply water to over 735,00 customers in parts of Surrey, West Sussex, Kent, and South London, and we are committed to playing our part to adapt to climate change and enhance climate resilience across our region.

This report is our second Climate Change Adaptation Report, providing an update from our first report in 2011 and a new climate change risk assessment based on the latest evidence from the Climate Change Committee and the UK Climate Projections.

This report summarises our current understanding of the key risks we face due to climate change and provides a summary of the progress we are making to adapt to climate change. It also highlights key areas for us to focus on in future investment periods.

Climate change and the key climate risks we face

In the South East of England, we are already experiencing the effects of climate change with temperatures in the recent decade (2009 – 2018) over 1°C warmer than pre-industrial times (1850 – 1900) (Figure 1-1).

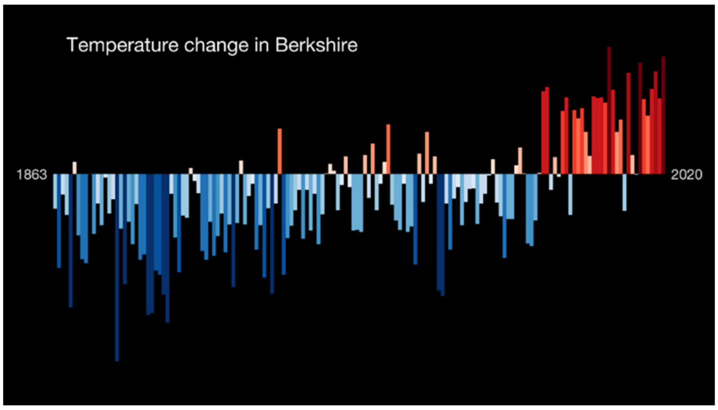
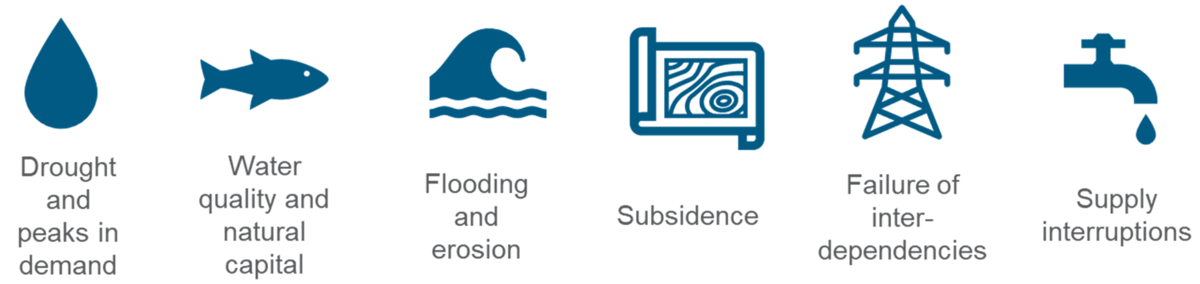


Figure 1-1 - Climate stripes chart for the South East of England[1]

Climate change projections demonstrate an increased chance of warmer, wetter winters and hotter, drier summers, along with an increase in the frequency and intensity of weather extremes.[2] The South East is already considered an area of water scarcity; although our water resource zone (WRZ) is projected to remain in a surplus until the late-century (2080), many of our neighbouring WRZs within other water company supply areas are not.[3] Climate change will exacerbate current challenges in managing water resources and water quality, and will increase our risk of flooding, erosion, subsidence, supply interruptions, and failures of our interdependent infrastructure. It is important that we understand the risks we face, we put in place controls to manage these risks, and we identify where additional investigation, action and investment are required to improve our overall climate resilience.

[1] University of Reading Climate Stripes using Met Office Had UK data
[2] UKCP18 Headline Findings
[3] HR Wallingford (2020). Technical Report, Updated projections of future water availability for the third UK Climate Change Risk Assessment, RT002 R05-00. Report produced for Committee on Climate Change.



Our key actions for managing risks and adapting to climate change

We have controls in place to manage climate change impacts and we are working to enhance these in the current and future investment periods. These include:

- **Sustainable management of our water resources**: our Water Resources Management Plan including demand management and leakage reduction programmes, and our Drought Plan
- **Enhancing resilience in our production and supply systems:** increasing the interconnectivity of our supply system supply, targeted asset renewal, flood resilience measures at key sites, backup power and communications, and storage for critical chemicals and spare parts
- **Safeguarding our water quality**: our catchment management activities, water treatment systems, and water quality monitoring
- **Enhancing the environment**: our Biodiversity Action Plan, environmental programmes throughout our region, and environmental monitoring

Our ongoing actions to enhance resilience

Adapting to climate change is an ongoing process, and our Adaptation Report reflects where we are at with understanding the risks and taking appropriate actions, while recognising we have to do more in future investment periods. Looking ahead, our work as a company will be focussing on the following areas:

- **Enhancing systems-based resilience across our company** – we will be progressing the work carried out in developing our climate change risk assessment, and operationalising this Adaptation Report to complement our systems-based resilience framework as part of our ongoing work towards 'resilience in the round'.
- **Embedding climate adaptation and resilience measures into all our investments** – our investments in infrastructure and across our business will consider climate change and embed adaptation measures into the investment, to ensure we remain resilient and able to deliver desired outcomes for our customers and the environment.
- **Enhancing our understanding of our risks from climate change** – we will be receptive to new evidence and we will further investigate key areas where we've identified risks are significant and our understanding could be improved.
- **Adapting to climate change whilst managing affordability** – we will continue to take action to adapt to climate change and enhance our environment, whilst managing affordability for our customers. We will use findings from this Adaptation Report to inform our planning for future investment periods, whilst engaging with customers to understand their priorities for investment.
- **Achieving Net Zero** – we are continuing work towards becoming a Net Zero company by 2030. We will continue to be mindful of the carbon footprint of any actions we take to adapt to climate change, ensuring that we are not hindering our efforts towards Net Zero.
- **Collaborating to enhance resilience** – we will continue to listen to and engage with our customers, and work closely with our partners and stakeholders to achieve the shared outcome of a climate resilient future for our region.
- **Learning from others** – we will continue to seek to learn from others across the water sector and from other sectors and countries in adapting to climate change.

Table 1-1 - A summary of our climate change risk assessment

Key climate risk (and Defra's CCRA2 risk code[4])	Cause of climate risk	Our understanding of the risk (H/M/L)	Risk scoring before controls and adaptation			Risk scoring after controls and adaptation			Examples of our risk controls and adaptation actions
			Likelihood (1-5)	Impact (1-5)	Risk score (1-25)	Likelihood (1-5)	Impact (1-5)	Risk score (1-25)	
Risks from drought and high/peak water demand (In9)	High/peak demand due to heatwaves	M	5	4	20	3	3	9	• Ensure sufficient water storage • Leakage reduction programme • Customer engagement and metering • Drought Plan 2021 • Planning for 1 in 500 year drought resilience • Future scenario testing
	Drought impacting water supply	H	4	5	20	2	4	8	
	Climate induced land use change leading to high/peak demand	L/M	4	3	12	3	2	6	
	High temperature and low precipitation leading to reduced abstraction allowance	M	3	4	12	2	3	6	
	Wildfires and urban fires increasing water demand	L	3	2	6	3	2	6	
Risks to water quality and natural capital (Pb13 & Ne1)	High precipitation increasing run off and pollution	M	5	5	25	4	3	12	• Catchment management strategy • Water source monitoring and selectivity • Biodiversity Action Plan • Wildlife Trust's Biodiversity
	Declining natural capital due to high temperatures and low precipitation	L/M	4	4	16	3	3	9	
	Algal blooms due to high temperatures	L/M	4	4	16	4	2	8	
	Increased INNS driven by high temperatures	L/M	5	3	15	3	2	6	
	Changing climate driving land use change increasing pollution	L	4	3	12	3	2	6	

[4] The UK's second Climate Change Risk Assessment 2017 (CCRA2)

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			Likelihood (1-5)	Impact (1-5)	Risk score (1-25)	Likelihood (1-5)	Impact (1-5)	Risk score (1-25)	
	Changing climate increasing wildfires driving increased diffuse pollution	L	3	3	9	3	2	6	Benchmarking certifications • Improved supply network connectivity • Water treatment processes • WINEP water quality investigations • Surveying of INNS
Risks from flooding and erosion (In2 & In5)	High precipitation causing river, surface water and/or groundwater flooding of assets	L/M	4	5	20	3	3	9	• Enhanced flood resilience at some key sites • Flood risk assessments • Incident management plan • Improved supply network connectivity and dual supply for customers
	High precipitation causing river bank erosion impacting assets	L	3	4	12	3	3	9	
Risks from subsidence (In8)	Subsidence causing damage to assets	L	5	5	25	4	3	12	• Enhanced monitoring and soil moisture modelling
	High temperature and low precipitation leading to failure of earth impounding reservoir	L	2	5	10	1	4	4	

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			Likelihood (1-5)	Impact (1-5)	Risk score (1-25)	Likelihood (1-5)	Impact (1-5)	Risk score (1-25)	
									• Targeted asset renewal
Risks from failure of interdependencies (In1)	Climate-induced disruptions to energy and telecoms	L	4	4	16	4	2	8	• Communications and power alternatives • Surplus chemical storage • Mutual aid schemes
	Disruption to supply of critical materials and equipment	L	4	4	16	3	3	9	
Risk of household water supply interruptions (Pb14)	Extreme weather causing failures in production network	L	4	3	12	3	2	6	• Improved supply network connectivity • Strategic placement and protection for key assets • Asset renewal
	Extreme weather causing failures in distribution network	M	5	4	20	3	3	9	
	High temperatures causing assets to fail in production and distribution networks	L	4	3	12	3	2	6	
	Wildfires causing damage to assets	L	3	3	9	3	2	6	

1. Introduction

The Climate Change Act (2008) established the Adaptation Reporting Power (ARP) which gives the Government the power to request organisations to report on their current and future climate change impacts, and their progress in preparing for and adapting to climate change.

At SES Water we published our first Climate Change Adaptation Report in 2011, during the first round of reporting (ARP1). The second round of reporting (ARP2) in 2015 was voluntary and we did not submit a report. We are now in the third round of reporting (ARP3) and we are taking the opportunity to provide an update on our plans and progress with adapting to climate change.

The Government has requested[5] an assessment of the current and future risks presented by climate change, and a summary of our programme of measures to address the risks, including progress since previous ARP reports.

This Adaptation Report provides us with an opportunity to highlight the importance we place on climate change adaptation and resilience and demonstrates the actions we are taking across our region to manage the impacts from climate change. It also provides an opportunity to identify areas which require additional investigation, action, and investment in our next round of business planning. Through ARP3 we are building on our previous ARP1 report and re-assessing our risks from climate change using the latest climate projections (UKCP18) and supporting evidence, to complement our ongoing work to embed systems-based resilience across our company. This work aligns with our actions to reduce our carbon emissions and become a Net Zero company by 2030, helping to address the causes of climate change.

By submitting an Adaptation Report we are also helping to inform the UK's third Climate Change Risk Assessment (CCRA3) and the UK's third National Adaptation Program (NAP).

We have engaged with our customers in developing this report, through a customer focus group in August 2021, and we presented this work to our Environmental Scrutiny Panel in October 2021.

This report demonstrates that we are continuing to play our part in adapting to climate change and enhancing resilience across our region, while strengthening our ambitions to do more in future.

1.1. Climate change risks for the Water sector

The UK's second Climate Change Risk Assessment (CCRA2)[6] in 2017 identified seven key risks for water infrastructure owners, which the Government has requested water companies to report on as part of their Climate Change Adaptation Reports. Not all of these risks are relevant to us as indicated in Table 1-1.

Table 1-1 - Key climate change risks for the Water sector

Risks	Relevant to SES Water (Y/N)
Risks to public water supplies from drought and low river flows	Y
Risks to infrastructure services from flooding (river, surface water and groundwater flooding)	Y
Risks of cascading failures from interdependent infrastructure networks	Y
Risks to pipelines from high river flows and bank erosion	Y
Risks to subterranean and surface infrastructure from subsidence	Y
Risks to infrastructure services from coastal flooding and erosion	N – our area is not located next to the coast
Risks of sewer flooding due to heavy rainfall	N – we do not own or manage sewers

[5] National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting: Making the country resilient to a changing climate. The guidance requested water companies to report on the following risks: cascade failures due to interdependencies; risks from flooding; risks to public water supplies from drought and low river flows; risks to productivity due to infrastructure disruption. Since this was published in 2018, the Department for Environment, Food and Rural Affairs (Defra) has provided updated guidance and templates for reporting, and received feedback on these from water companies. We have used the updated guidance to inform our Climate Adaptation Report.

[6] UK-CCRA-2017-Chapter-4-Infrastructure.pdf (theccc.org.uk)

Other risks were also identified in CCRA2, such as risks to health from poor water quality, risks to species and habitats, and risks of disruption to public water supply. These are optional for water service providers to report against, and we have elected to report against these in this Adaptation Report.

1.2. Our previous Adaptation Report

In our previous Climate Adaptation Report in 2011 we completed a risk screening exercise based on 2007 guidance from Water UK[7]. Our risk assessment was based on the previous set of UK climate projections, UKCP09, using the medium emissions scenario, SRES A1B. Data from the UK Climate Impacts Programme (UKCIP02) was used for the detailed assessment of the priority risks. The medium, high, and very high-risk impacts identified in our ARP1 report were as follows:

- Water resources: reduction of available supply and increase in water demand
- Flooding: increased flooding of assets
- Utilities: disruptions to power and communications for our sites

For this Adaptation Report we are using the latest guidance issued by the Government and considering the latest climate projections (UKCP18). Our approach is described in Section 4.

2. Overview of SES Water

We are the water company suppling water to those parts of Surrey, West Sussex, Kent, and South London as shown in Figure 2-1. We supply over 730,00 customers with an average of 160 million litres of water every day - to households, schools, hospitals, offices, and important infrastructure such as Gatwick airport. We do not manage drainage and wastewater in our region. Due to the interconnectivity of our water supply network, we have one Water Resource Zone (WRZ). 85% of our water is sourced from groundwater beneath the North Downs, the remaining 15% is abstracted from the River Eden and stored in Bough Beech reservoir near Edenbridge. We operate eight water treatment works (WTW): Bough Beech, Elmer, Cheam, Woodmansterne, Kenley, Godstone, Westwood, and Cliftons Lane, in addition to our 74 boreholes, 24 pumping stations, 30 service reservoirs, five water towers, and 3,500 km of water mains.

Our area is geographically small, but we have a relatively high population which is projected to grow significantly in coming decades. Our area has dense residential zones, as well as industrial sites, farms, golf courses, major roads, and many natural assets.

[7] https://www.water.org.uk/wp-content/uploads/2018/11/water-uk-climate-change-adaptation-approach-to-asset-management-planning.pdf

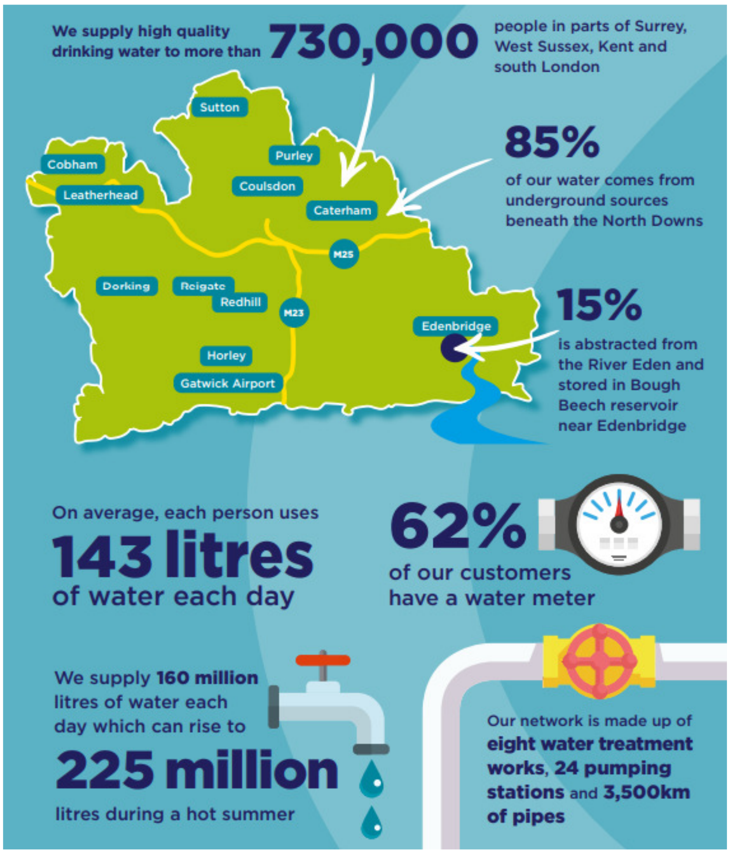


Figure 2-1 - Our operating area

2.1. Our pledges

As part of our Business Plan for 2020 to 2025[8] we are investing £39.8 million into improvements to our service, resilience, and the environment. We embed systems-based 'resilience in the round' across our operations and decision-making. Our commitment to customers centres around the issues that matter most to them and has led to us making five pledges that we will deliver between 2020 and 2025 (Figure 2-2). Of these five pledges, our ability to adapt to climate change and improve our resilience is at the forefront of three of them: 'High quality water all day, every day'; 'A service that is fit now and for the future'; and 'Support a thriving environment we can all rely on'.

By adopting a twin-track approach of 'minimising the impact that we and our customers have on the environment' whilst 'actively improving the environment in areas of benefit to our customers' we are able to protect and enhance the environment both now and for the future. Under this approach, our strategy compromises four pillars:

1. Leaving more water in the environment and mitigating the impact of our abstractions by reducing both demand from customers and leakage from the network
2. Reducing energy use, embracing renewables and where possible, stopping greenhouse gas emissions created by our operations
3. Enhancing biodiversity and the catchments we operate in through the delivery of regulatory requirements and additional improvement by working in partnership with environmental stakeholders
4. Engaging with our customers, both current and future, about the linkage between water use and the environment.

[8] Business Plan for 2020 to 2025

Figure 2-2 - Our pledges for our 2020 to 2025 Business Plan

2.2. Our systems resilience framework

Our systems-based resilience framework addresses 'resilience in the round' through proactively managing risks across our company (Figure 2-3). This includes preparing for shocks and stresses, stress testing our systems and addressing vulnerabilities before impacts occur and enhancing our capacity to respond and build back better. From investing in the resilience of our water supply network, to ensuring our employees are given the tools to be the best they can be, we recognise the essential service we provide and how important it is to be resilient in all areas not just today, but far into the future. Our systems resilience framework is evolving, and we are working to enhance our understanding and management of risks across our business, including risks posed by climate change.

Figure 2-3 - Our systems resilience framework

The application of our resilience framework to our climate change adaptation activities can be seen throughout this Adaptation Report, where many of our actions benefit multiple areas of our business. It is through this systems-based approach that we are able to provide a high level of service to our customers, and protect our environment, regardless of the challenges we face.

3. Climate Change in Our Region

3.1. UK Climate Projections 2018

The UK Climate Projections 2018 (UKCP18) are the latest UK climate projections, superseding UK Climate Projections 2009 (UKCP09) which were available for ARP1 and ARP2 reporting.

Changes to seasonal precipitation and summer temperatures will affect the quality and quantity of our groundwater and surface water sources. Secondary climate impacts such as flooding, subsidence, wildfires, and heatwaves as result of changes to precipitation and temperatures pose a challenge to our assets and networks.

In line with Government guidance, we have considered UKCP18 projections up to 2050 and 2080 for summer and winter precipitation, and summer temperatures. We considered impacts across the high and medium emission scenarios[9]. The UKCP18 projections considered are specific to our operational area and have been used to inform our climate change risk assessment (Section 4). Detailed maps and graphs for the climate projections, along with our analysis can be found in Appendix B. Table 3.1 presents the key UKCP18 findings, and their implications relevant to our area and company.

Table 3-1 - Summary of UKCP18 climate projections and their impact to our Company

Climate Variable	Change	Impact
Summer temperatures and heatwaves	Hot summers will be more common: • By 2050, there is a 50% chance of summers to be as hot as 2018 (one of the warmest UK summers to date) • Under a high emissions scenario, the frequency of hot spells increases from an average of once every four years to four times per year by 2070 • Under the high emissions scenario, maximum summer temperatures will increase by an average of 2.7°C, rising to 5.5°C by 2080	• Increased summer peak demand for water • Increased likelihood of drought conditions • Increased risk of failures in our production and supply networks due to overheating • Increased risk of algal blooms on Bough Beech reservoir occurring, and for longer periods of time if temperatures are sustained, causing water quality issues • Increased risk of decline of natural capital and biodiversity in our region, due to increased evapotranspiration and increased water temperatures • Increased likelihood of summer wildfires causing damage to assets and water quality issues
Summer precipitation and storm intensity	A trend for drier summers but with possible increases in the intensity of heavy summer rainfall events: • There is a high level of variability in summer precipitation projections from year to year with a range of +40% to - 60% change by 2050 and +35% to -90% change by 2080 • Under the medium emissions scenario, on average summer	• Increased likelihood of drought conditions, particularly if the antecedent winter has been dry and groundwater levels are already low • Increased likelihood of low river flows causing a decline in river water quality, natural capital and biodiversity • Increased summer peak demand for water

[9] RCP4.5 – medium greenhouse gas emissions, RCP8.5 – high greenhouse gas emissions

	rainfall is projected to decrease 24.6% by 2050 and 25.3% by 2080 • Under the high emissions scenario, on average summer rainfall is projected to decrease 28% by 2050 and 35.2% by 2080	• Increased risk of subsidence due to shrinking clay soils leading to damage to above ground and underground assets • Increased likelihood of summer wildfires causing damage to assets and water quality issues • Increased storm intensity may increase the likelihood of flooding or damage to assets in addition to an increased likelihood of run-off events impacting water quality
Winter precipitation	A trend for an increase in winter precipitation with a high level of variability: • There is a high level of variability in winter precipitation projections from year to year with a range of +40% to - 20% change by 2050 and +60% to -20% change by 2080 • Under the medium emissions scenario, on average winter rainfall is projected to increase 6.8% by 2050 and 11.8% by 2080 • Under the high emissions scenario, on average winter rainfall is projected to increase 8.7% by 2050 and 18.0% by 2080	• Increased likelihood of flooding of our assets • Increased likelihood of damage to assets from river bank erosion and higher river flows • Increased likelihood of run-off impacting water quality • High variability in winter precipitation may lead to an increased risk in drought if multiple consecutive winters experience lower than average rainfall leading to low groundwater levels

3.2. The Third UK Climate Change Risk Assessment

The UK's Climate Change Committee (CCC) published technical and policy reports in June 2021 to inform development of the third UK Climate Change Risk Assessment (CCRA3) in 2022[10]. We have used some of this evidence to complement our analysis of the UKCP18 climate projections and to provide evidence for our climate change risk assessment. Summaries of the research can be found in Appendix C.

For ARP3 the government has asked water companies to report against the risks relating to the UK's second Climate Change Risk Assessment (CCRA2)[6]. Appendix D demonstrates how our climate change risk assessment provides a good coverage of the relevant risks identified in both the UK's CCRA2 and the CCC's independent CCRA3 report.

4. Our climate change risk assessment

4.1. Our approach

We are already experiencing the impacts of climate change, and we know the scale of the challenge ahead. We have taken a precautionary approach in our climate change risk assessment to avoid underplaying the significance of the challenges that we face, and the challenges faced by our suppliers and interdependent infrastructure.

Our approach to assessing our risks from climate change followed three steps:

1. **Risk screening:** we considered the impacts of climate change across our area and our business and we screened for risks which are of most significance. This was informed by guidance provided by

[10] Technical Report of the Third UK Climate Change Risk Assessment (CCRA3)

Government[11,12], the risk screening we carried out in our last ARP report in 2011, and our knowledge of current and emerging risks.

2. **Risk assessment without adaptation actions:** we considered the impacts of climate change on our business and our ability to provide services to customers in the case that we didn't put in place risk management measures and adapt to climate change. We considered medium and high climate change scenarios (RCP4.5 and RCP8.5) to the year 2080 when making these assessments.
3. **Risk assessment with adaptation actions:** we reassessed our risks from climate change taking into consideration our risk management measures and adaptation actions already in place or planned to be in place by 2025 (the end of the current funding period).

Our assessments are based on a combination of qualitative and quantitative data where this was available (for example, from our Water Resources Management Plan) and our expert judgement. We have scored each risk using a 5x5 matrix of likelihood and impact giving a maximum score of 25 to our highest risks. The scoring follows our principles of ranking corporate risks (Table 4-1, Table 4-2). The ratings for impact and likelihood are then multiplied to give our overall risk score for each climate risk (Table 4-3).

Table 4-1 – Our principles for ranking corporate risk: Impact

Impact	Impact Score	Impact Levels
Very Low	1	Financial impact of less than 1% of turnover and/or no, minimal effect on the ability to deliver our company aims, and/or has a minor impact on our interested parties and unlikely to cause any dissatisfaction or reputational damage
Low	2	Financial impact of 1-2% of turnover and/or small but quantifiable effect on the ability to deliver our company aims, and/or has a small but measurable impact on our interested parties and unlikely to cause any dissatisfaction or reputational damage
Medium	3	Financial impact of 2-5% of turnover (potentially putting the company under some financial strain) and/or creates difficulties to deliver to one or more of our company aims, and/or has a measurable impact on our interested parties which may cause some dissatisfaction and reputational damage
High	4	Financial impact of 5-7% of turnover and/or a significant effect on the ability to deliver our company aims (likely resulting us missing some performance commitments), and/or has a major measurable impact on one or more of our interested parties and is highly likely to cause dissatisfaction or reputational damage.
Very High	5	Would result in catastrophic business failure. Financial impact over 7% of turnover and/or has a very significant effect on the ability to meet company aims (would result in missing of ODIs and receiving associated penalties) and/or has a significant impact on interested parties which will do definite harm to company reputation.

Table 4-2 – Our principles for ranking corporate risk: Likelihood

Probability	Probability Score	Description
Highly Unlikely	1	Less than 5% likelihood of occurrence in a year
Unlikely	2	Between 5% and 10% likelihood of occurrence in a year

[11] The Government's National Adaptation Programme and the third strategy for climate adaptation reporting https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727252/national-adaptation-programme-2018.pdf

[12] The Government's UK Climate Change Risk Assessment 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf

Possible	3	Between 10% and 50% likelihood of occurrence in a year
Likely	4	Between 50% and 75% likelihood of occurrence in a year
Highly Likely	5	Greater than 75% likelihood of occurrence in a year

Table 4-3 - Our risk scoring matrix

Impact	Very high	5	10	15	20	25
	High	4	8	12	16	20
	Medium	3	6	9	12	15
	Low	2	4	6	8	10
	Very low	1	2	3	4	5
		Highly unlikely	Unlikely	Possible	Likely	Highly likely
		Likelihood				

We have also assessed our level of understanding of each risk which depends on two factors:

1. **Our analysis of the risk** – our current level of analysis and evidence related to the risk and the impacts on our business, with consideration of the latest UKCP18 climate projections.
2. **General uncertainty associated with the risk** – there is greater certainty about some risks arising from climate change than others. For example, risks arising in the short to medium term (up to the 2050s) are more certain than long-term risks (2080s), and some risks driven by temperature are more certain than risks driven by rainfall and storms.

Based on these factors we scored our understanding of each risk as Low, Medium, or High (Table 4-4).

Table 4-4 - Our understanding of risk

Understanding of the risk	Analysis of the risk	Uncertainty
Low	We are yet to complete detailed analysis related to the risk and the impact to our business. Further investigation would be required to develop a good understanding of how climate change increases the risk.	There is greater uncertainty about the risk over the long term, and greater uncertainty over how climate change may increase the risk.
Medium	We have completed detailed analysis related to the risk and the impact to our business. We have a reasonable understanding of how climate change increases the risk.	There is moderate uncertainty about the risk over the long term, and moderate uncertainty over how climate change may increase the risk
High	We have completed detailed analysis related to the risk and the impact to our business, including considering UKCP18 climate projections. We have a good understanding of how climate change increases the risk.	There is lower uncertainty about the risk over the long term, and lower uncertainty over how climate change may increase the risk

4.2. Summary of climate change risk categories

Overall, we assessed 22 major causes of climate risk under six key risk categories:

1. Risks from droughts and peaks in water demand
2. Risks to water quality and natural capital (including algal blooms, INNS, run-off and pollution)
3. Risks to assets from subsidence
4. Risks to assets from flooding, high river flows, and river bank erosion
5. Risks of household water supply interruptions

6. Risks from the failure of interdependencies

Table 4-5 shows the climate hazards that affect each of these risk categories and their sub-risks. Each risk is discussed in the following chapters, where we've highlighted our understanding of the risk, our key actions in place to manage the risk, and some of our potential future actions to manage the impacts of climate change. Our complete risk assessment can be found in Appendix A.

Table 4-5 – Climate hazards driving key risks. The risks which the Government requested us to report against are shown in blue, the additional risks we are reporting against are shown in light blue.

	Climate hazards						
Risks	Increasing temperatures	Heatwaves	Low precipitation	Increased severity and intensity of storms	High precipitation	Freeze thaw	Wildfires
Algal blooms and INNS	x						
Run-off and pollution of water supply				x	x		
Decline in Natural Capital	x		x				
Drought impacting water supply	x		x				
Increased and peaks in demand for water	x	x	x			x	x
Risks to assets from flooding				x	x		
Risks to assets from high river flows and bank erosion				x	x		
Subsidence damaging assets	x		x				
Failure of inter-dependencies	x	x		x		x	x
Household supply interruptions	x	x		x		x	x

5. Risks from drought and peaks in demand

5.1. Drought impacting water supply

Understanding the risk

Climate change will affect how much water is available in the future. Evidence from the CCC's CCRA3 report[13] presents large deficits by the mid and late century in the South East of England, even with current adaptation measures. Our supply area, which is already an area of serious water stress, will see changes to rainfall patterns, and therefore water availability, throughout the year. Prolonged periods of hot and dry weather and increasing temperatures will exacerbate the effect of changing rainfall patterns on our river flows and reservoir levels. Consecutive winters which are drier than average will result in reduced aquifer recharge and pose a high risk to our groundwater supply which accounts for 85% of our water resources. Such a strain to both our surface water and groundwater supplies could lead to drought conditions. At present, our supply is resilient to an extreme drought with a 1 in 200-year frequency, and we are enhancing our resilience and taking into account population growth and climate change.

A further risk to our supply is potential changes to our abstraction licence. 60% of our supply is taken from Chalk aquifers (Table 5-1) which are vulnerable to both over abstraction and climate change. As part of the Water Framework Directive (WFD)[14] 'No Deterioration' requirements and the Thames River Basin Management Plan (RBMP)[15] we are responsible for ensuring that our abstraction practices do not cause long-term harm to the environment, and where applicable, restore sustainable abstraction if there has been deterioration. At present, the Environment Agency (EA) is concerned about the protection of Chalk streams and aquifers which could lead to reductions in licenses[16]. Whilst we are yet to see any reductions to our licenses, the threat of reduced abstraction could have a significant impact on our Company, particularly if changes are to be made over less than one planning cycle (AMP period). Should we face increased requirements to reduce abstraction, we would have to make up the deficit through other options which are likely to be at a higher cost. Sourcing additional water supply or implementing higher demand management measures outside of the plans outlined in our Water Resource Management Plan 2019 (WRMP19)[19] and in our upcoming draft Water Resource Management Plan 2024 (dWRMP24) would lead to increased capital and operational costs.

Table 5-1 - Groundwater sources (Chalk aquifers are highlighted blue)

Aquifer Resource Unit (ARU)	Number of abstraction sources
North Downs Chalk	16
Confined Chalk	1
Mole Valley Chalk	4
Lower Greensand	12

Current adaptation and planned adaptation actions

Collaborating with partners in Water Resources South East

We are a member of Water Resources South East (WRSE) which is an alliance of the six water companies in the South East of England[17], collaborating with advisory members from the Government[18], the Environment Agency (EA), and Ofwat (our economic regulator). A key aim of WRSE is to consider the opportunities and options for sharing water resources and enhancing resilience on a regional basis. WRSE commissioned modelling for the WRMP19 plans to identify optimum solutions for water resources in the wider region, in terms of costs and future resilience. The scenario testing in our WRMP19[19] utilised the options considered as part of the WRSE modelling work and helped to inform our individual company plan. We are continuing to work with our

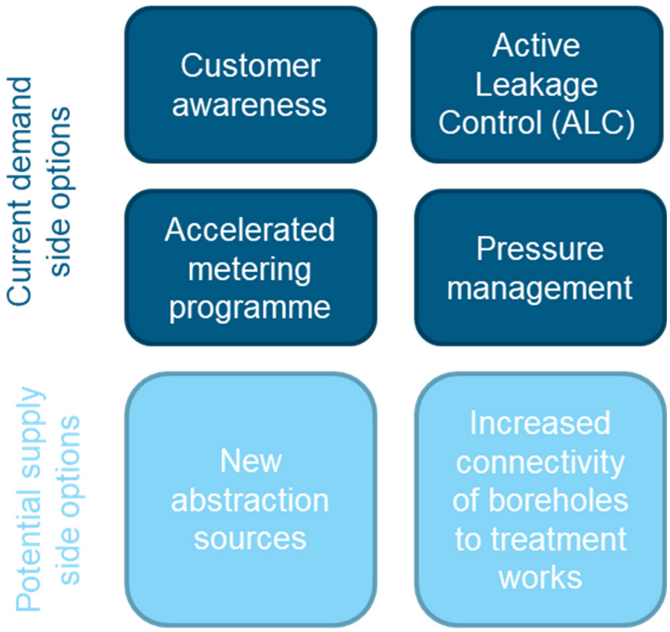
[13] CCRA3 Briefing – Water
[14] The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
[15] Part 1: Thames River Basin District – River Basin Management Plan 2015
[16] https://environmentagency.blog.gov.uk/2019/10/02/protecting-our-precious-chalk-streams/
[17] Affinity Water, Portsmouth Water, SES Water, South East Water, Southern Water, and Thames Water.
[18] Department for Environment, Food and Rural Affairs

neighbouring water companies and other stakeholders in our region to maximise the sustainable use of water resources, including the option for us to transfer water to other companies in future at times when they are in need and we have surplus supply.

Scenario testing to reduce abstractions and manage supply and demand

We are actively looking at where we may be required to reduce our abstractions and testing these reductions against our ability to meet the demand requirements in our region. As 60% of our supply comes from Chalk aquifers, scenario testing is allowing us to explore the impact of reduced abstractions in these environmentally sensitive catchments. We will likely incur additional costs for us to abstract water from other sources which require enhanced water treatment, but we are moving ahead where we can, to protect our environment.

In our 2019 WRMP[19] we tested the impacts of climate change on the River Eden catchment (our surface water source) and our groundwater sources for a 1 in 200-year drought event across 11 scenarios of climate to 2098. We also forecasted future demand for both a normal year and a dry year, using climate factors for rainfall and temperature to inform our assessment. We then tested the impact of a 1 in 200-year drought event on our forecasted availability of supply to meet the forecasted demand. From this we were able to consider and test various supply-side and demand-side adaptation actions taking into account environmental considerations, costs, and inputs from stakeholders and customers to develop a preferred programme of demand and supply options. Our customers told us they prefer demand management options, so our preferred plan consists of demand management options which will ensure the security of water supply for our customers at the levels of service defined in our Drought Plan[20,21].



Enhancing our Drought Resilience

We have begun planning to enhance our levels of resilience to a 1 in 500 year drought event by 2040. Our 2024 WRMP, which is currently underway, will include these plans, increasing resilience from the current level of 1 in 200 year drought resilience. This will further reduce the risk that emergency drought measures will be needed in future, under a changing climate. As part of our 2024 WRMP we are using an adaptive planning approach by considering both high and medium levels of climate change, in addition to high and medium levels of population growth, so that we select options that are resilient to a range of potential futures.

Our Drought Plan

Our 2021 draft Drought Plan[21] was published for public consultation in June. Our plan sets out how we intend to continue supplying water during a drought to reduce the impact to our customers and the environment. The two key areas of focus are to maximise our water supplies and to reduce water demand; the actions we will take depend on the level of drought (Table 5-2). Our water supplies are currently resilient to a 1 in 200 year drought event which means that there is a 0.5% chance per year of needing to enact our most severe emergency drought measures.

Table 5-2 - Summary of actions in our Drought Plan

Stage	Action
Normal (no drought)	Continual monitoring of our water sources
Impending drought (level 1)	Use water sources conjunctively to preserve groundwater

[19] SESW Water Resource Management Plan 2019
[20] SESW Drought Plan 2019
[21] SESW Drought Plan Consultation 2021

	Water transfers to the north of our area Environmental monitoring Postpone planned works that would make less water available Customer awareness campaigns promoting water efficiency Increase leakage reduction work Coordination with other water companies and regulators
Drought (level 2)	Increase output of peak water sources Continue with water transfers and using Bought Beech reservoir where appropriate Begin drought permit preparations and environmental mitigation Implement temporary use bans (TUBs) Increase communications to our stakeholders and customers Support vulnerable customers
Severe drought (level 3a)	Apply for a drought permit to abstract from the River Eden in May (and throughout the summer after a non-essential use ban (NEUB) has been introduced) to refill Bough Beech reservoir Apply for one or more groundwater drought permits Enhanced environmental monitoring and mitigation measures Apply for a drought order to implement NEUB Ask retailers, large businesses, fire authorities, hospitals, and schools to reduce demand Further increase to leakage reduction works Implement water pressure reduction where possible
Severe drought (level 3b)	Tanker in additional supplies of water to our region Remove all exemptions of TUBs and NEUBs Implement further water pressure reduction where possible Consider limiting consumption to 50L of water per person per day
Emergency drought (level 4)	Increase use of tankers to provide extra water supplies Coordinated communication with Government and relevant agencies about extreme water restrictions Introduce phased water pressure reduction Introduce standpipes and/or rota cuts as appropriate Work with emergency planning bodies to ensure supply security

Possible future adaptation actions

We've carried out feasibility and environmental impact studies on four potential future supply schemes including: a new borehole in the Mole Valley Chalk at Fetcham Springs; an increase to our abstraction license at Leatherhead and a new abstraction source in the Lower Mole; and a pipeline linking boreholes at Pains Hill, Duckpit Wood, and Chalk Pit Lane to Godstone and Westwood treatment works. In addition to future supply schemes, we will be considering demand-side schemes such as variable tariffs to incentivise efficient water usage, as well as rainwater harvesting and greywater recycling which we hope to explore further in future. We will continue to monitor the requirement for additional actions to manage supply and demand over time through our 5-yearly WRMP, whilst prioritising demand reduction activities.

5.2. Peaks in demand for water

Understanding the risk

We typically see two peaks for water demand within a year, one in the summer corresponding to increased demand from customers, and one in the winter which corresponds to increased pipe bursts. Climate change will impact both of these peaks and drive other changes to land and wildfires which will affect demand for water.

Summer demand peaks due to customer demand

Both household and non-household demand for water is anticipated to increase with climate change, with increased numbers of heatwaves and high temperatures placing additional strain on water resources. We supply our customers an average of 160 million litres of water each day which can rise up to 260 million litres on a hot summer day. A collaborative water company study of the peak demand period[22] in 2018 showed an 11% increase in the demand for water over 39 consecutive days. The report also demonstrated an increasing correlation between water demand and temperature for temperatures above 20°C. As water resources were in a favourable position ahead of the hot, dry summer in 2018, no drought plan measures were introduced, and customer usage remained high. However, this highlights the importance of accounting for variability in the summer demand, when water resources may be more tightly constrained under climate change, and temperatures are likely to be higher than seen in the past. Summer demand places additional costs on us as a company to implement demand management measures and to pump water around the region, particularly during peak times (where electricity costs for pumping are higher), in order to maintain water supplies and water pressure.

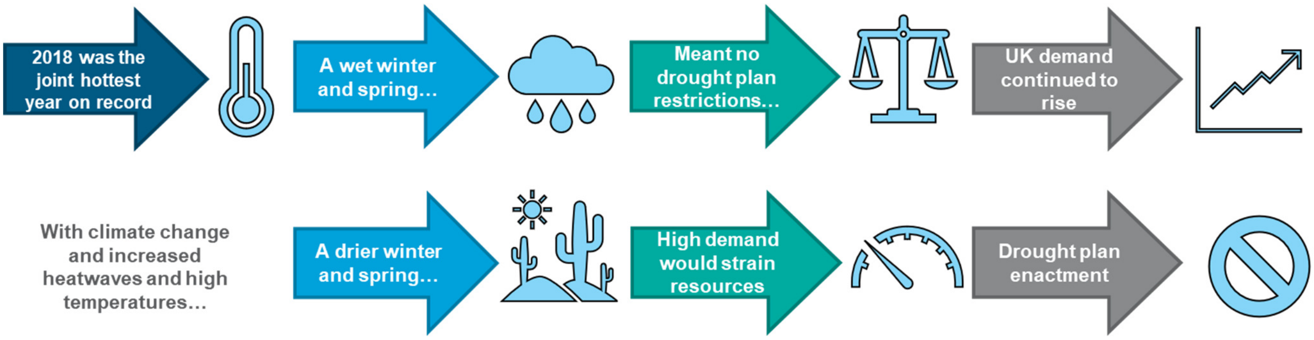


Figure 5-1 – Summary of impacts following the hot summer of 2018 (taken from report by Artesia)[23]

Winter demand peaks due to pipe bursts

Winter pipe bursts are a result of pipes expanding and contracting as water freezes and thaws inside the pipes and in the soil surrounding pipes. The number of days below 0°C and soil moisture are likely to change as a result of climate change which could reduce this risk over time. However, extreme cold events cannot be ruled out due to potential shifts in climate systems, and therefore we are continuing to monitor this risk.

Land use change

As the climate changes, it's likely that some activities within our catchments will change, for example the types of agricultural crops grown could change. These changes add additional pressures to increasing water demand. At present, the majority of agriculture within our region is dairy farming or cereal crops, but there is the possibility that practices will shift towards more fruit growing and vineyards, as is seen in other regions in the South East, which could result in increased demand for water. Population growth and a shift from non-residential to residential land use will increase demand further; forecasts suggest that between 2020 and 2025, 2,500 new properties will be built in our area on land that was previously used for industry or agriculture.

Wildfires

The CCC's CCRA3 report[23] highlights wildfires as an emerging climate-related risk within the UK. In the UK wildfires are considered a semi-natural hazard as their occurrence typically stems from land management practices and social causes. Historically fire activity in the UK has been limited by a lack of dry vegetation and soil (peat), however, with climate change resulting in hotter conditions and more frequent periods of water

[22] Collaborative water sector study on the peak summer demand of 2018 (Artesia)
[23] Belcher et al., (2021) UK wildfires and their climate challenges. Expert Led Report Prepared for the third Climate Change Risk Assessment

scarcity, the risk of wildfire occurrence is expected to double under a 2°C warming scenario and quadruple under a 4°C scenario. Wildfires have the potential to cause damage to our assets such as some strategic mains that run across heathland/common land, in addition to increased demand for water to tackle the fires themselves; both will place pressures on our available supplies and network capacity. Incidence data shows that both forest and agricultural land are at risk of wildfires and whilst we have yet to experience any incidences within our region, significant fires have occurred in neighbouring areas such as Swinley Forest in 2011 and Chobham Common in 2020.

Current and planned adaptation

Maintaining availability of our network

Our high levels of customer metering, currently around 62%, allows us to anticipate and prepare for our summer peak each year. The change in water demand is often gradual and with the knowledge that increasing demand correlates with temperatures above 20°C we are confident in our ability to mitigate against the impacts of a summer peak in demand. Already we limit any maintenance work to outside our May to July summer peak period to ensure that our network is able to run at near 100% capacity if required.

For our winter peak, our research testing multiple measurable variables has indicated that the number of days with temperatures below 0°C and soil moisture, when combined, are strong predictors of sudden leakages that place immediate stress on our systems. Through this work we can now ensure that supplies are online, and maintenance work is not underway, therefore enabling us to meet the increased demand and address pipe busts with no interruption to supply.

Leakage reduction

Reducing leakage and demand management is at the forefront of our environmental strategy. Having set ourselves the ambitious target of reducing leakage by 15% by 2025 and at least 50% by 2045 we are aligning with our customer and stakeholder engagement programme and with the Government's 25-year Environment Plan. We are currently meeting our leakage target of no more than 24 million litres of water leaking each day, an equivalent of 84 litres per property we serve, which is one of the lowest levels in the water industry. We are improving our ability to detect, find, and fix leaks on our network with Active Leakage Control (ALC) and improved pressure management to create a more stable network. Additionally, we are replacing our oldest, leakiest mains as a priority, increasing our renewal rate from 0.6% to 1.0% per year as of 2020. Our modelling has shown that this increased rate of mains renewal could result in a leakage saving of 5% every 5 years.

Customer engagement and metering

Over 60% of our customers have a water meter, and we aim to increase this to at least 90% of homes by 2025, and 95% by 2030. These will be installed under a programme where we install meters and encourage our customers to switch to paying on a metered basis over a fixed tariff. Following this, we will have a transition period of up to 12 months after which charging on a metered basis will become compulsory. On average our metered customers tend to use less water than our non-metered customers, around 139 litres per person compared to 163 litres per person respectively. In order for us to be successful in our metering programme and other aspects of demand management programme, we know that customer engagement will be essential.

Our environmental education programme teaches the value of water and engages our customers on water-related issues to increase awareness and participation. We currently have an education centre at Bough Beech reservoir and as part of our environmental strategy we are striving to make education even more accessible, so we plan to extend our education programme with a second centre at our Elmer Treatment Works. Our partnership with housing associations, charities, and community groups means that we can provide a joined-up water saving experience to all customers through our home visit programme where we provide water and energy saving advice in addition to retrofitting services for water saving devices, leak checks, and repairs on household pipes.

5.3. Summary

Table 5-3 - Summary of risks from drought and high demand in order of severity

Risk	Risk score before adaptation	Risk score with adaptation	Our Current and Planned actions	Our Performance commitments
High water demand due to heatwaves	20	9	• Ensure sufficient water storage • Leakage reduction • Customer engagement and metering • Drought Plan 2021 • Planning for 1 in 500 year drought resilience • Future scenario testing	• Per capita consumption • Leakage • Water supply interruptions • Risk of severe restrictions due to drought • Unplanned outage • Risk of supply failures • Customer experience (C-MeX)
Drought impacting water supply	20	8		
Climate-induced land use change leading to high water demand	12	6		
High temperatures and low precipitation leading to reduced abstraction allowance	12	6		
Wildfires and urban fires increasing water demand	6	6		

6. Risks to water quality and natural capital

6.1. Algal blooms and invasive species impacting water quality

Understanding the risk

Algal blooms and the presence of invasive and non-native species (INNS) are an increasing threat to water companies driven by increasing temperatures and changing climate conditions. The CCC's CCRA3 evidence report[24] (Appendix C.2) determines that algal blooms and increased microbial growth can occur above a threshold of 17°C on freshwater lakes – and this poses a risk to our water supply at Bough Beech reservoir. 'Hot months' where temperatures exceed this threshold are projected to occur more than 4 months a year in our area under a 4°C warming scenario, compared to the baseline period of 2-3 months a year.

Algal blooms contaminate our water supplies and require additional treatment to ensure we can deliver safe drinking water to our customers. The additional treatment and monitoring required to mitigate against the impacts of algal blooms has an estimated UK wide cost of £59.3 million per annum, as of 2020. Historically, algal blooms at Bough Beech reservoir have reduced the amount of water available to us for several weeks. In future this could create a compounding risk as algal blooms are more likely in warmer months when water demand is also high, so the risk is amplified, and we have less water available to meet demand.

INNS may be introduced to our area through several means – such as dispersion by wind, birds, animals, or people, and by transferring water into our region from another area. Findings from the CCC's CCRA3 report highlight the risk of increased INNS driven by an increase in warmer, wetter winters, creating conditions where some INNS grow or outcompete native species more rapidly[25]. At present there are no water transfers to our supply area, however in the future we are exploring options to transfer water out of our supply area. Although the costs associated with INNS vary depending on the type of species, actions to mitigate against their introduction and spread are likely to be expensive across our catchment, so this is a risk that we are continuing to monitor.

[24] Jones et al., (2020) Climate drive threshold effects in the natural environment. Report to the Climate Change Committee. May 2020.
[25] CCRA3 Briefing – Freshwater Habitats

Current and planned adaptation

Surveying of INNS

We have recently commissioned a biodiversity survey on all our relevant sites including Bough Beech reservoir to update our understanding of our risk from INNS. This is part of the Water Industry National Environment Programme (WINEP) (see Section 6.3 sub-section 'Water Industry National Environment Programme') to:

- Investigate INNS pathways & biosecurity
- Review biosecurity facility provision and training
- Produce a company-wide INNS plan

While surveying for INNS we are also looking for opportunities to improve biodiversity to support the work outlined in our Biodiversity Action Plan.

Water quality monitoring

As required by the Water Supply (Water Quality) Regulations 2016, we carry out regular sampling at our treatment works, service reservoirs and supply points in accordance with our annual programme[26]. Monitoring is carried out in addition to the tests performed on treated waters to monitor the efficiency of treatment processes, check the integrity of our distribution network, and to confirm source water quality at our raw water abstraction points. In 2020, we carried out approximately 120,000 water quality tests for our operational and regulatory abstraction monitoring, alongside 45,000 compliance tests which were made under our annual programme.

Water treatment solutions

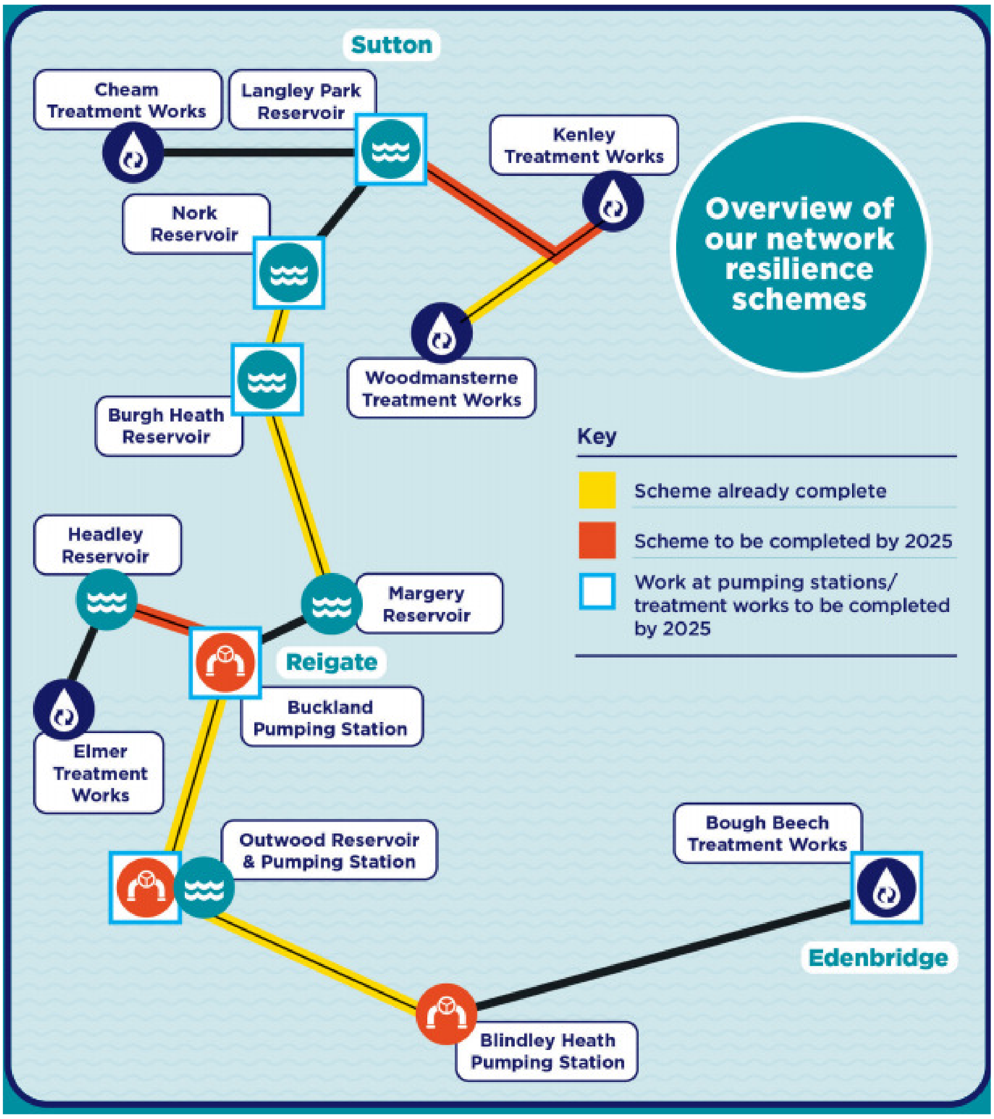
In situ measures at Bough Beech in the form of an air curtain assists in the improvement of our raw water quality. The air curtain works by aerating our reservoir and encourage mixing of the water and limiting the stratification that facilitates the build-up of algae in the surface layers, hence reducing the risk at the source rather than relying on expensive water treatment processes.

All our raw water undergoes treatment at one of our eight WTWs. We use filtration and chlorination to clean and treat the water, removing algae, microbes, and INNS that may be present. Chlorination ensures that the quality of the water is maintained right to the extremities of our network so that all our customers can be guaranteed a high level of water quality. We also add ammonia during water treatment which aids in the preservation of these chlorine levels.

Improved supply network connectivity

Historically when water quality issues have arisen, we have been able to select alternative water sources and move water around due to the interconnectivity of our supply system. The ability to easily switch to alternative water sources reduces the need for temporary water supplies and ensures continuity in the supply of safe drinking water to our customers. Since 2010, we have been progressing a resilience programme to increase the interconnectivity of our supply with strategic mains between Outwood and Buckland pumping stations; Burgh Heath service reservoir to Nork service reservoir; Woodmansterne Treatment Works to Purley; Buckland Pumping Station to Headley Service Reservoir; and Blindley Heath Service Reservoir to Outwood Pumping Station. On completion of this work in 2025 we will be able to supply every single customer from more than one treatment works, increasing our resilience to water quality issues due to algal blooms in addition to any other supply interruptions.

[26] SESW Water Quality Report 2019



6.2. Runoff and water pollution impacting water quality

Understanding the risk

Run-off from farms, roads, and other urban sources causes pollution to our water supplies, both ground and surface water. Climate change will increase precipitation over the winter and is anticipated to increase the severity and intensity of summer storms, increasing run-off and the potential for water pollution. In recent years we have experienced problems with farm based micro-pollutants, such as metaldehyde, that have prompted us to improve the resilience of our treatment works to these substances. As part of our Water Industry National Environment Programme 2 (WINEP2) we identified our main risks to water quality from land-use and run-off as bacteria/parasites (e.g. Cryptosporidium), nitrates, and pesticides (e.g. metaldehyde).

Other sources of pollution that are likely to increase as a result of climate change include leakage and overflow of sewers within our supply area. Contaminated water from these sewers may infiltrate into our groundwater sources decreasing the quality of the raw water. We do not own or maintain the sewer network in our area. Where we have previously seen a deterioration in raw water quality we have investigated and engaged with the relevant asset owners to remove the source of pollution. The events have not caused a significant challenge to the treatment capability at our works.

The impact of increased run-off under climate change will result in increased water treatment requirements and costs, in addition to increasing our water quality monitoring requirements.

Current and planned adaptation

Catchment management

As a company we have previously faced several challenges with farm based micro-pollutants such as metaldehyde (a pesticide) and Cryptosporidium (an infectious Protozoa). Our catchment management strategy addresses the risks posed by both diffuse and point pollution sources. The strategy involves engaging with our different stakeholders within the farming community by sending out regular newsletter communications relating to pesticide usage to ensure that they are well informed. In addition, we have worked directly with the local farmers whose land, and runoff, has a direct influence on the quality of the water in the River Eden. Through our strategy we encourage the use of alternative products that do not impact our water quality and ensure that cattle are kept aware from any boreholes that may affect groundwater quality.

Through our catchment management programme, we have reduced the risk of pollution to our greensand aquifers from a 20% chance of pollution in 5 years to a 5% chance. We believe that as climate change impacts the agricultural industry our sites will be challenged by other types of micro-pollutants which may mean that we have to review the resilience of our works and incorporate other measures to reduce their effect on water quality.

Catchment management will become a more significant activity for us moving forward to ensure improvements to our raw water quality and drive efficiencies in water treatment. Our continued collaboration with our regulators, landowners, sewerage companies, and local governments will ensure that we provide the optimum solution to any emerging water quality concerns that we face from climate change.

Water source monitoring and selectivity

Metaldehyde is difficult to treat using conventional pesticide removal processes and so, since the micro-pollutant was first identified in 2008, many of our efforts have sought to manage the risk through selective surface water abstraction to reduce the concentration abstracted into Bough Beech reservoir. The River Eden is also tested daily during active abstraction to mitigate against the risk of deterioration. This has improved our understanding of the risk and we have found that a useful ‘indicator’ of elevated Metaldehyde concentrations is when the river first increases above approximately 200 million litres per day from late-September onwards, which is typically accompanied by the highest ‘first flush’ Metaldehyde concentrations. As part of our abstraction protocol, this first major increase in river flow is allowed to pass without abstraction, thus significantly reducing Metaldehyde concentrations in Bough Beech Reservoir with minimal impact on the refilling of the reservoir.

We also take care to regularly rotate our abstraction boreholes and test in accordance with our groundwater monitoring programme to ensure a high-quality supply of water and to inform us of any potential hazards and necessary modifications in good time.

Potential future actions

We have the potential to consider additions to our water treatment processes and our water quality monitoring programme in future to ensure we continue to provide safe and quality water to our customers. We continuously assess the need for enhancements, and major upgrades can be completed through our 5-year business planning process.

6.3. Decline in Natural Capital impacting water quality

Understanding the risk

Natural Capital refers to our natural assets and resources: our groundwater, surface water and our surrounding environment. The health and longevity of the ecosystems and natural environment in our region are essential for our supply of safe and good quality water. Healthy ecosystems can help to breakdown water pollutants and maintain natural balance in the water cycle. However, high temperatures due to climate change, in addition to reduced precipitation and subsequent low flows, pose a threat to Natural Capital in our region which could have wide ranging impacts on people and species, including impacting water quality.

Chalk streams within our region, including the River Wandle,the River Hogsmill and the River Darent, are particularly vulnerable to low flows and the effects of climate change and require additional protection due to the fragility of their ecosystems and their rarity. The Chalk streams area is fed by the Chalk aquifers that we abstract from, and therefore it is important to maintain a balance between meeting our water demands whilst not causing any deterioration to our Chalk streams. Failure to protect our Chalk streams could result in a reduction to our abstraction licenses to mitigate against environmental decline, particularly in our Chalk aquifers. This would place additional stress on our water resources, requiring us to source additional water supplies or incur increased costs for water transfers from neighbouring companies. Not only would it impact our services, but it could lead to the loss of rare habitats and ecosystems that rely on the Chalk streams.

Current and planned adaptation

Catchment management activities

Alongside our catchment management activities to reduce pollution from run-off (Section 6.2), we carry out additional catchment management work to protect and enhance our Natural Capital. In line with our strategic environmental management plan, we are currently undertaking habitat surveys to gain a better understanding of the Natural Capital assets in our region, their current state, and the risks posed to them.

As part of our recent catchment management work, we have worked in partnership with our local river and wildlife trusts to deliver projects that enhance the environment that we and our local communities rely on. This includes maintaining augmentation of the flows in both the River Hogsmill and the River Wandle to protect trout spawning habitats, maintain a healthy ecosystem, and provide recreational benefits for the surrounding community. In the coming years we will continue to improve our Natural Capital through river restoration and naturalisation to enhance the rivers further and allow for free movement of fish. Whilst our ongoing work is focused on improving biodiversity, our future Business Plans will take a wider outlook to address total environmental net gain.

Water Industry National Environment Programme

To date, we have met all our obligations set out through previous versions (1 & 2) of the Water Industry National Environment Programme (WINEP). Under WINEP3 we will be investing £1.5 million to complete a further 24 investigations or actions before 2025. All of the agreed actions are driven by the need for either water quality (Drinking Water Protected Area – DrWPA), water resources (Water Framework Directive – WFD) or INNS improvements:

- Five water quality investigations focussed on identifying action points for preventing potential deterioration in surface or ground water quality
- Eight catchment management schemes
- Eight water resources schemes focussing on the prevention of deterioration of the ecological status of the River Wandle and the Upper Darent catchments due to flow pressures, and low flows on the Hogsmill
- Three companywide schemes relating to INNS and biosecurity, as outlined in Section 6.1 sub-section 'Surveying of INNS'

Our Biodiversity Action Plan

Biodiversity is the variety of plant, animal, fungal, and microbial life in a particular habitat. Ecosystems with higher biodiversity are generally healthier and more resilient to change. Biodiversity is important in our region and our sites, and we've made a commitment to enhance biodiversity. In 2018 we released out first Biodiversity Action Plan[27] where we identified the following areas as focal points for our business:

- **Company land management**: continue keeping the land we own rich in biodiversity while meeting all legal requirements for supplying drinking water
- **Minimising the impact of Company activity on the environment**: Prevent potential loss of biodiversity and mitigate risks to the environment from our operations, and reinstate the environment where loss has occurred due to our operations
- **Partnership working**: Extend our work with Thames Water, the South East Rivers Trust, and the Surrey & Kent Wildlife Trust to both enhance and protect existing biodiversity with river restoration and re-naturalisation projects
- **Engagement, education, and awareness raising**: Raise awareness and report our activities to reach the largest number of people possible, while making sure the information and work we have delivered is used to inform catchment decisions.

[27] SESW Biodiversity Action Plan 2018

Wildlife Trusts Commitment to Biodiversity

We are the only water company to currently hold The Wildlife Trust's biodiversity benchmarking certification, making us industry-leaders in our commitment to enhance and protect biodiversity. Our site at Elmer WTW in Leatherhead is the first of hopefully three of our sites to achieve this award; we hope to attain this accreditation at Bough Beech Reservoir in Kent and Fetcham Springs in Surrey by 2025. To obtain this award, we have undertaken habitat surveys; reduced mowing to allow wildflowers to flourish; installed bird boxes; created bug hotels and deadwood piles to provide a food source and habitat for a range of species including beetles, bees, and birds. At Elmer WTW and Young Street Boreholes our land is managed according to a five-year ecological management plan to help the biodiversity potential of the site to be realised. Particular attention has been made to maintain the unique flower-rich grasslands that support rare and protected species on site. Receiving this accreditation honours the commitments made in our 2020-2025 Business Plan[3] outlined in Section 2. We are now committing ourselves to continue our biodiversity work across all our sites to protect our Natural Capital. For example, we've installed eel screens at our Goatbridge site in Hackbridge and Barn Owl boxes on the land we lease to Kent Wildlife Trust near Bough Beech Reservoir.

6.4. Summary

Table 6.4: Summary of risks to water quality and Natural Capital in order of severity

Risk	Risk score before adaptation	Risk score with adaptation	Our Current and Planned actions	Our Performance commitments
High precipitation increasing run-off and pollution	25	12	• Catchment management strategy • Water source monitoring and selectivity	• Water quality compliance (CRI) • Water supply interruptions • WINEP Delivery – including river-based improvement • Taste, odour, discolouration • Abstraction incentive mechanism • Customer experience (C-MeX)
Declining Natural capital due to high temperatures and low precipitation	16	9	• Biodiversity Action Plan • Wildlife Trust's Biodiversity Benchmarking certifications	
Algal blooms due to high temperatures	16	8	• Improved supply network connectivity • Air curtain and water treatment processes • Water quality monitoring	
INNS driven by high temperatures	15	6	• Surveying INNS	
Changes in land use change increasing pollution	12	6	• Catchment management strategy • WINEP water quality investigations	
Increased wildfires driving increased diffuse pollution	9	6	• Catchment management strategy	

7. Risks from flooding and erosion

7.1. Flooding

Understanding the risk

The CCC's CCRA3 evidence report[28] (Appendix C.3) on flooding projects a significant increase in flood exposure to Category A infrastructure sites from surface, river, and coastal sources. Category A sites include our eight water treatment sites. Additionally, groundwater flooding from our Chalk aquifers is one of our most significant flood risks and it is anticipated that across the UK the costs associated with this risk will increase by 75% under a 4°C future scenario[28]. The risk of surface water flooding, affected by drainage and intense rainfall, is expected to double across the country by the 2080s under a 4°C scenario accounting for high population growth[28].

We know that our risk to groundwater and surface water flooding will increase due to changes in both winter and summer rainfall patterns, however, there remains uncertainty regarding the magnitude and the rate of these changes. UKCP18 data suggests that it is likely that we will see an increase in winter precipitation, which will increase our risk to groundwater flooding; the data also suggests that there will be an increase in the intensity and frequency of storms which will affect both surface and river flooding[13, 29].

In early 2014, our region experienced extensive groundwater flooding which affected our Kenley WTW and caused disruption within our area. Through collaborative action with the London Fire Brigade, the London Borough of Croydon, the Environment Agency, and neighbouring water companies we ensured that no customers lost supplies during the winter 2014 floods. More recently, we have experienced smaller-scale flood events during storms that have resulted in a loss of access to sites such as at our Goatbridge Pumping Station, river intake to Bough Beech, and Leatherhead. Whilst these events have been minor and service has been maintained, we are aware that flooding poses an increasing risk to our assets, which could result in supply interruptions, increased risks to water quality, and reputational damage.

Current and planned adaptation

Enhanced flood resilience

Since 2014, we have delivered flood protection and mitigation measures at our key 'at risk' sites, and we are continuing to assess our ongoing resilience to flooding. One of our highest risk sites, Kenley WTW had flood defence work completed in 2014 which included installing upstream flood relief, improved pumped drainage, and a bund wall around the site to provide protection against 1 in 200 year flood events. Other sites where work is ongoing include:

- **Leatherhead Pumping Station**: All electrical panels and equipment have been relocated and raised to the first floor to reduce the impact of any flooding. We are currently undertaking ongoing work to relocate and raise our switchgear to improve its resilience.
- **Woodmansterne Treatment Works**: A stormwater tank is located beneath the carpark and work has been completed to pump water out of the tank, reducing the flood risk to the lagoon offsite. A flood wall has also been installed to reduce the flood risk from overland surface flow.

We have also identified sites where we hope to increase our flood resilience in future investment periods, including an access road around the river intake to Bough Beech, and valve replacement and drainage enhancements at the river intake at Goatbridge.

Flood resilience review

As part of the Government's Flood Resilience Review in 2016 we submitted an assessment of the risk of our key assets taking into consideration the number of people each asset serves, it's location and proximity to known areas of both river and surface water flood risk. Table 7-1 shows the number of assets located within 20m of high, medium, and low risk areas for surface water flooding:

[28] CCRA3 Future flood risk
[29] UK extreme events – Heavy rainfall and floods

- **Low risk** – Areas where the chance of flooding in any one year is between 0.1% (1 in 1000) and 1% (1 in 100)
- **Medium risk** – Areas where the chance of flooding in any one year is between 1% (1 in 100) and 3.3% (1 in 30)
- **High risk** – Areas where the chance of flooding in any one year is greater than 3.3% (1 in 30)

We have 19 assets with a greater than 1 in 30 chance of flooding in any given year, including six out of eight of our WTWs. Of these WTWs, two have flood defences in place. Enhancing flood resilience will be a key focus of ours going forward.

Table 7-1 - Number of assets in or within 20m of a high, medium, and low risk area for flooding

Asset Type	Low risk area	Medium risk area	High risk area
Borehole	9	6	6
Bulk transfer (booster) pump	1	1	0
Service Reservoir	7	4	1
Water pumping station	6	6	6
WTW	6	6	6
Total	**29**	**23**	**19**

7.2. Erosion

Understanding the risk

Erosion is a naturally occurring process, however climate change is accelerating erosion in some locations due to more intense rainfall and flooding. Erosion threatens structures such as bridges and assets located close to riverbanks, as well as the structural integrity of the embankments of our reservoirs[13]. Human intervention such as vegetation removal from riverbanks, river re-direction around infrastructure, and river straightening can increase the rate of riverbank erosion further. The impact caused by erosion is two-fold: firstly, our assets such as pipes or reservoirs may become exposed or damaged thus requiring urgent repair, and secondly, bridges or adjacent access roads may become inaccessible or damaged preventing access to our sites. Impacts are likely to be localised but can be significant – potentially interrupting supply to some customers or creating water quality risks, often requiring temporary water supplies to be deployed whilst repairs are carried out and flood water is managed.

The risks to our reservoirs are discussed further in Section 8.1 where we describe the plans we have in place to maintain reservoir safety.

Current and planned adaptation

Incident management plan

In the case of an incident, we have robust plans in place to ensure disruption is kept to a minimum and we are still able to serve our customers to a high standard. For each of our assets we have procedures to safely isolate or re-route supply where we need to. All our incident managers and operational staff are trained to respond to events, and we have clear escalation routes for both in and out of hours operations to ensure that incidents can be managed safely and efficiently.

Alongside our incident management plan, we regularly test and exercise the valves at each of our sites to ensure they remain operational. We carry out scenario simulations with a third-party partner on an annual basis as part of our training in addition to in-house event response drills.

Strategic mains enhancements

Our climate risk assessment in 2011 identified four pipe bridges at significant risk of bank erosion. One of these bridges, Flanchford Road in Reigate, was subsequently damaged during a flood event, affecting our mains supply. To enhance our network resilience, on replacement of the main we made the decision to install a twin main across the river, providing additional redundancy to reduce the risk of supply disruptions in future. We are continuing to assess our mains that cross rivers and will consider additional enhancements in future.

We are continually improving the interconnectivity of our supply network and by 2025 all our customers will be able to receive water from an alternative treatment works if a mains supply becomes damaged due to riverbank erosion.

7.3. Summary

Table 7.3: Summary of risks from flooding and riverbank erosion

<table>
<tr><th>Risk</th><th>Risk score before adaptation</th><th>Risk score with adaptation</th><th>Our Current and Planned actions</th><th>Our Performance Commitments</th></tr>
<tr><td>High precipitation causing river, surface water and/or groundwater flooding of assets</td><td>20</td><td>9</td><td>• Enhanced flood resilience at some key sites
• Flood risk assessments</td><td rowspan="2">• Water quality compliance (CRI)
• Water supply interruptions
• Mains repairs
• Unplanned outage
• Taste, odour, discolouration
• Greenhouse gas emissions
• Water softening
• Pollution incidents
• Risk of supply failures
• Customer experience (C-MeX)</td></tr>
<tr><td>High precipitation causing river bank erosion impacting assets</td><td>12</td><td>9</td><td>• Incident management plan
• Improved supply network connectivity and dual supply for customers</td></tr>
</table>

8. Risk of supply interruptions

8.1. Disruptions due to subsidence

Understanding the risk

Subsidence caused by the shrinking and swelling of clay soils occurs in response to changes in soil moisture. When clay-rich soils are water saturated, the ground swells and rises in a process called heave; when the weather becomes warmer and drier and these soils dry, the ground shrinks and cracks which causes subsidence. Subsidence presents a significant problem for our underground assets, our pipelines, which are susceptible to damage[13]. As leakage reduction is one of our performance commitments it is essential for us to understand our risks from subsidence so we can limit and manage the impacts accordingly. Bough Beech reservoir also faces risks from subsidence; shrinkage of the soils surrounding the reservoir may lead to cracks appearing in the reservoir walls or failure of the earth-filled embankment itself, the impacts of which would be very severe.

London and the South-East of England are particularly susceptible to subsidence due to the underlying geology. The map in Figure 8-1 shows reported subsidence events within our area[30]. Whilst there are fewer reported hotspots than other parts of London and the South East, the problem is widespread across our area.

The higher temperatures and reduced summer precipitation projected under climate change suggests that our risks from subsidence will increase. Recent work from the British Geological Society (BGS)[31] combined

[30] Geobear UK Subsidence Maps
[31] BGS GeoClimate

geotechnical information with long-term rainfall and temperature scenarios to identify high risk areas of Britain. Figure 8-2 shows the worst-case scenario of the future subsidence risk driven by climate change in the South East. Our regions is identified as likely and highly likely to experience a large increase in susceptibility to subsidence by 2030 and 2070.

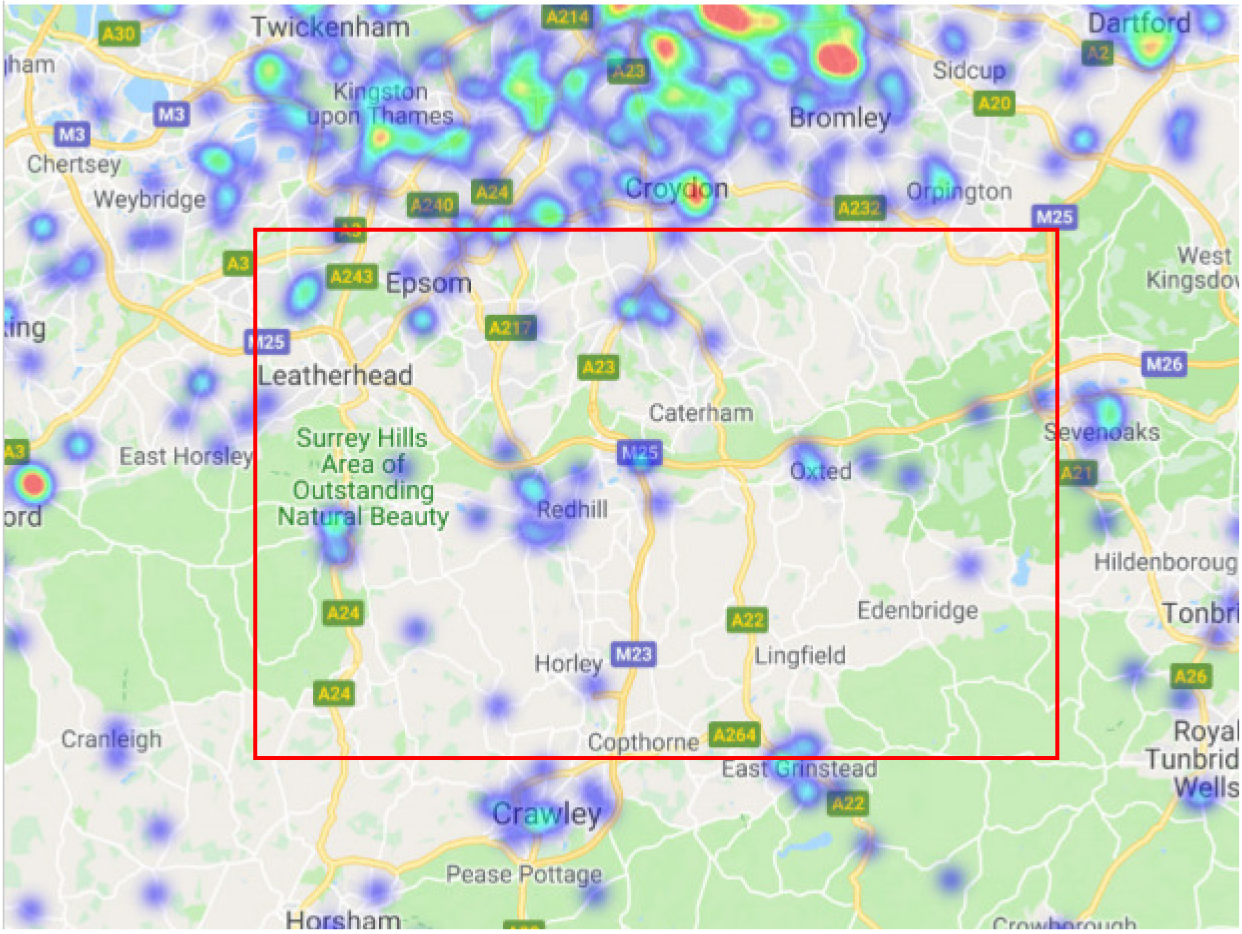


Figure 8-1 - Subsidence map for London and the South East. The red bounding box shows the area in which we operate[30]

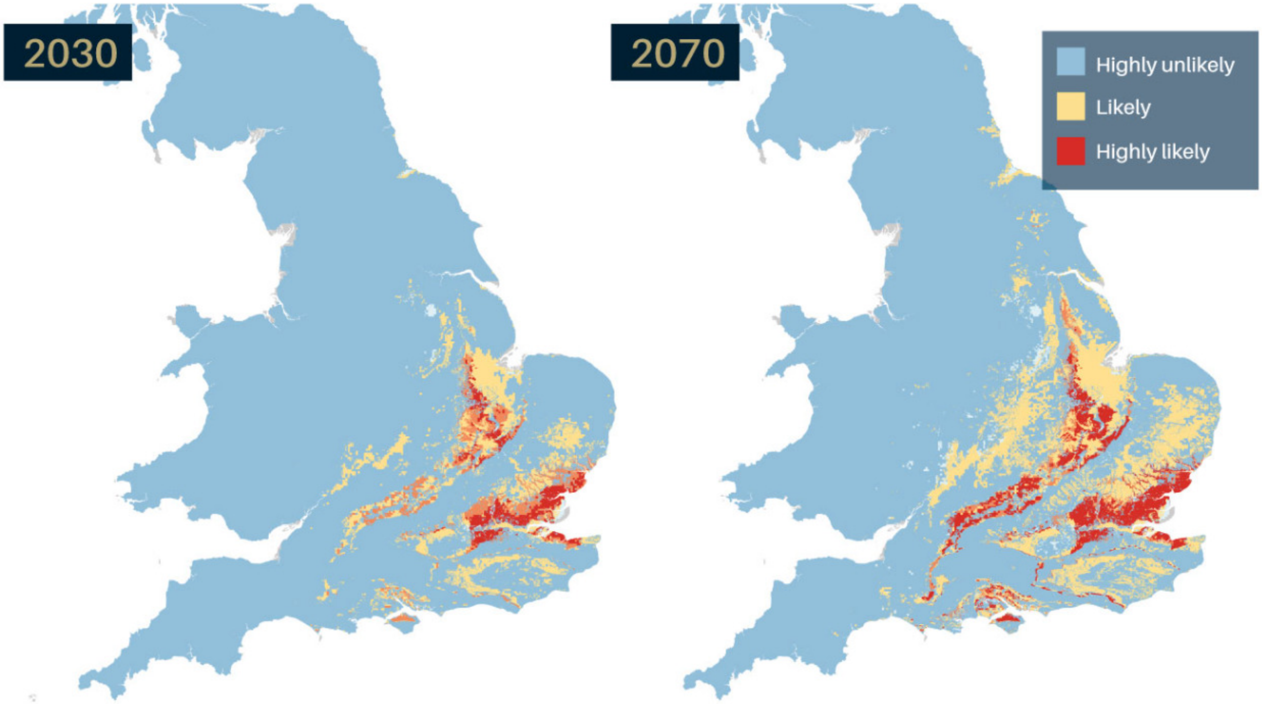


Figure 8-2 – Future likelihood of subsidence for 2030 and 2070[31]

Current and planned adaptation

Enhanced monitoring and soil moisture modelling

In recent years, we have made links between dry summers and increased ground movement with subsequent disruption to our pipe network. We are already seeing the impact of climate change with increased numbers of pipe bursts during dry summers. Whilst these bursts may not be catastrophic, it has highlighted the need for enhanced monitoring so we can respond rapidly to minimise water loss and any disruption to customers.

To improve our understanding of our risk, we have carried out soil moisture modelling with a particular focus on the London Clay formation which is most susceptible to subsidence. Our modelling looks at the shrinkage and expansion of the clay, based on soil moisture deficits, to proactively predict ground movement and potential asset failure. Further to this, we have strategically placed piezometers at Bough Beech to monitor ground movement which are inspected every three months. An annual assessment is made using this data to update our understanding of ground movement in our area.

Targeted asset renewal

Whilst we cannot control subsidence, we can mitigate the severity of impacts by ensuring that our assets remain in a good condition and are replaced accordingly. Alongside our monitoring and Active Leakage Control (ALC) programme, we undertake a targeted asset renewal programme. This is based on burst history and predictive preventative maintenance, prioritising the elements of our network which have the poorest integrity and a greater propensity to leak.

Pollution incidents as a performance commitment

Incidents such as burst mains and leaking pipes have the potential to pollute waterways. To reflect the importance we place on our role in minimising the impact the water sector has on the environment, we are the only water-only company to have included pollution incidents as a performance commitment in our Business Plan. We strive never to cause severe pollution to land, air, or water and for our 2020 to 2025 planning period we have committed to the target of no category 1 or 2 pollution incidents (as measured by the Environment Agency). To achieve our commitment, we will:

- Maintain our compliance with ISO14001 – our Environmental Management System has first achieved this accreditation in 2015 and has been continuously certified as conforming to the standard since

- Take action to reduce the probability of pollution-causing incidents such as burst mains, and improve our response to such incidents to minimise their impact
- Working closely with the Environment Agency, we continue to thoroughly investigate all pollution incidents and near-misses to understand root causes and learn from them
- Work with stakeholders such as the Environment Agency and environmental groups to find additional ways of reporting and mitigating the impact of more minor category 3 and 4 pollution incidents

8.2. Disruption due to extreme weather

Understanding the risk

Extreme weather includes all events outside of the normal climatic range experienced in the UK and includes, but is not limited to: windstorms, heatwaves, electric storms, and extreme cold. As these events fall outside the normal range of conditions that our systems and infrastructure are used to operating in, there is a higher tendency for assets to fail under extreme weather conditions which could result in interruptions to household water supply. Failures could occur at several points in our supply chain, affecting our production network, distribution network, and our operational response. Climate change is expected to increase the frequency and severity of extreme events, particularly heatwaves and storms, although extreme cold events may decrease but can't be ruled out[32]. The CCC's CCRA3[33] report indicates heatwaves will become more frequent, which when prolonged, could result in assets overheating leading to failures in the production and distribution network. Windstorms and electrical storms also have the potential to damage assets and interrupt power and communications at our sites.

Current and planned adaptation

Enhancing resilience to extreme weather

We have several controls in place to manage the impacts of extreme weather and respond if disruptions occur. We are also enhancing our resilience to extreme weather events. The following controls are already in place or will be by the end of 2025:

- Increasing redundancy with additional capacity at Bough Beech WTW so that more water can be treated and transferred across our region if our production network is interrupted at other WTWs.
- Increasing redundancy and reliability through our long-term network enhancement, including network calming and optimisation, improving our ability to remain operational should we face disruption due to extreme weather.
- Increasing resistance and reliability through Active Leakage Control (ALC) and targeted asset replacement to minimise the chance of damage to assets under extreme weather.
- Increasing resistance through strategic location of critical equipment away from severe weather in kiosks and buildings, and maintaining lightening protection for vulnerable assets.
- Increasing resistance with ventilation installed on critical electrical and communications equipment, reducing the risk of overheating during extreme heat events.
- Increased resistance, response, and recovery through exploring opportunities to generate renewable energy and make our standby energy generation more environmentally friendly.

8.3. Failure of interdependencies

Understanding the risk

Interdependencies refer to our reliance on external parties, networks, and services such as energy, telecommunications, transport, and waste management systems. The CCC's CCRA3 report highlights increasing evidence for the impacts of weather-related events on telecommunications and ICT due to heavy rainfall, temperature extremes and fluctuations[34]. As a company we rely on these to carry out our daily duties and serve

[32] UK extreme events - Cold
[33] CCRA3 Briefing – High Temperatures
[34] CCRA3 Briefing – Telecoms and ICT

our customers. Without any one of these components, our ability to continue providing clean and safe drinking water would be impacted, potentially resulting in supply interruptions and impacts on water quality. Our risks from the failure of our interdependencies is variable; short-term interruptions would likely have minor impacts but as the failures themselves are out of our control, prolonged interruptions could result in severe and costly impacts.

Failures may occur as a result of many climate driven phenomena such as heatwaves, flooding, wildfires, subsidence, and electric storms. Just as we are vulnerable to a range of impacts due to climate change, so are our interdependent infrastructure suppliers such as our energy provider. For example, power outages are commonplace due to lightning strikes affecting our local electricity distributor.

For our distribution network, the biggest risk is a loss in telecommunications. Our network sensors rely on a 5G network, which if lost, would result in a loss of visibility across our network. Whilst we would still obtain flow and pressure measurements from our telemetry loggers, we would lose the ability to rapidly detect and respond to leaks or breaks within our network and manage demand surges that may occur alongside critical infrastructure outages. Our supply chain is also vulnerable to climate induced disruption; flooding often causes disruption to transport networks posing a threat to the timely delivery of critical equipment and materials, for example chemicals for water treatment. Flooding also impacts our ability to get around our region to operate our sites and respond to any disruptions.

Our actions to respond to these risks focus on mitigating against the worst of the impacts and ensuring that we can be self-sufficient where possible, through improved network capacity, when required, until normal service can be resumed.

Current and planned adaptation

Power and communications alternatives

To manage the impact of power supply interruption, we have ensured that we have secondary, independent sources of power in the form of diesel generators available at our key sites. We are aware of the negative impacts that diesel generators have on the environment so are actively looking to replace them with greener solutions. For example, we are currently trialling the use of Hydrotreated Vegetable Oil (HVO) in our generators which is more environmentally friendly. In addition, we are increasing our own solar generation to drastically reduce our carbon emissions. We hope that as battery technology improves and can meet the power demand required by our sites, we will be able to transition towards the use of batteries as our secondary power source.

In the case of interruption to telecommunications, our logging devices at critical sites can use the 4G mobile network to record key information. Any data recorded during a period of outage is recoverable once full telecommunications services resume. This means that once service resumes, we can respond to any leaks or issues in the network that occurred during the period of outage.

Surplus storage of chemicals and critical parts

Whilst we cannot control interruptions to our supply chain, we can mitigate and manage impacts in the short to medium term. All our key sites have sufficient storage capabilities where we can safely store a seven-day surplus of essential chemicals for water treatment, in addition to critical spare parts for our network. We also have the capacity to store our own sludge and waste products safely should this aspect of our supply chain be disrupted.

Supply chain resilience

Brexit and Covid-19 have led to supply chain interruptions that all water companies have had to face in recent years. As a result of these two events, we have made enhancements to increase our supply chain resilience. This has included our participation in mutual aid schemes with other water companies for the procurement of additional resources and critical supplies during times of need.

8.4. Summary

Table 8-1 - Summary of risks to supply interruptions

Risk	Risk score before adaptation	Risk score with adaptation	Our Current and Planned actions	Our Performance Commitments

Subsidence causing damage to assets	20	12	• Enhanced monitoring and soil moisture modelling • Targeted asset renewal	• Water quality compliance (CRI) • Water supply interruptions • Leakage • Mains repairs • Unplanned outage • Taste, odour, discolouration • Greenhouse gas emissions • Pollution incidents • Risk of supply failures • Customer experience (C-MeX)
Failure of earth impounding reservoir	10	4		
Extreme weather causing failures in distribution network	20	9	• Enhanced supply connectivity • Strategic placement of assets • Asset renewal	
Extreme weather causing failures in production network	12	6		
High temperatures causing assets to fail in production and distribution networks	12	6		
Wildfires causing damage to assets	9	6		
Disruptions to supply of critical materials and equipment	16	9	• Communications and power alternatives • Surplus chemical storage • Mutual aid schemes	
Climate induced disruptions to energy and telecommunications	16	8		

9. Our ongoing commitment to climate resilience

What we're doing well

At SES Water we are making great progress in increasing our resilience to climate change, particularly through our work in water resources. We have a good level of understanding of how climate change will impact our water resources through our 2019 WRMP and we are building upon this in our 2024 WRMP. Through our 2019 WRMP work we have optimised our strategy for future water security, undertaken scenario testing at a 1 in 200-year level of resilience and developed a strategy to ensure secure supplies to meet demands in our region for the next 25 years without placing any additional strain on our natural capital and resources. Our strategy focusses on demand management and our understanding of how climate change will influence our customers' behaviour has seen us make significant progress towards increasing the uptake of metering through our successful customer engagement programmes.

As part of our 2020-2025 Business Plan, we are enhancing our network resilience by increasing the connectivity of our water supply network. This will improve our security of supply and service resilience, ensuring that every customer can be supplied by more than one treatment works by 2025.

We have a good understanding of our vulnerability to supply interruptions from extreme weather such as freeze thaw events, and we have been proactive in our mitigation of this risk through a combination of monitoring and targeted asset renewal.

Our ongoing commitment to 'resilience in the round' would not be possible without the collaboration of key stakeholders in our region. Whilst collaboration is an area of strength for us, it is not without its challenges. Engaging with stakeholders takes time and addressing the views of stakeholders often requires compromise. Working closely with the regional sewage provider, local farmers, South East Rivers Trust, and the Surrey & Kent Wildlife Trust has helped us to reduce our risk to poor water quality in addition to securing long-term water quality through increased biodiversity and enhancements to our Natural Capital.

Areas for further investigation, action, and investment

We recognise that there are some areas where our understanding of our risks from climate change could benefit from investigation and analysis, including considering the findings from the CCC's CCRA3 reports (Appendix C) and the most recent climate projections, UKCP18. Some work is underway through our WRSE work, but it is important for us as a company to also invest in the areas most pertinent to our region and business.

Table 9-1 presents the risks that we have identified as areas for potential further focus where either our understanding or our management of the risk could be enhanced.

We've identified two risks which remain high after controls are in place where our adaptation actions should go further in future investment periods. These are: the risk of asset damage due to subsidence; and the risk to water quality due to increasing run off.

We've identified 16 risks which are medium or high risks before controls are in place where our understanding of the risks could be improved. This includes 11 risks where our understanding is low and 5 risks where our understanding is between low and medium. It's possible that our actions to control these risks are not sufficient in the medium to long term due to the fact that our understanding of the risks is limited. Therefore, our understanding of these risks could be improved to inform decisions for future investment periods. These include risks relating to flooding, water quality, supply interruptions, and the failure of interdependencies.

Our current flood risk assessments rely on the older UKCIP02 and UKCP09 datasets and are in need of updating to reflect recent work, including changes to our sites and surrounding areas over the last 12 years using the latest UKCP18 data. We recognise this as a key area for investment to improve our understanding of our current and future flood risk. An updated flood risk assessment will help us inform our decision making for future upgrades at our sites.

Our understanding of the risk from subsidence in our area is low, in part due to a lack of any catastrophic events within our region. However, we are aware that our risk to subsidence is likely to be high due to our geological setting and the drier climate in the South East. Moving forward we hope to improve our understanding of our risk to subsidence utilising the latest UKCP18 and BGS datasets available.

We currently have a low understanding of the risks climate change poses to interrupting our supply and impacting our interdependencies, particularly where hazards such as wildfires and subsidence are concerned. We are developing our thinking about wider system issues, and we will be addressing this as our systems resilience framework evolves.

Table 9-1 - Areas for further focus: 1. Risks where understanding is Low or Low/Medium and risk assessment score before controls is Medium or High; 2. Risks where the post mitigation score remains High (>10)

Risk Group	Risk	Our understanding of the risk	Risk score before controls & adaptation	Risk score after controls & adaptation
Water quality and natural capital	Algal blooms	L/M	16	8
	INNS	L/M	15	6
	High precipitation increasing run off and pollution	M	25	12
	Climate driven land use change increasing risk of pollution	L	12	6
	Declining natural capital	L/M	16	9
	Wildfires leading to increases in diffuse pollution	L	9	6
Drought and peak/high water demand	Climate driven land use change increasing water demand	L/M	12	6

	Wildfires leading to high water demands	L	9	6
Flooding and erosion	Flooding of assets	L/M	20	9
	River bank erosion impacting assets	L	12	9
Supply interruptions	Subsidence causing damage to assets	L	20	12
	Failure of earth impounding reservoir	L	10	4
	Extreme weather causing failures in production network	L	12	6
	High temperatures causing assets to fail in production and distribution networks	L	12	6
	Wildfires causing damage to assets	L	9	6
Failure of interdependencies	Climate-induced disruptions to energy and telecoms	L	16	8
	Disruption to supply of critical materials and equipment	L	16	9

Our ongoing actions

Adapting to climate change is an ongoing process, and our Adaptation Report reflects where we are at with understanding the risks and taking appropriate actions, while recognising we have to do more in future investment periods. Our climate change risk assessment has been based on our corporate risk framework which is currently evolving as we work towards enhancing our systems-based resilience framework. Looking ahead, our work as a company will be focussing on the following areas:

- **Enhancing systems-based resilience across our company** – we will be progressing the work carried out in developing our climate change risk assessment and operationalising this Adaptation Report to complement our systems-based resilience framework as part of our ongoing work towards 'resilience in the round'.
- **Embedding climate adaptation and resilience measures into all our investments** – our investments in infrastructure and across our business will consider climate change and embed adaptation measures into the investment, to ensure we remain resilient and able to deliver desired outcomes for our customers and the environment.
- **Adapting to climate change whilst managing affordability** – we will continue to take action to adapt to climate change and enhance our environment, whilst managing affordability for our customers. We will use findings from this Adaptation Report to inform our planning for future investment periods, whilst engaging with customers to understand their priorities for investment.
- **Achieving Net Zero** – we are continuing work towards becoming a Net Zero company by 2030. We will continue to be mindful of the carbon footprint of any actions we take to adapt to climate change, ensuring that we are not hindering our efforts towards Net Zero.
- **Collaborating to enhance resilience** – we will continue to listen to and engage with our customers and work closely with our partners and stakeholders to achieve the shared outcome of a climate resilient future for our region.
- **Learning from others** – we will continue to seek to learn from others across the water sector and from other sectors and countries in adapting to climate change.

Appendices

Appendix A. Climate Change Risk Assessment

A version of our climate change risk assessment in the simplified Water industry format requested by Defra can be seen below[35]. For the detailed risk assessment please refer to the accompanying excel workbook.

Table A-1 - Defra simplified climate risk assessment

Climate change risk and Defra's CCRA2 2017 Risk Code	SES Water's Understanding of the risk (H/M/L)	Scoring before controls			Controls	Metrics/reporting
		Likelihood of occurring (1-5)	Magnitude of impact (1-5)	Risk score (1-25)		
Risks from drought and high/peak water demand (In9)	M	4	5	20	• Ensure sufficient water storage • Leakage reduction programme • Customer engagement and metering • Drought Plan 2021 • Planning for 1 in 500 year drought resilience • Future scenario testing	• Per capita consumption • Leakage • Water supply interruptions • Risk of severe restrictions due to drought • Unplanned outage • Risk of supply failures • Customer experience (C-MeX)
Risks to water quality and natural capital (Pn13 & Ne1)	M	5	5	25	• Catchment management strategy • Water source monitoring and selectivity • Biodiversity Action Plan	• Water quality compliance (CRI) • Water supply interruptions

[35] Where there are multiple causes of the climate risk, we have selected the scoring of the key cause for each climate risk. For climate risks where there are two equally significant key causes, we have shown the maximum score across the two. Where appropriate, the key cause for each group has been identified using an asterisk (*) in the detailed climate risk assessment.

Table A-1 - Defra simplified climate risk assessment

Climate change risk and Defra's CCRA2 2017 Risk Code	SES Water's Understanding of the risk (H/M/L)	Scoring before controls			Controls	Metrics/reporting
		Likelihood of occurring (1-5)	Magnitude of impact (1-5)	Risk score (1-25)		
					• Wildlife Trust's Biodiversity Benchmarking certifications • Improved supply network connectivity • Air curtain and water treatment processes • Water quality monitoring • WINEP water quality investigations • Surveying INNS	• WINEP Delivery – including river-based improvement • Taste, odour, discolouration • Abstraction incentive mechanism • Customer experience (C-MeX)
Risks from flooding (In2)	L/M	4	5	20	• Enhanced flood resilience at some key sites • Flood risk assessments	• Water quality compliance (CRI) • Water supply interruptions • Mains repairs • Unplanned outage • Taste, odour, discolouration • Greenhouse gas emissions • Water softening • Pollution incidents • Risk of supply failures • Customer experience (C-MeX)
Risks to assets from high river flows and bank erosion (In5)	L	3	4	12	• Incident management plan • Improved supply network connectivity and dual supply for customers	

Table A-1 - Defra simplified climate risk assessment

Climate change risk and Defra's CCRA2 2017 Risk Code	SES Water's Understanding of the risk (H/M/L)	Scoring before controls			Controls	Metrics/reporting
		Likelihood of occurring (1-5)	Magnitude of impact (1-5)	Risk score (1-25)		
Risks from subsidence (In8)	L	5	4	20	• Enhanced monitoring and soil moisture modelling • Targeted asset renewal	• Water quality compliance (CRI) • Water supply interruptions • Leakage • Mains repairs • Unplanned outage • Taste, odour, discolouration • Greenhouse gas emissions • Pollution incidents • Risk of supply failures • Customer experience (C-MeX)
Risks from failure of interdependencies (In1)	L	4	4	16	• Communications and power alternatives • Surplus chemical storage • Mutual aid schemes	
Risk of household water supply interruptions (Pb14)	L	5	4	20	• Improved supply network connectivity • Strategic placement and protection of key assets • Asset renewal	

Appendix B. UK Climate Projections

The UK Climate Projections 2018 (UKCP18) are a UK climate projection tool that supersedes the UK Climate Projections 2009 (UKCP09). The tool helps decision-makers to assess their risk exposure to climate change for various climate factors by providing updated observations and climate change projections for the current century up to 2100.[36] UKCP18 provides a range of products, including probabilistic projections, Global Climate Models (GCMs) and Regional Climate Models (RCMs), where a range of emissions scenarios – Representative Concentration Pathways (RCP) – and model ensembles show the uncertainty in climate change across a wide range of climate variables.

For this Adaptation Report we present the projected changes to the average and maximum summer temperature, and winter precipitation in our area[37] for the 2050s and 2080s. Three different climate emission scenarios[38] are presented in the following graphs and maps:

- **RCP8.5** – 'Business as usual scenario', where the trajectory of emissions is comparable to a future with >4°C warming by 2100.
- **SRES A1B** – Intermediate scenario. This scenario has been included as it was used in our 2011 ARP report so offers an opportunity to compare across the Adaptation Reports. This scenario is comparable to a 3-4°C future by 2100.
- **RCP4.5** – Low to intermediate scenario where the trajectory is comparable to a future with 2-3°C warming by 2100.

The three scenarios used in our assessment provide an indication of future climate change but contain a significant amount of uncertainty, particularly for projections further in the future (2080s). We have presented values for 10th, 50th and 90th percentiles[39] to acknowledge this and the range of probable outcomes.

B.1. Temperature

B.1.1. Average Summer Temperature

Summer temperatures are expected to increase as a result of climate change. This is consistent with the projections in Figure B-1, Figure B-2, Figure B-3, Figure B-4, Figure B-5 and Figure B-6 which show the predicted change in average summer temperatures (°C) in our region for the 2050s and 2080s, respectively. Under RCP4.5, 50th percentile projections show average summer temperatures could increase 1.8°C by 2050 (Figure B-1) and 3.1°C by 2080 (Figure B-2), above the 1981-2000 baseline of 16.5°C. The projected increase under RCP8.5 is greater, reaching 2.4°C by 2050 (Figure B-1) and 4.8°C by 2080 (Figure B-2), above the 1981-2000 baseline.

Increased temperatures present a range of risks to our business and our ability to maintain an uninterrupted supply to customers. Higher temperatures are associated with an increased risk of drought events due to higher rates of evapotranspiration. This can increase the risk of supply interruptions, particularly during periods of peak demand. Additionally, the risk of pipework leakage and bursts is increased as a result of ground shrinkage and movement which can cause supply interruptions. Increased temperatures create more favourable conditions for some invasive non-native species (INNS) which impacts the biodiversity of our water bodies, and algal blooms thrive during periods of warmer weather which can have negative impacts on water quality and our water treatment processes. Temperature increases can also have knock on impacts causing failure of interdependent infrastructure, which impact our operations.

[36] About UKCP18 - Met Office

[37] Projections are probabilistic climate projections for a 25km grid cell (537500.00, 162500.00). The projections are calculated from baseline data for the period 1981-2000.

[38] Emissions Scenarios (SRES). For easy comparison with UKCP09 projections, UKCP18 include SRES A1B which is most similar to RCP6.0 (medium emissions scenario), and this scenario has been included in this report. RCPs define the level of radiative forcing in the atmosphere as a result of greenhouse gases; a larger number indicating greater radiative forcing. For the purpose of risk assessments, RCP 4.5 (low/medium emissions) and RCP8.5 (high emissions / business as usual) are most commonly used.

[39] Representing the lowest 10%, the median and highest 90% of values.

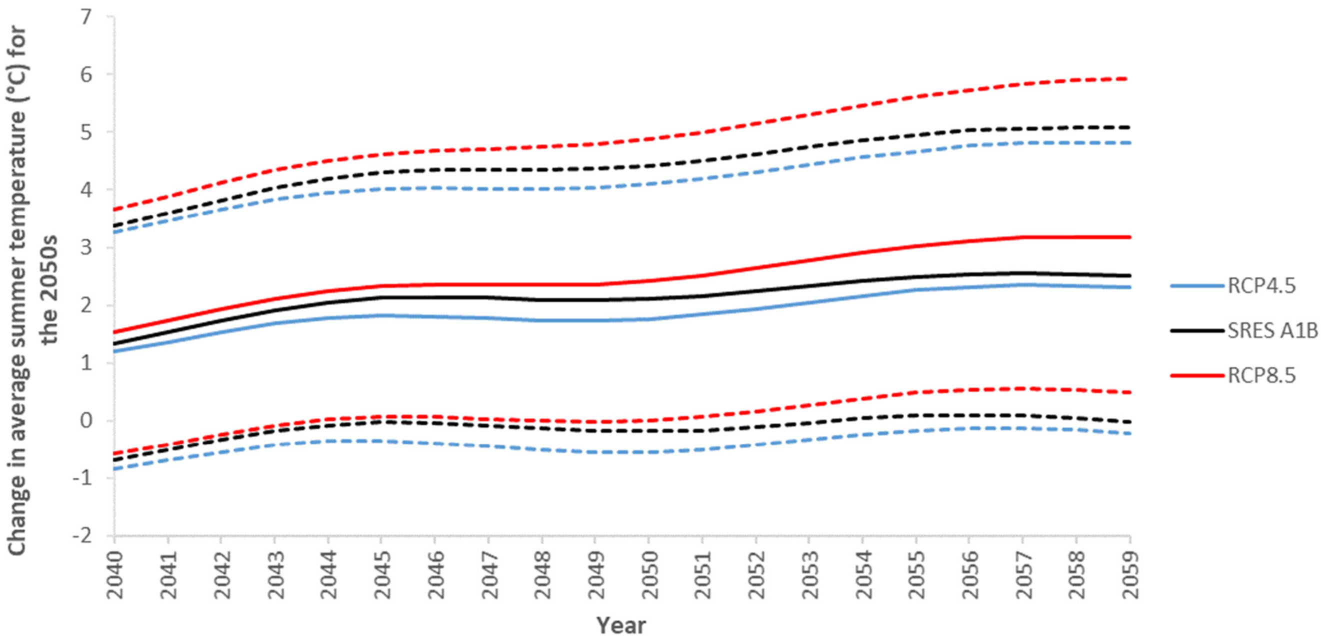


Figure B-1 - Projected change in average summer temperatures (℃) for the 2050s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

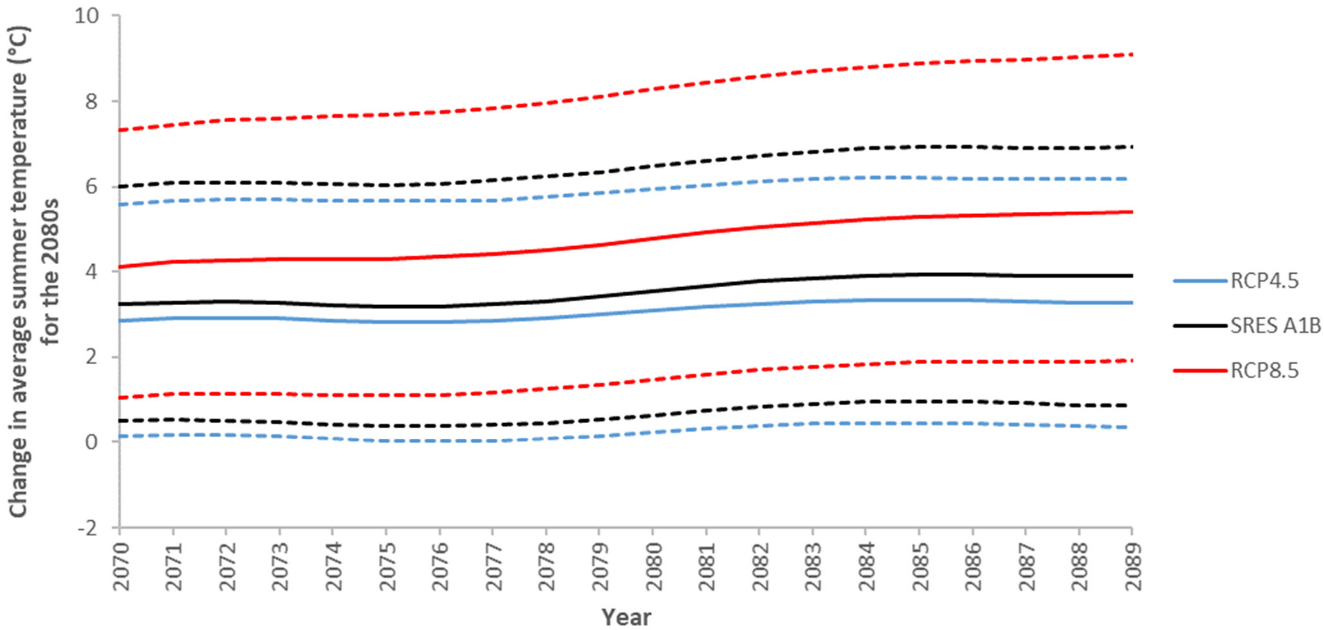


Figure B-2 - Projected change in average summer temperatures (℃) for the 2080s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

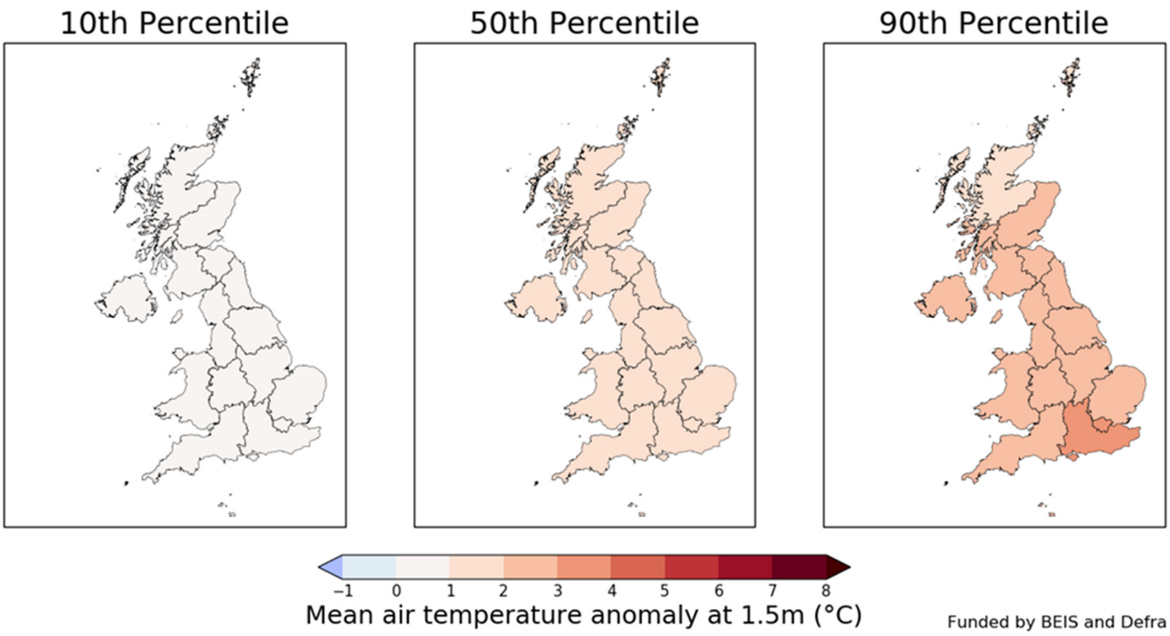


Figure B-3 - Change in average summer air temperature (℃) for the 2050s using scenario RCP4.5

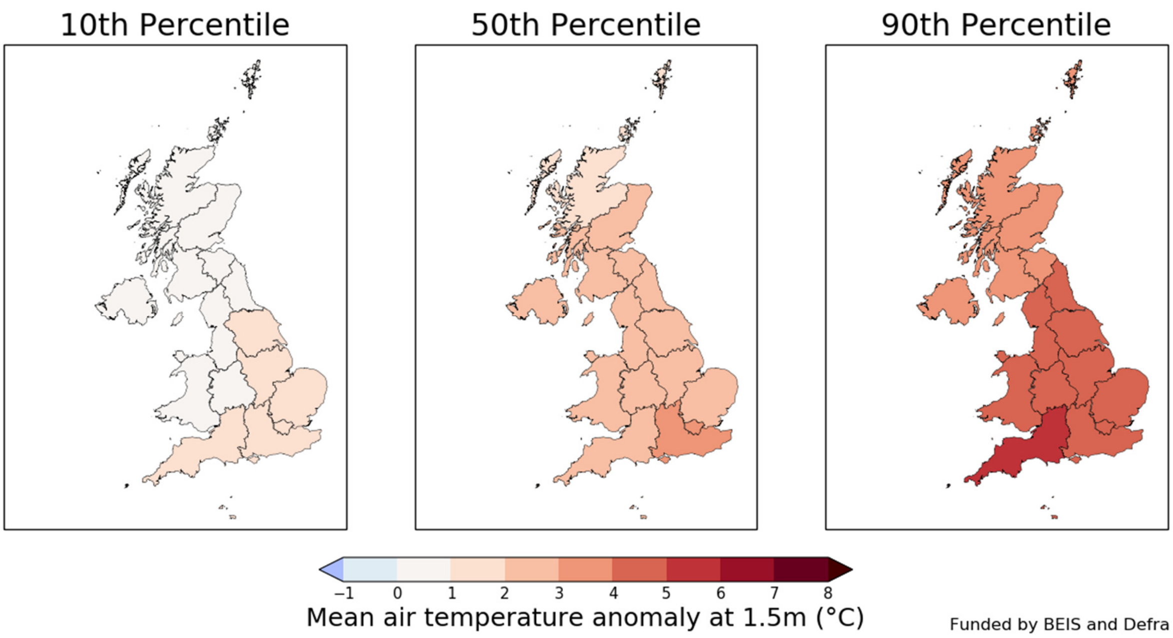


Figure B-4 - Change in average summer air temperature (℃) for the 2080s using scenario RCP4.5

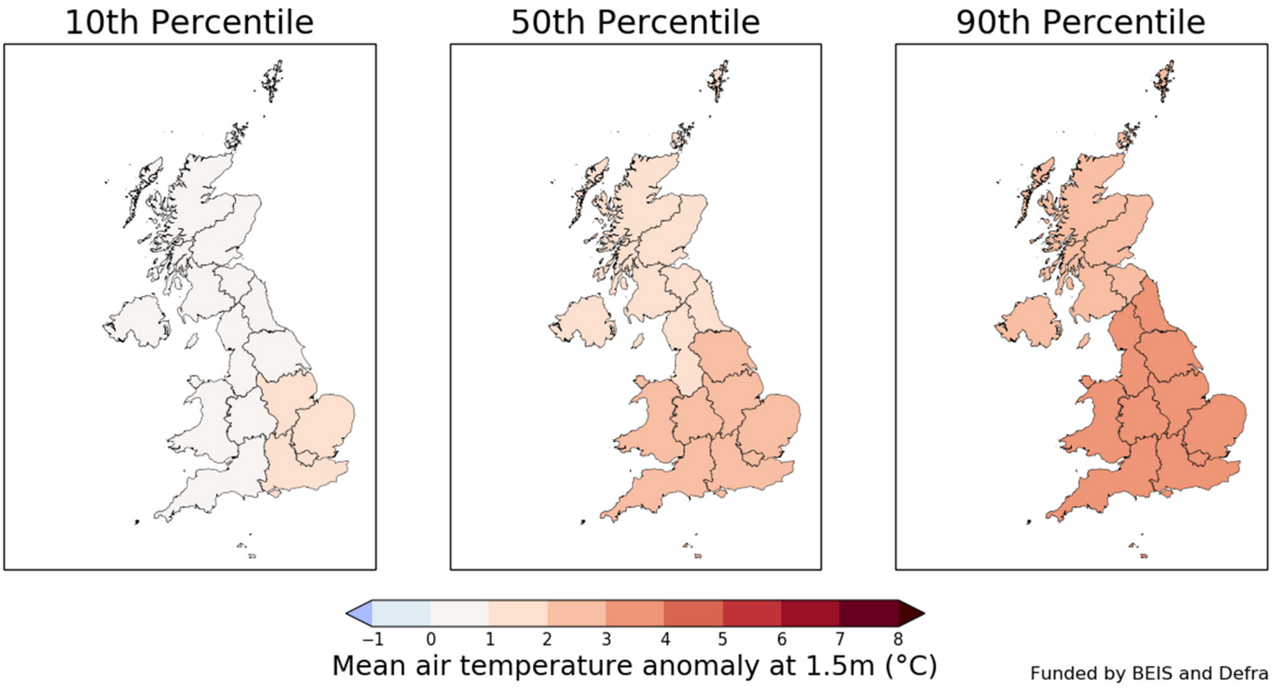


Figure B-5 - Change in average summer air temperature (℃) for the 2050s using scenario RCP8.5

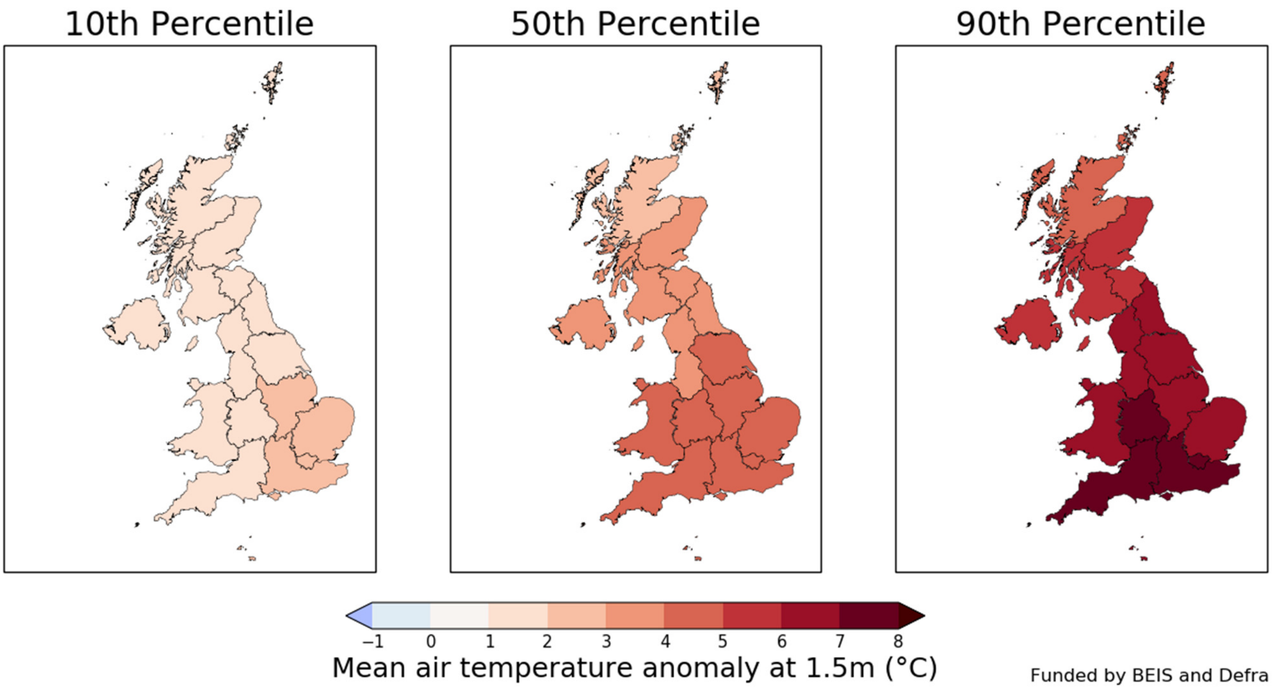


Figure B-6 - Change in average summer air temperature (℃) for the 2080s using scenario RCP8.5

B.1.2. Maximum Summer Temperature

Alongside average summer temperatures, temperature extremes are expected to increase with climate change. This is consistent with the projections in Figure B-7, Figure B-8, Figure B-9, Figure B-10, Figure B-11, Figure B-12 which show the projected change to maximum summer temperatures (℃) in our region for the 2050s and 2080s. Under RCP4.5, 50th percentile projections suggest maximum summer temperatures could increase 2.0℃ (Figure B-7) by 2050 and 3.5℃ by 2080 (Figure B-8), above the 1981-2000 baseline. Under RCP8.5, maximum summer temperatures are projected to increase by 2.7℃ by 2050 (Figure B-7) and 5.5℃ by 2080 (Figure B-8), above the 1981-2000 baseline.

Extended periods of high temperatures, or heatwaves, generate greater demand for water and reduced water supply from increased rates of evapotranspiration which impacts our ability to maintain a secure water supply. Our operations also face the risk of knock-on effects as a result of failure of interdependent infrastructure.

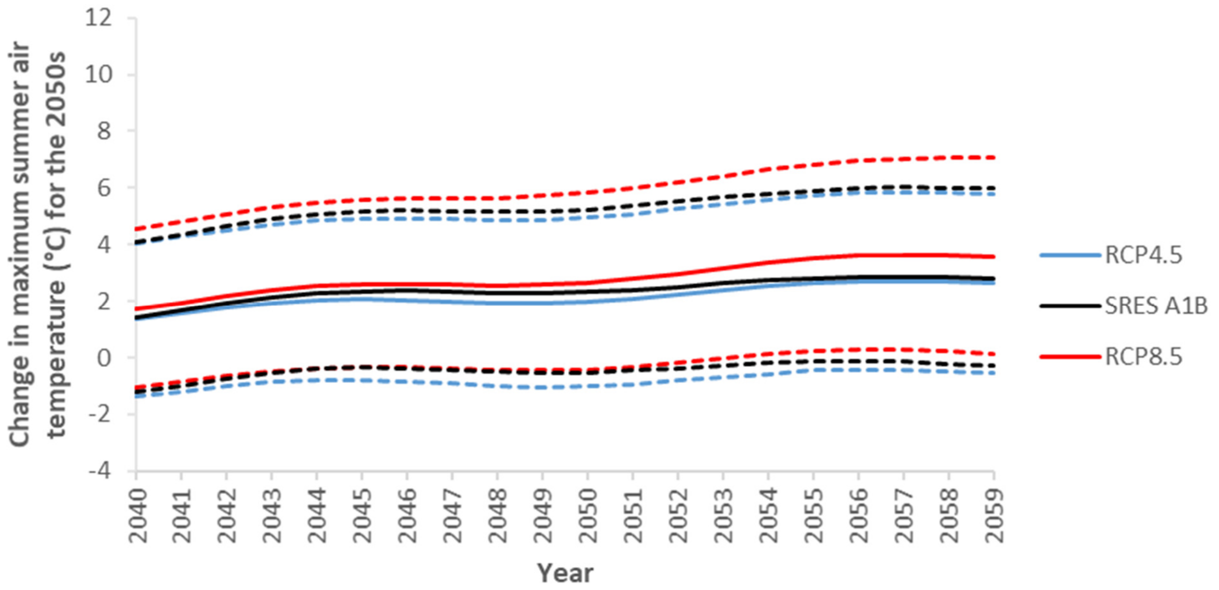


Figure B-7 - Projected change in maximum summer temperatures (℃) for the 2050s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

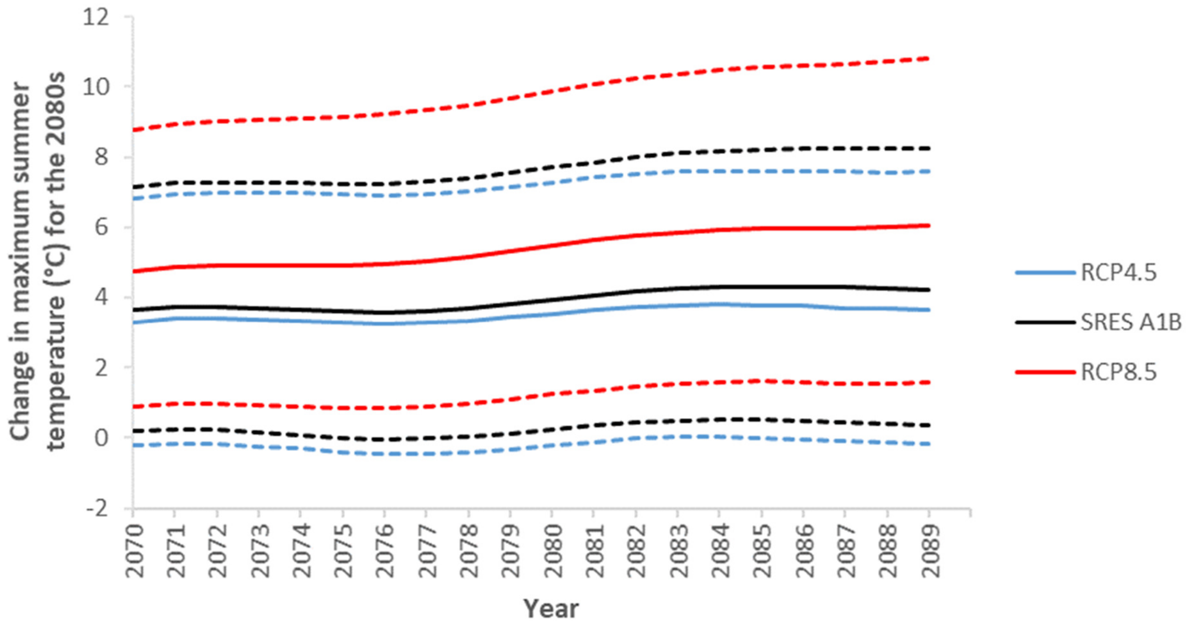


Figure B-8 - Projected change in maximum summer temperatures (℃) for the 2080s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

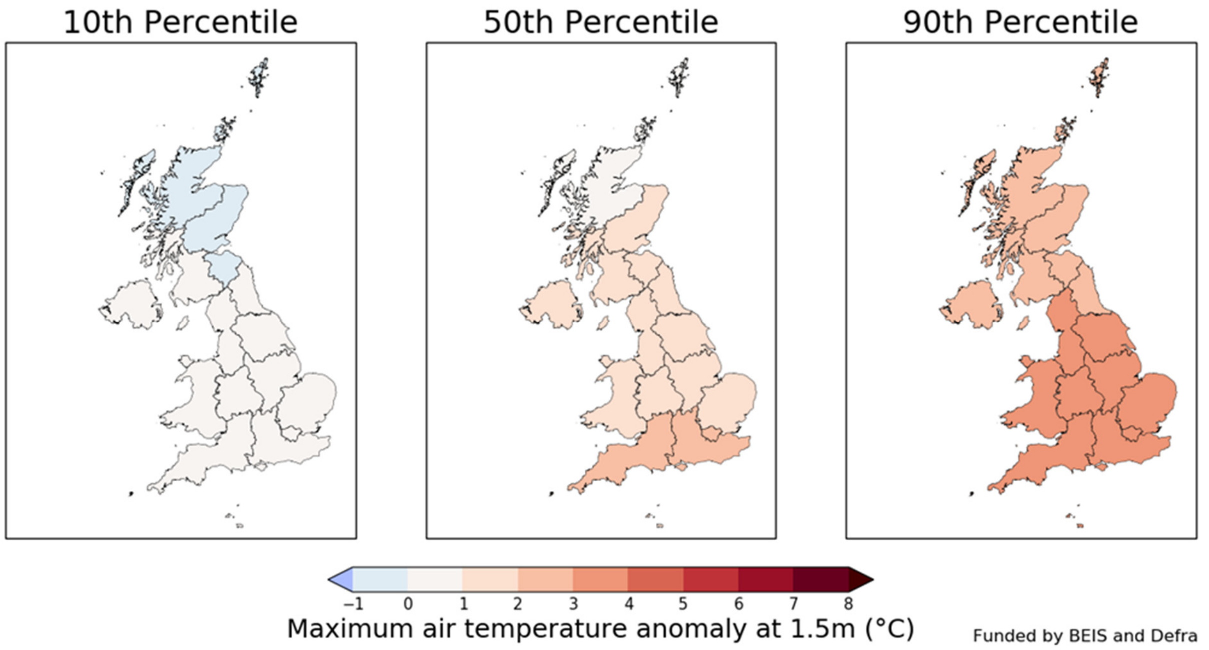


Figure B-9 - Change in maximum summer air temperature (℃) for the 2050s using scenario RCP4.5

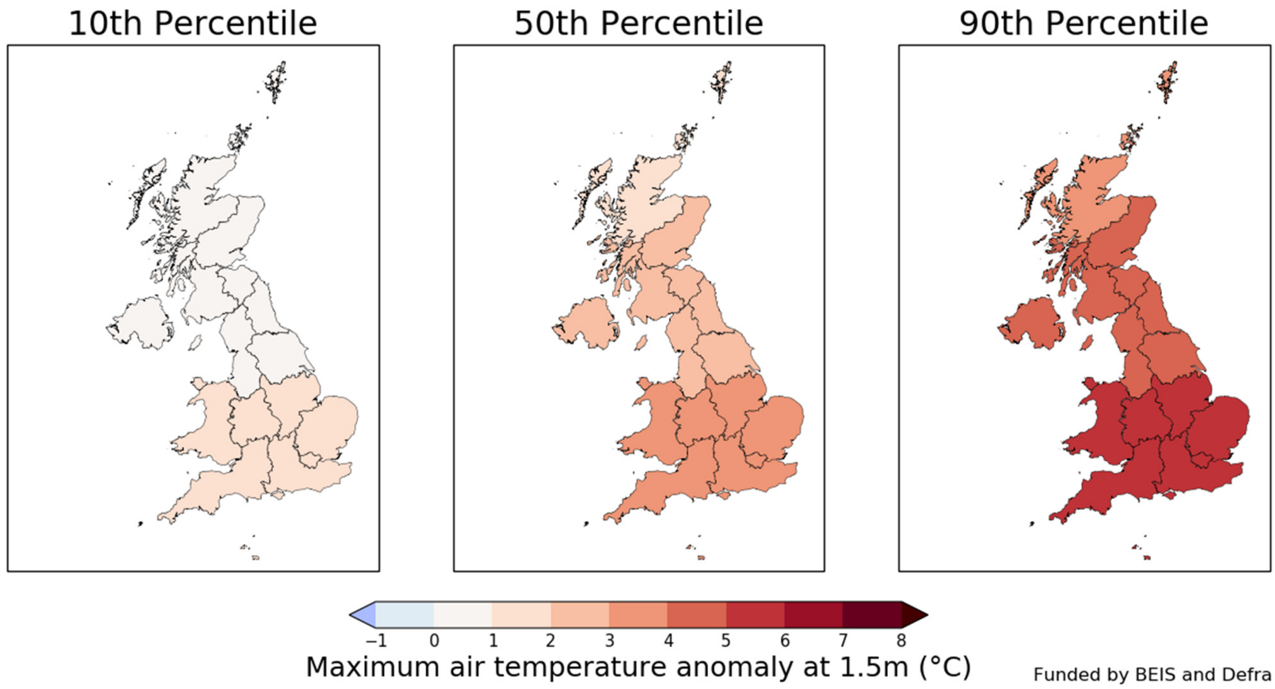


Figure B-10 - Change in maximum summer air temperature (℃) for the 2080s using scenario RCP4.5

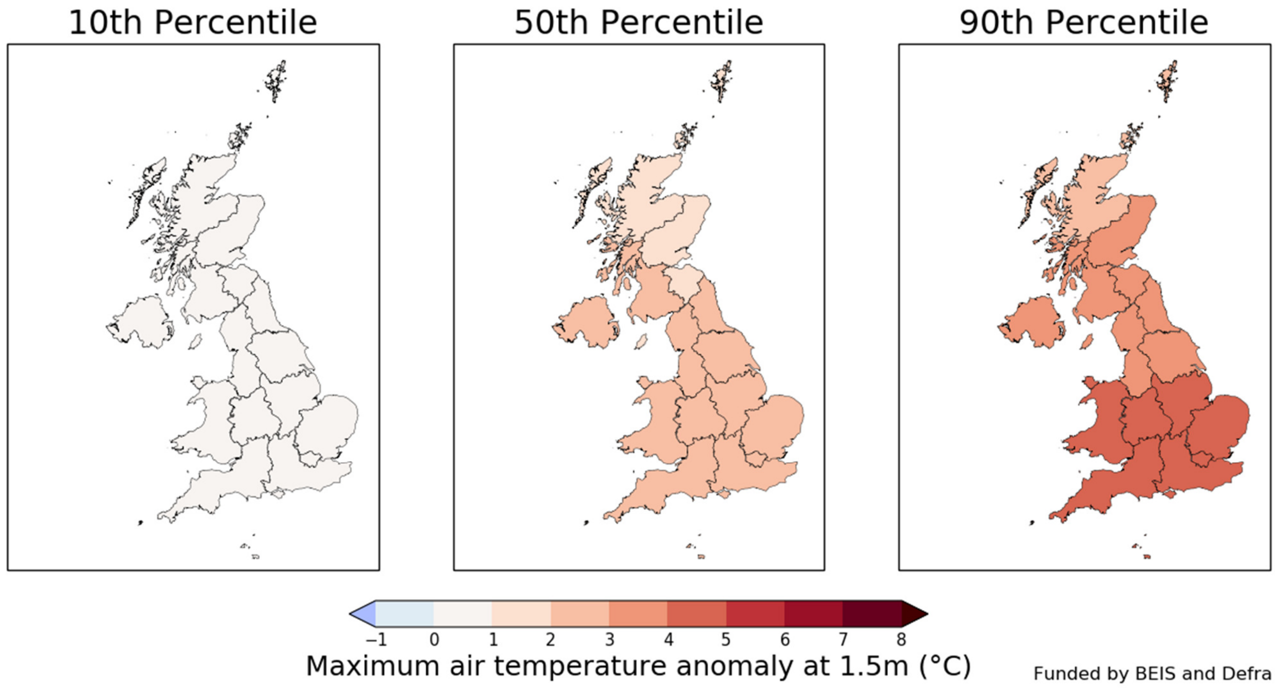


Figure B-11 - Change in maximum summer air temperature (°C) for the 2050s using scenario RCP8.5

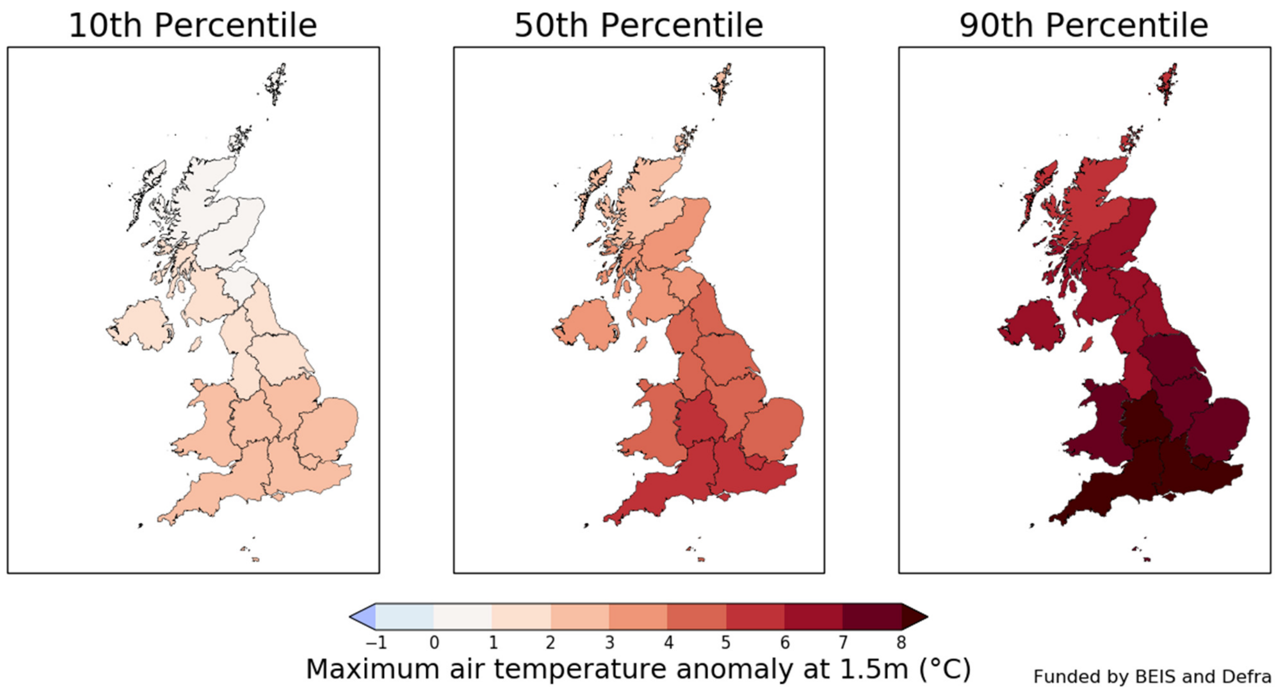


Figure B-12 - Change in maximum summer air temperature (°C) for the 2080s using scenario RCP8.5

B.2. Precipitation

B.2.1. Average Summer Precipitation

Summers in the UK are expected to become drier although the intensity of summer rainfall when it occurs is expected to increase. A general decreasing trend in rainfall can be seen in Figure B-13, Figure B-14, Figure B-15, Figure B-16, Figure B-17, Figure B-18, which show the projected change in average summer precipitation

(%) in our area for the 2050s and 2080s, respectively. Under RCP4.5, 50th percentile projections show summer rainfall is projected to decrease 24.6% by 2050 (Figure B-13) and 25.3% by 2080 (Figure B-14), below the 1981-2000 baseline of 150.7 mm/month. Under RCP8.5, the decrease is expected to be 28.0% by 2050 (Figure B-13) and 35.2% by 2080 (Figure B-14), below the 1981-2000 baseline.

Low rainfall and drought impact the availability of water and our ability to maintain a secure water supply whilst also presenting an increased risk of subsidence which could damage our assets.

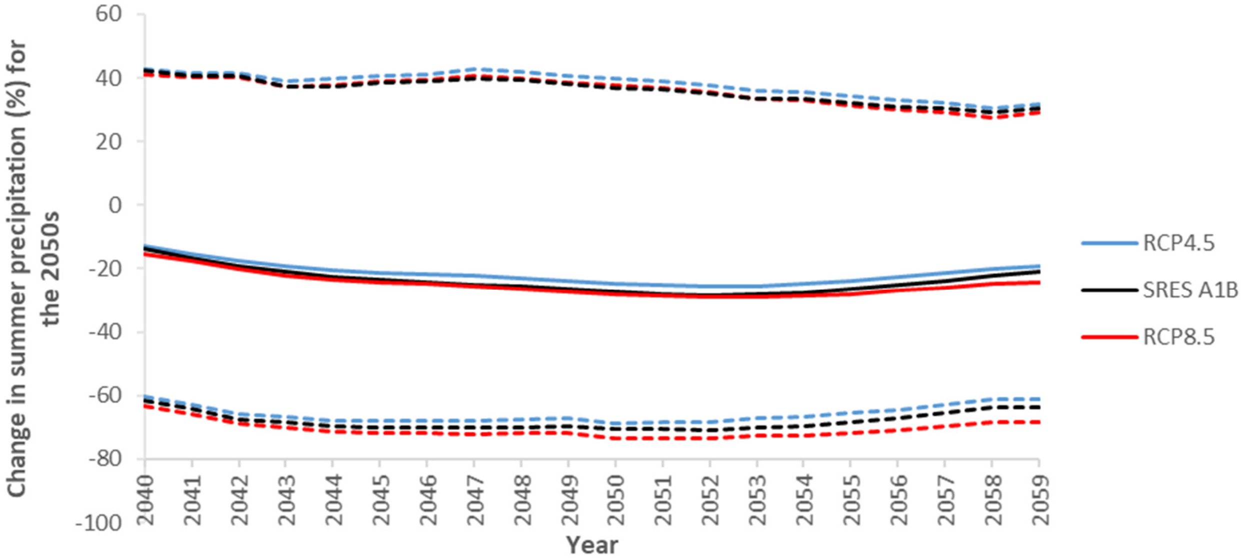


Figure B-13 - Projected change in average summer precipitation (%) for the 2050s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

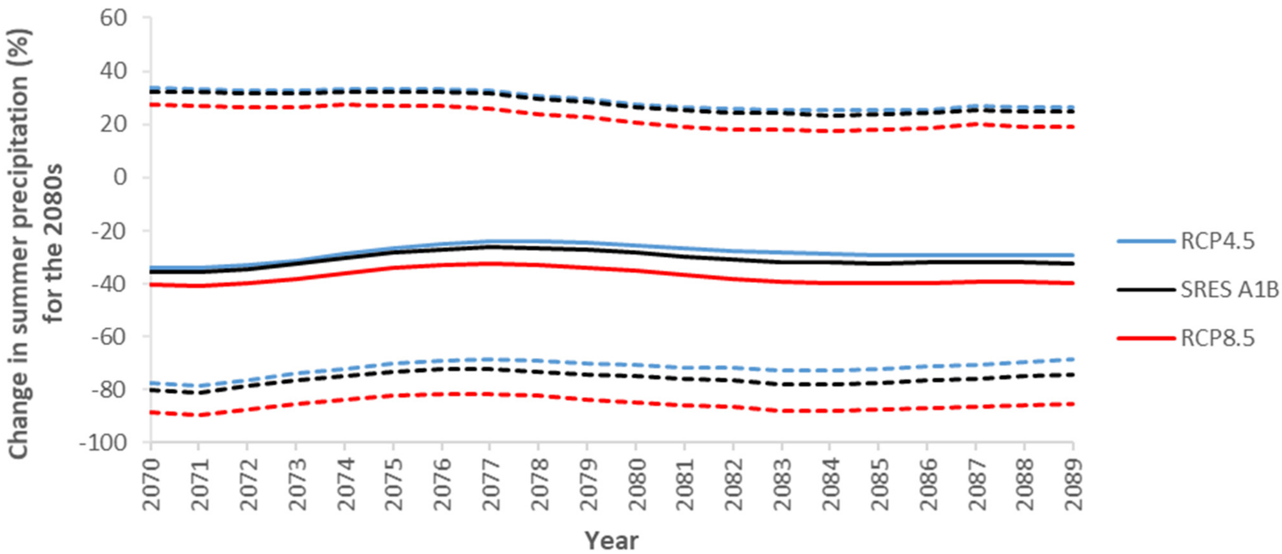


Figure B-14 - Projected change in average summer precipitation (%) for the 2080s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

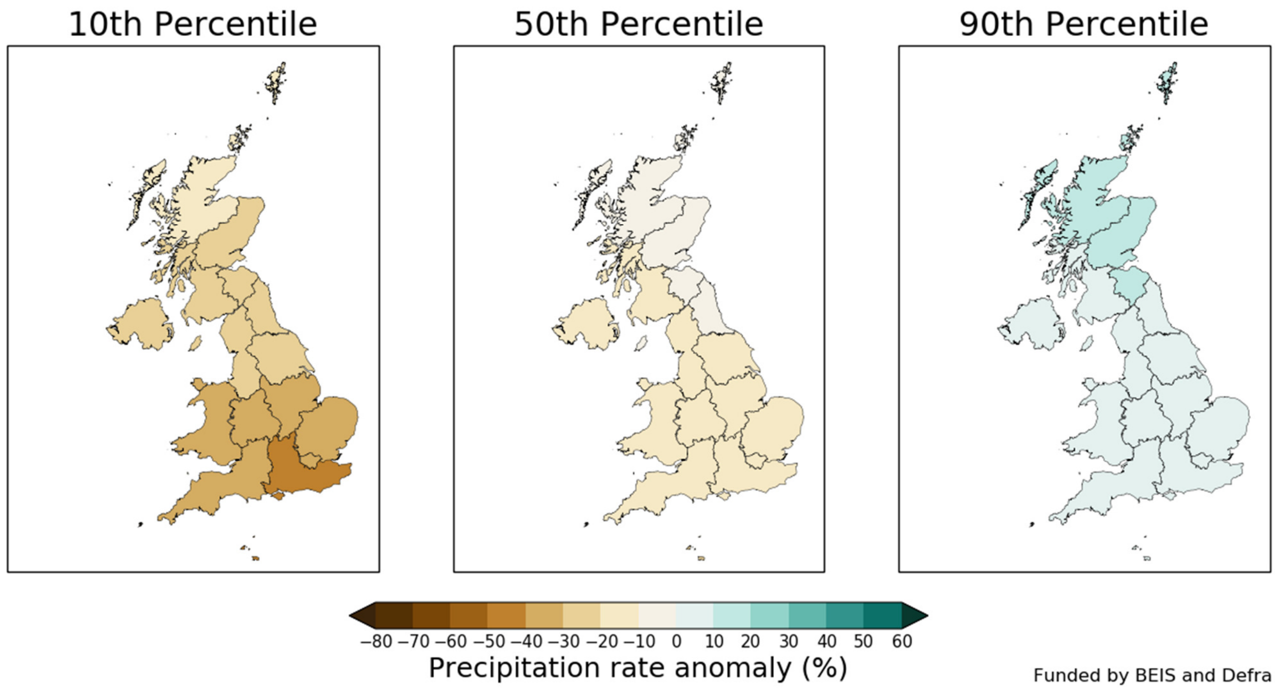


Figure B-15 - Change in average summer precipitation (%) for the 2050s using scenario RCP4.5

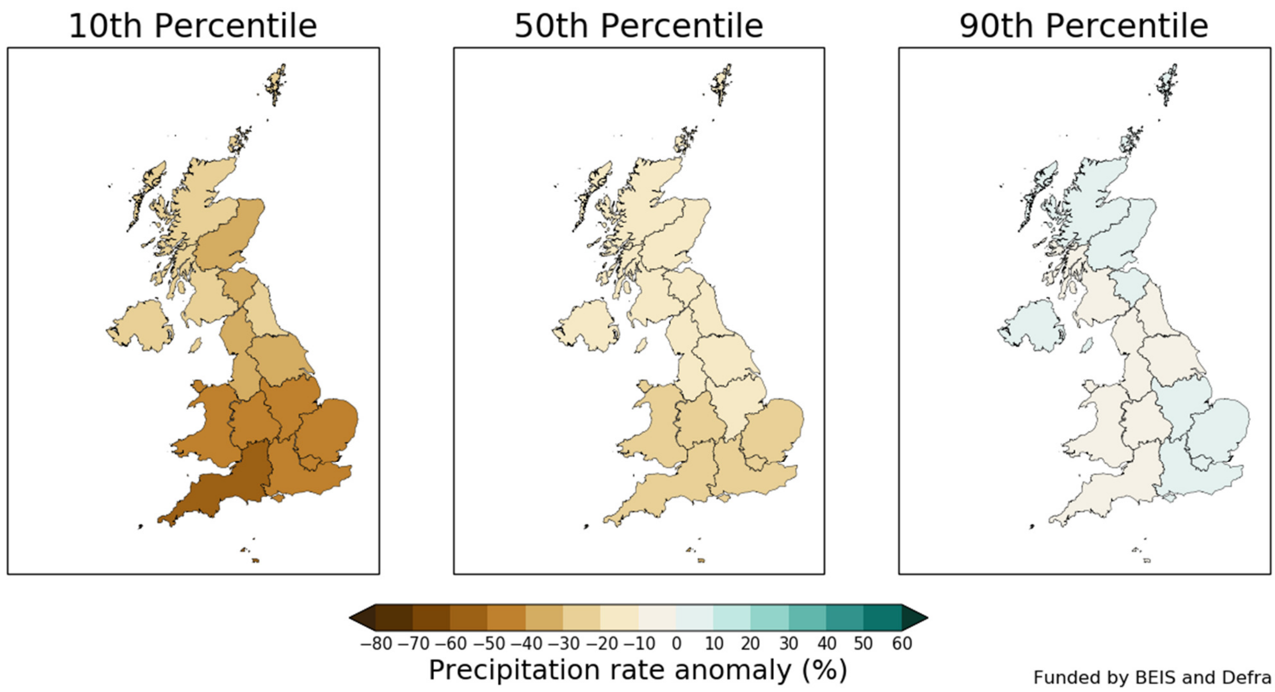


Figure B-16 - Change in average summer precipitation (%) for the 2080s using scenario RCP4.5

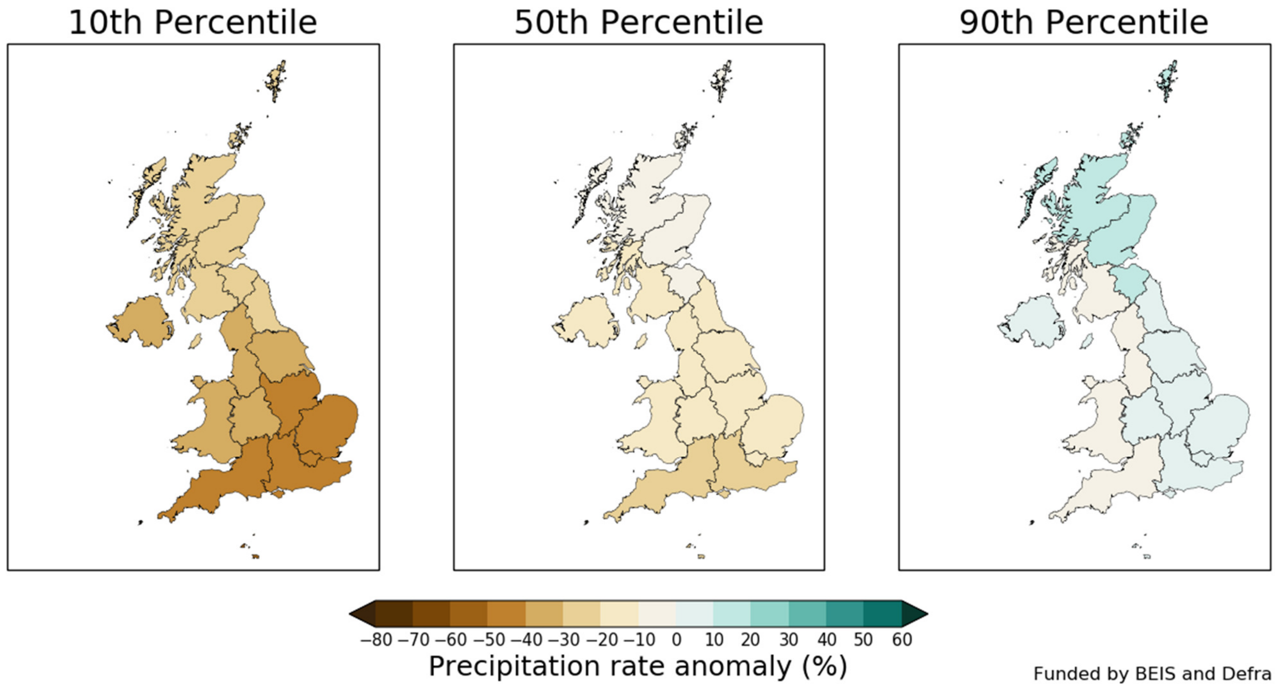


Figure B-17 - Change in average summer precipitation (%) for the 2050s using scenario RCP8.5

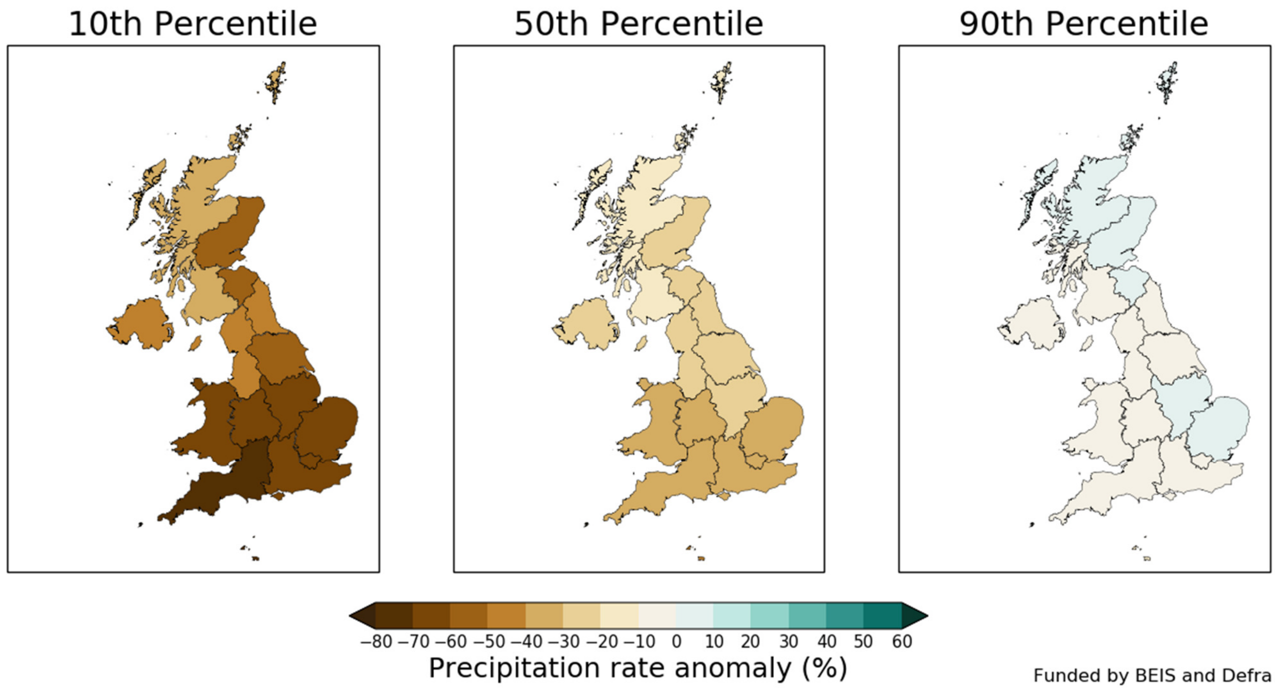


Figure B-18 - Change in average summer precipitation (%) for the 2080s using scenario RCP8.5

B.2.2. Average Winter Precipitation

Winters are expected to become wetter in the UK as a result of climate change, both in terms of frequency and intensity of rainfall. The projected increase in winter precipitation (%) for our region is shown Figure B-19, Figure

B-20, Figure B-21, Figure B-22, Figure B-23, Figure B-24. Under RCP4.5, 50th percentile projections suggest that winter rainfall will increase 6.8% by 2050 (Figure B-19) and 11.8% by 2080 (Figure B-20), above the 1981-2000 baseline of 190.6 mm/month. This increase is greater for RCP8.5, under which 50th percentile projections show winter rainfall could increase 8.7% by 2050 (Figure B-19) and 18.0% by 2080 (Figure B-20), above the 1981-2000 baseline.

High winter rainfall increases run-off into our water supply which impacts water quality and our treatment processes. Alongside this, our assets face increased risks from high flows, flooding and bank erosion which impacts our ability to maintain an uninterrupted water supply.

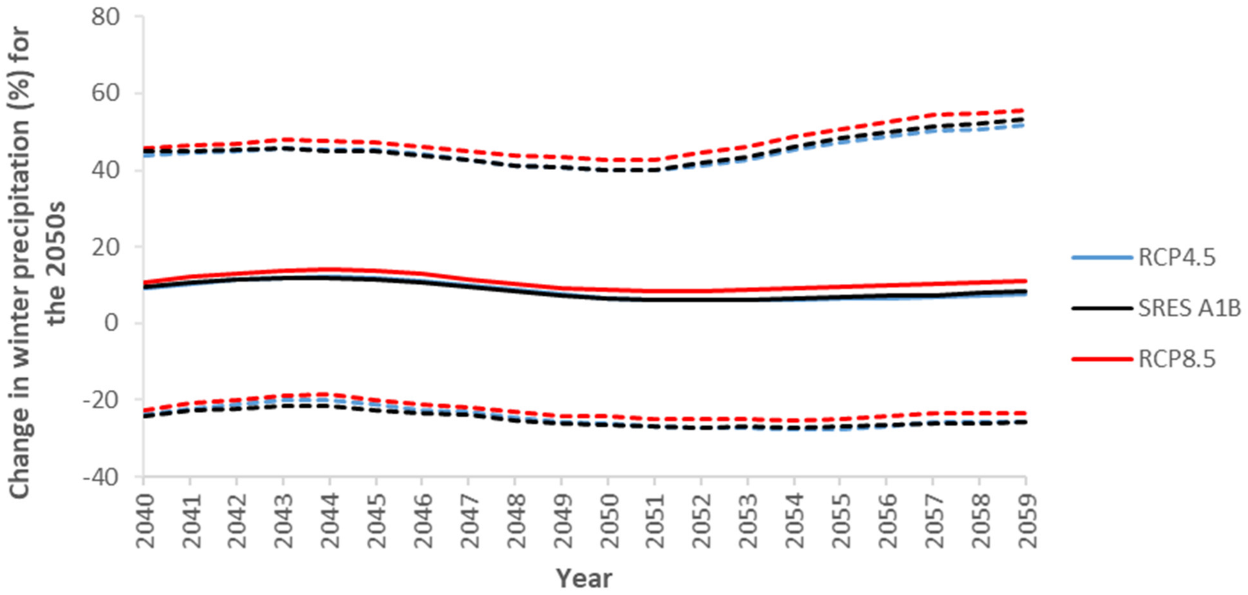


Figure B-19 - Projected change in average winter precipitation (%) for the 2050s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

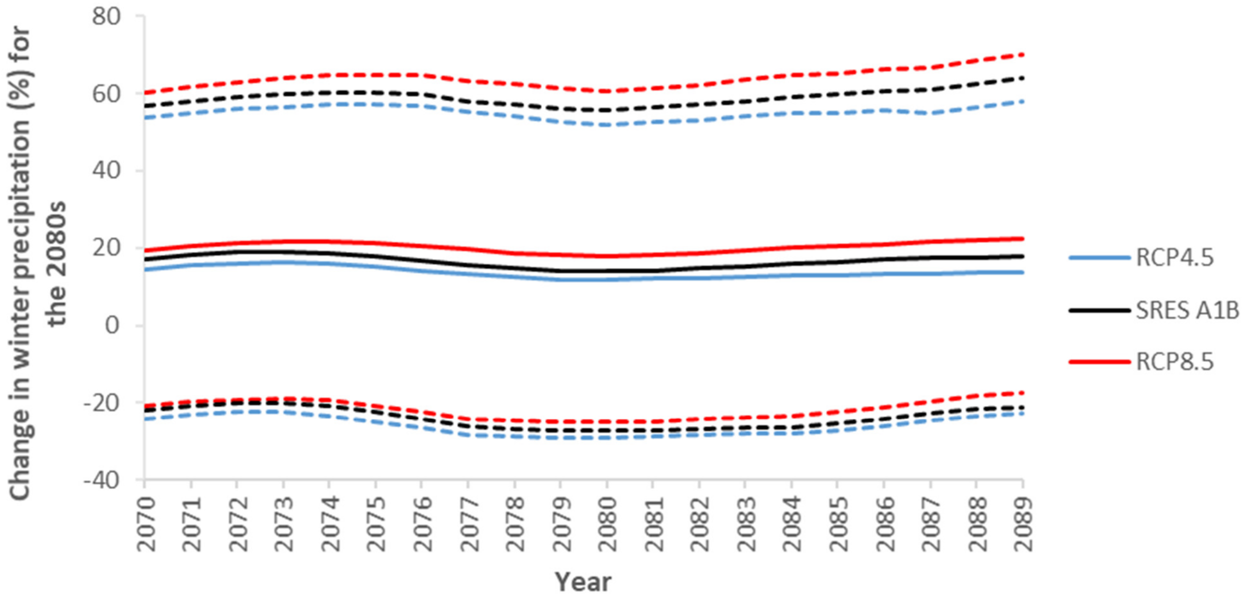


Figure B-20 - Projected change in average winter precipitation (%) for the 2080s. The median is indicated by a solid line and the 10th and 90th percentiles (the 10% lowest and 90% highest projections) are shown as dashed lines.

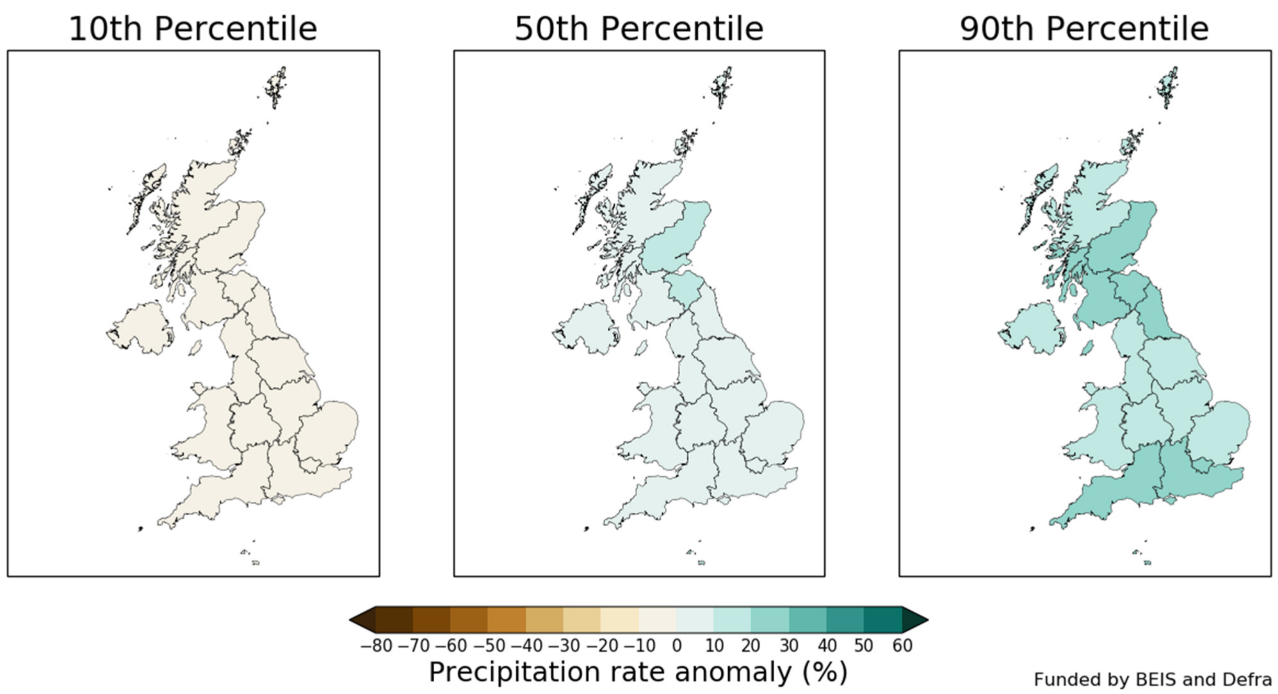


Figure B-21 - Change in average winter precipitation (%) for the 2050s using scenario RCP4.5

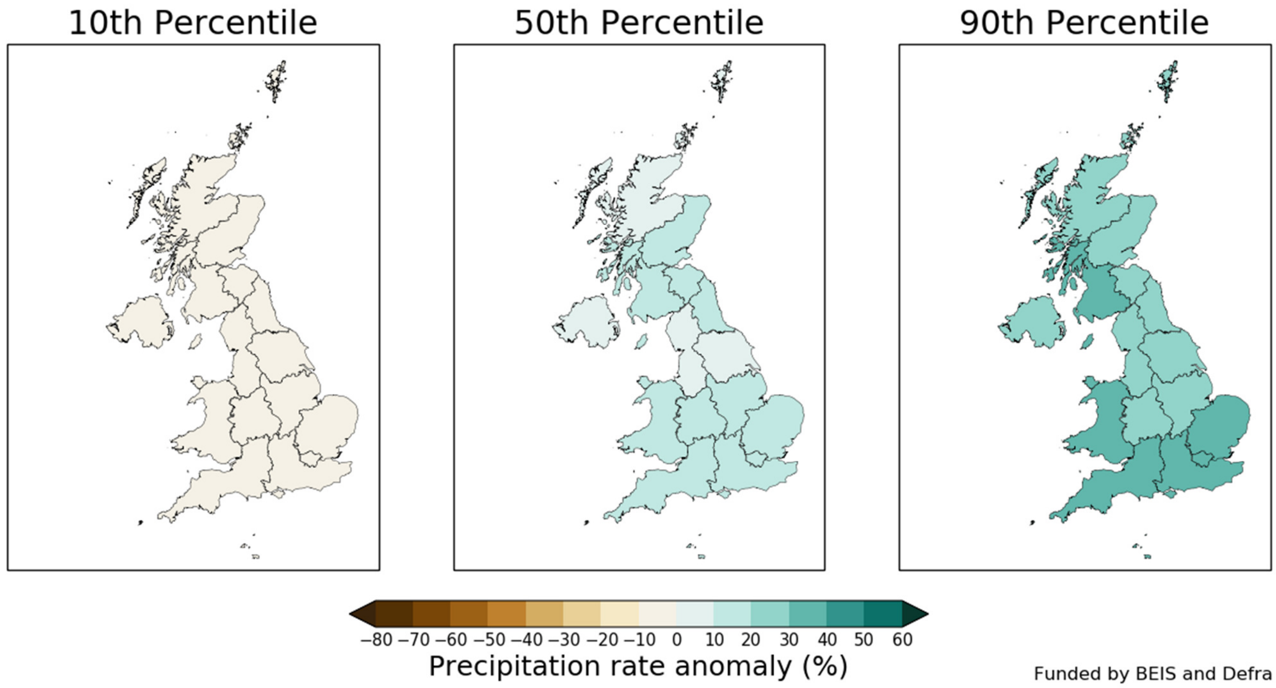


Figure B-22 - Change in average winter precipitation (%) for the 2080s using scenario RCP4.5

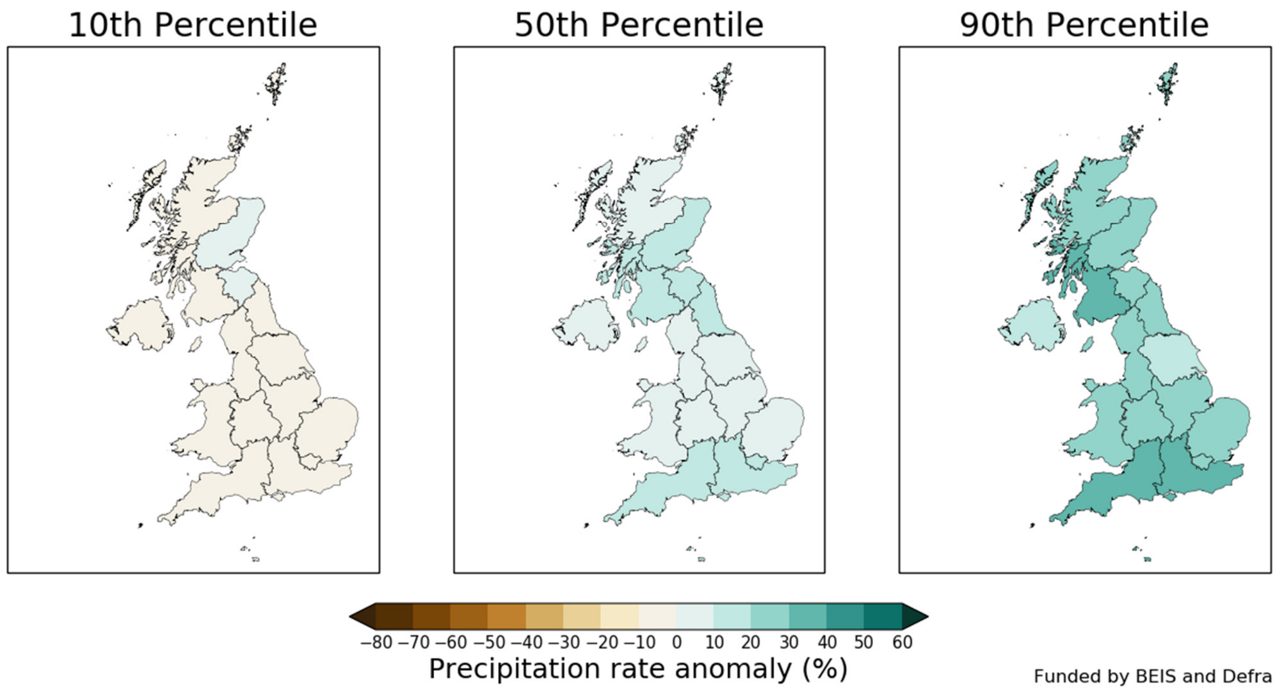


Figure B-23 - Change in average winter precipitation (%) for the 2050s using scenario RCP8.5

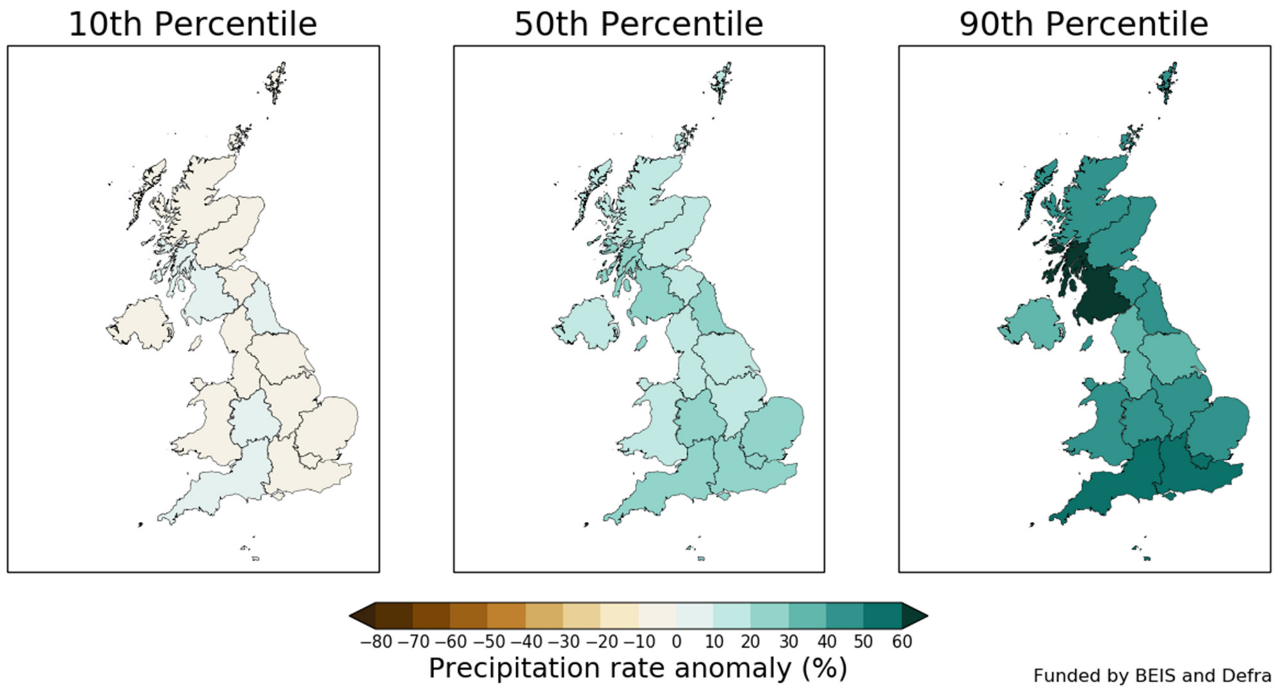


Figure B-24 - Change in average winter precipitation (%) for the 2080s using scenario RCP8.5

Appendix C. Findings from CCC's CCRA3 evidence reports

The Climate Change Committee (CCC) is an independent statutory body established under the Climate Change Act 2008 and acts as the UK's independent adviser on tackling climate change[40]. In June 2021 the CCC published their technical and policy reports to inform the UK's third Climate Change Risk Assessment (CCRA3). The CCC commissioned research projects from leading institutions and researchers to feed into the technical chapters of the main report and are also published as separate evidence reports[41]. Of the evidence reports available, we considered four key reports in developing our Adaptation Report:

- **Water resources, availability, and demand**: Projections of Future Water Availability[3]
- **Water quality and natural capital**: Climate driven threshold effects in the natural environment[24]
- **Flood risk**: Projections of Future Flood Risk[28]
- **Wildfires**: UK Wildfires and their climate challenges[23]

In addition to the main technical report there are also 17 factsheet summaries that summarise the assessment for different themes chosen by the Government. Some of those relevant to this Adaptation Report are:

- **Water sector briefing**[13]
- **Flooding and coastal change**[42]
- **Freshwater habitats**[25]
- **High temperatures**[33]
- **Telecoms and ICT**[34]

We have summarised the key findings from these reports in the sections below.

C.1. Water availability

C.1.1. Water resources

Some deficits already exist in some water company water resource zones and without the actions currently being taken by water companies, these zones would not be able to offer the level of resilience to drought specified by the current water resources plans. At present, the UK currently operates a supply and demand balance of around 950 Ml/d; the surplus within the SES WRZ is far below this overall balance (Figure C-1, Figure C-2).

By the mid-century under a 4℃ world scenario, with a central population and no additional demand-side adaptation Water Resources South East (WRSE), Water Resources North (WRN) and Water Resources East (WRE) are all projected to have deficits. Current and announced demand-side adaptation actions are insufficient for WRSE to mitigate the projected impacts of climate change in a 4℃ world (Table C-1), only with additional demand-side adaptation will WRSE avoid a deficit.

The climate impacts on water supply are greater in the late century compared to the mid-century. Increases to the population will affect demand, placing additional pressure on water resources across England with deficits in all WRZ. A surplus is projected in Wales, Northern Ireland and Scotland under both a 2 and 4℃ scenario but the combined surplus is insufficient to compensate for the deficit in England even if the appropriate water transfer infrastructure was in place.

Increased drought resilience to a 1 in 500-year event will reduce the headroom further for water resources. The DO for England will reduce by approximately 1,140 Ml/d (more than 2.5 times the present-day surplus).

[40] The CCC
[41] Research and Supporting Analysis – UK Climate Risk
[42] CCRA3 Briefing – Flooding and Coastal Change

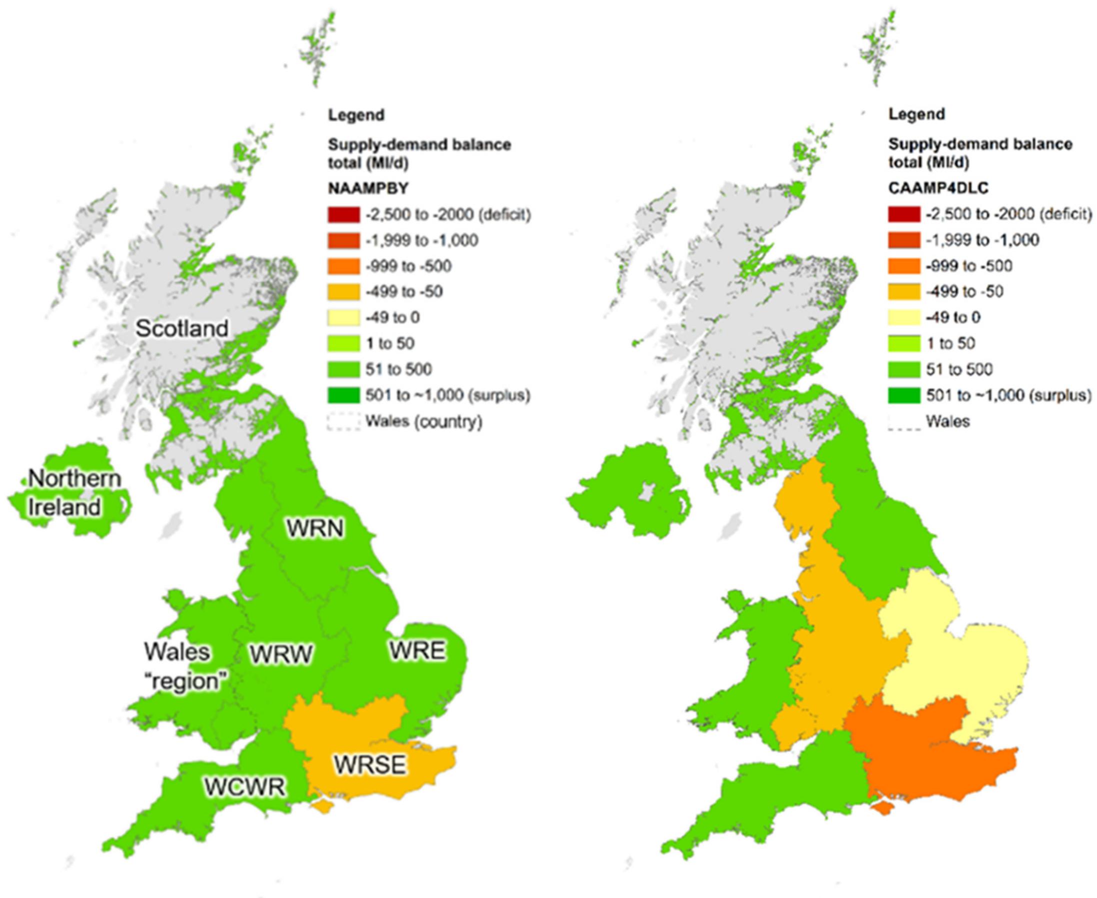


Figure C-1 - Supply and demand balance for the present day and the late-century, 4°C world scenario with a central population projection with current and announced adaptation

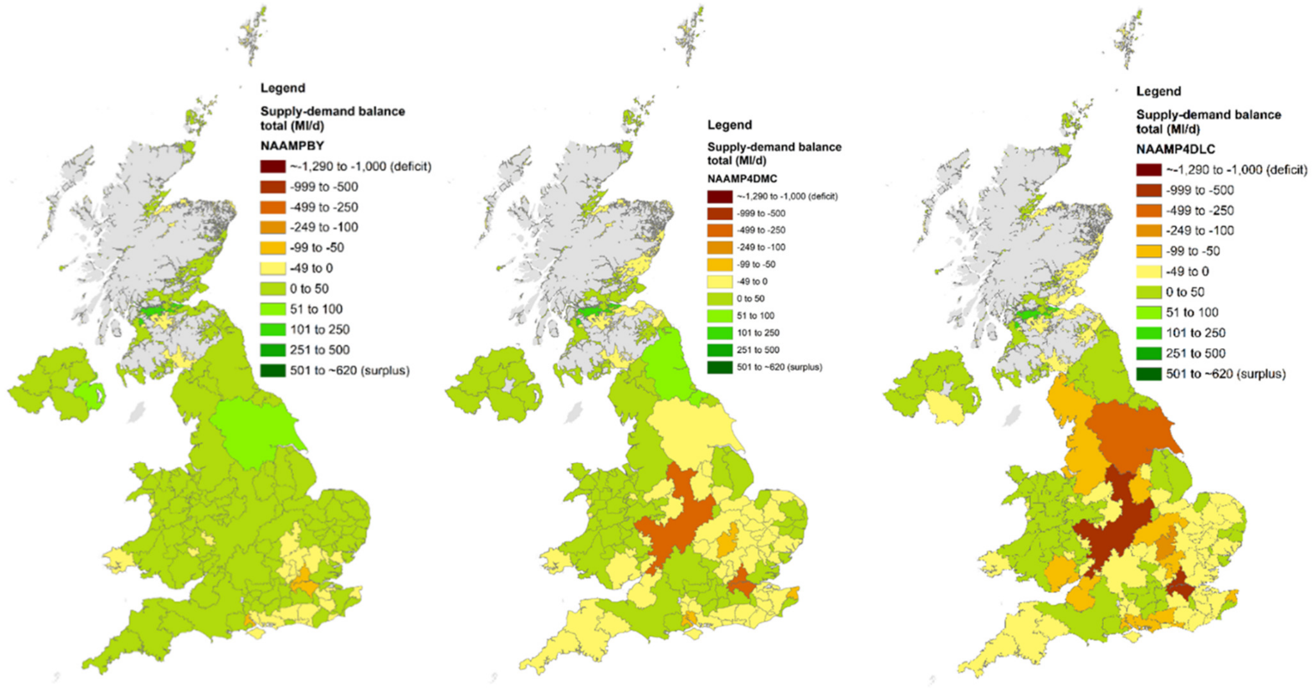


Figure C-2 - Supply-demand balance by WRZ for the present day, mid-century with central population projection under a 4℃ scenario and late-century with a central population projection under a 4℃ scenario

Table C-1 - Supply and demand balance scenarios with no additional adaptation[3]

	Baseline	Mid-century, 2℃, central population, no additional adaptation	Mid-century, 4℃, central population, no additional adaptation	Late-century, 2℃, central population, no additional adaptation	Late-century, 4℃, central population, no additional adaptation
SES WRZ	1 to 50	1 to 50	1 to 50	-49 to 0	-49 to 0
WRSE	-499 to -50	-999 to -500	-1,999 to -1,000	-1,999 to -1,000	-1,999 to -1,000

Q95 low flows

Projected changes in river flows will affect the water available for both abstractors and the environment. It is projected that there will be a 0 – 20% reduction in Q95 flows by the mid-century for a 2℃ world everywhere in England and Wales; for parts of Wales, the Severn and Tweed basins this will increase to a 30% reduction under a 4℃ scenario. By the late century, projected changes in Q95 flows are in the order of a 0 – 50% reduction in a 4℃ world.

Catchments in the west of the UK, particularly Wales, are most at risk for missing existing environmental flow volume targets in a 4℃ world and therefore are at risk of negative available resource. Catchments that are at risk of over-abstraction tend to be located in the south and east of the UK.

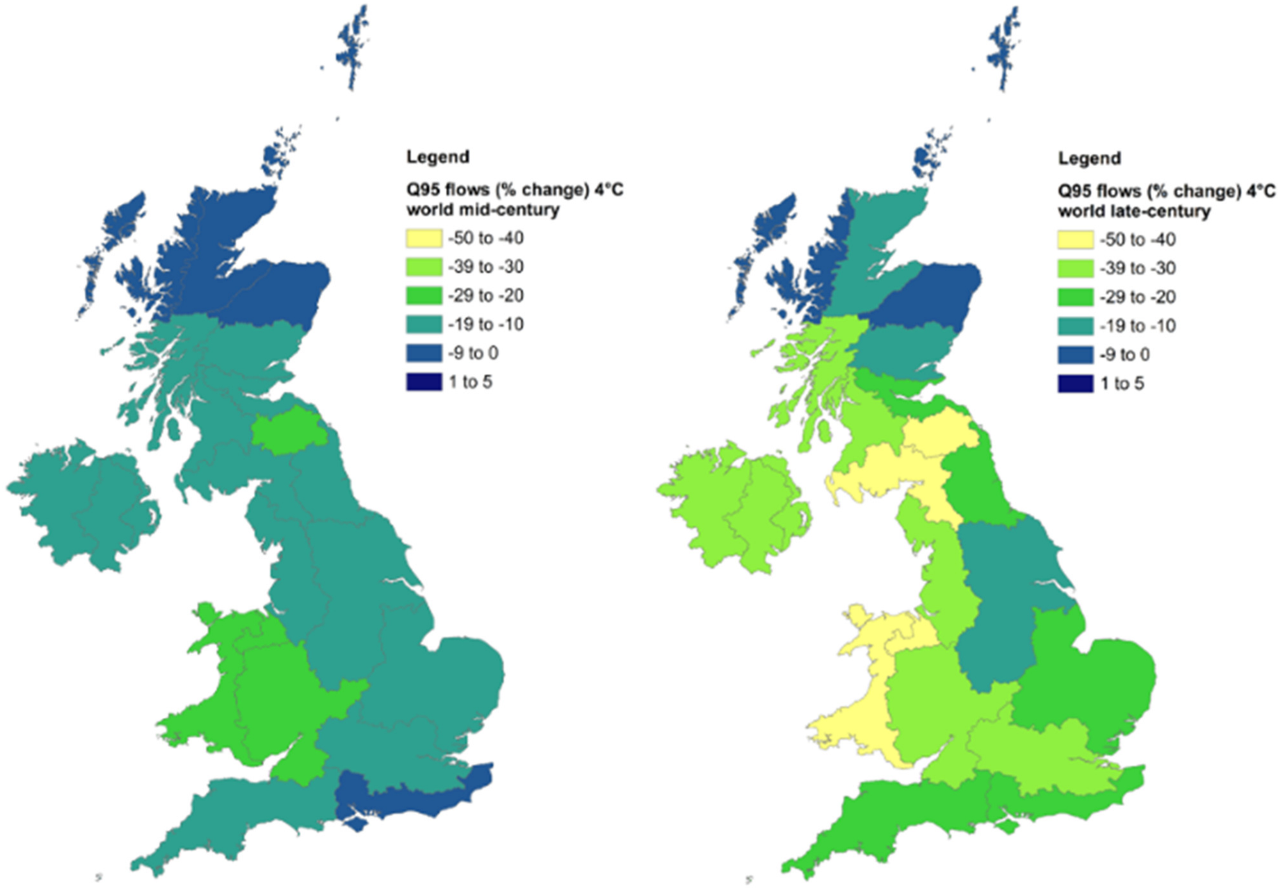


Figure C-3 - Percentage change in Q95 flows under a 4°C scenario by the mid and late century

C.2. Water quality

The Jones et al. (2020) report 'Climate drive threshold effects in the natural environment[24] is the most relevant CCRA3 evidence report for the water quality challenges discussed within this report.

An increased incidence of algal bloom formations in lakes is seen when mean monthly water temperatures exceed a threshold of 17°C, in combination with elevated nutrients. The threshold for algal bloom formation in rivers is 19°C. The overall risk under a 4°C future scenario for both fluvial and lacustrine blooms is projected to be high in England. Under both scenarios there will be a marked increase in the number of lacustrine algal blooms. The costs associated with algal blooms will increase from a baseline of £173 million to £295 million under a 2°C scenario and up to £481 million under a 4°C scenario for the whole of the UK.

Table C-2 - The estimated change in algal bloom outbreaks in lakes in the UK due to temperature threshold exceedance[24]

	Baseline (2001 – 2010)	2°C scenario	4°C scenario
UK average ratio of change in number of months exceeding the threshold compared with the Baseline	-	1.52 (+52%)	2.28 (+128%)

Algal blooms can bring considerable financial losses to the water industry due to the costs of managing filter blockages and correcting for taste and odour changes in drinking water; there is also the risk that an entire source of public water supply may need to be closed temporarily whilst algal blooms are managed.

Table C-3 shows an excerpt of the costs associated with the impacts of algal blooms that a relevant to UK water companies like SESW; this is the present-day cost and is projected to increase with the change in threshold exceedances under both warming scenarios considered within the CCRA3 report.

Table C-3 – Adapted version of the re-calculated annual costs of algal blooms scaled up to UK (£ million)[24]

Impact of algal bloom	Value (£m)
Drinking water treatment costs (algal removal)	28.8
Drinking water treatment costs (nitrogen removal)	30.5
Clean up costs of waterways	1.5
Ecological damage costs	15.4

There is capacity available to reduce the risk with adaptation measures focusing on catchment-wide management of nitrogen and phosphorous in nitrate vulnerable zones, but this is not applied widely elsewhere. Figure C-4 highlights the processes and impacts involved in algal blooms with the brown box indicating the potential adaptation measures that may be taken.

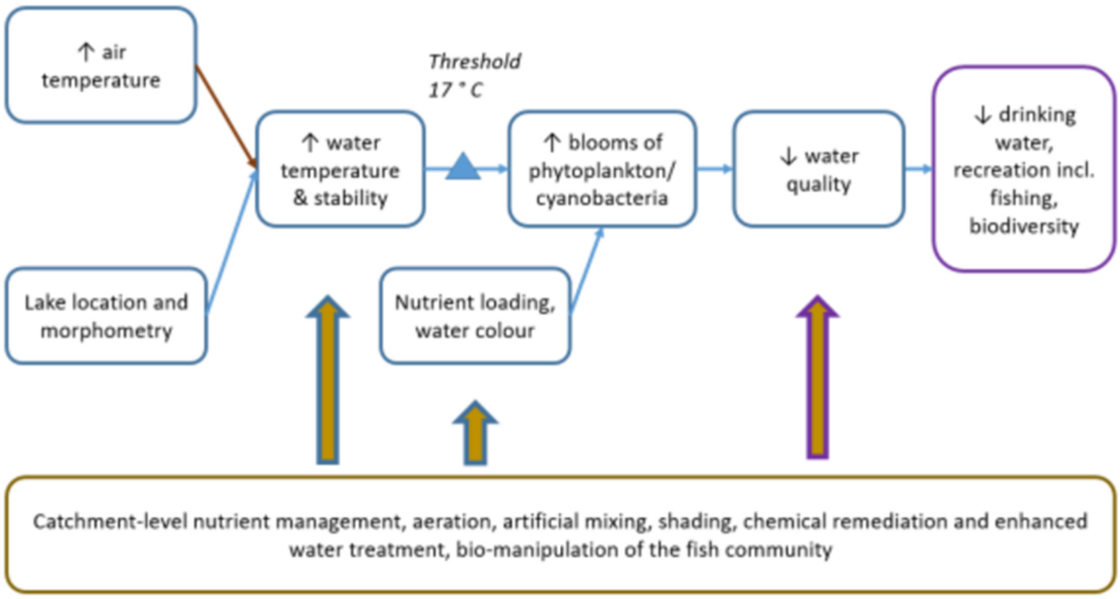


Figure C-4 - Impact chain for temperature effects on phytoplankton blooms in lakes. The purple box shows social/economic or biodiversity endpoints; the brown box shows potential adaptation measures[24]

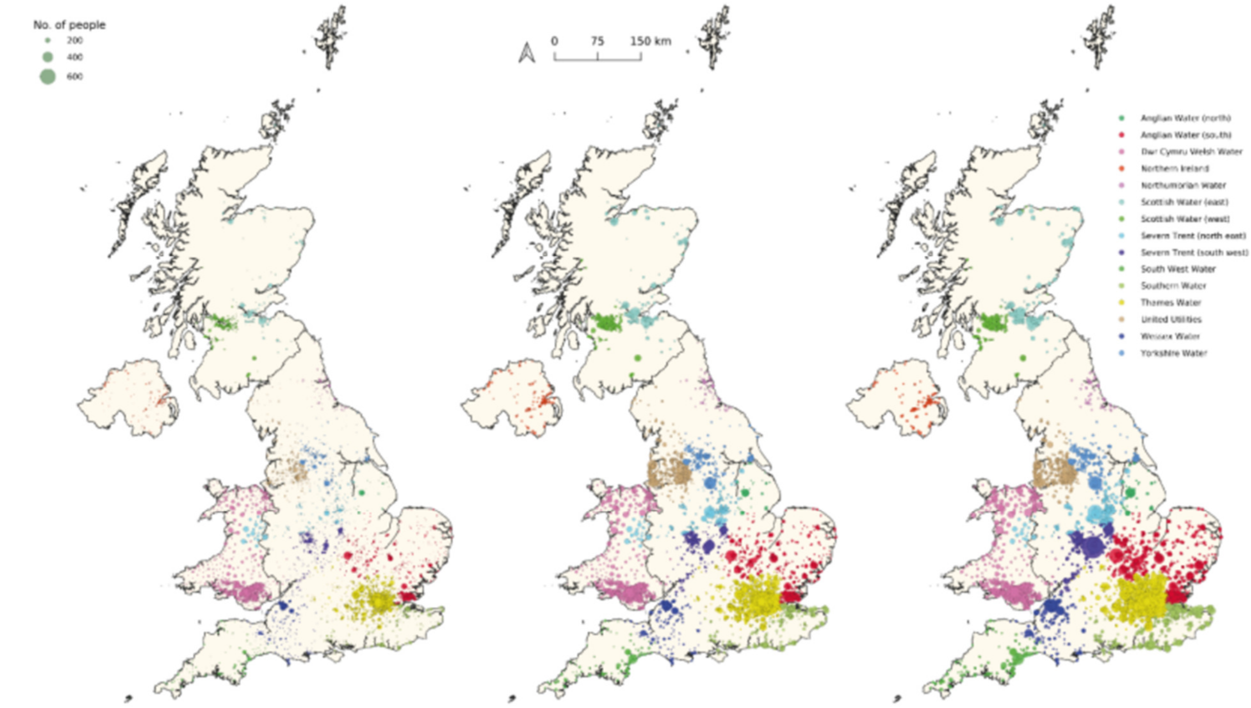
C.3. Flooding

Expected Annual Damages (EAD)

Climate change is the main influencing factor in driving future flood risk in terms of Expected Annual Damages (EAD) with an anticipated £4.2bn under a 2℃ future and £6.9bn under a 4℃ without adaptation; continued current levels of adaptation offsets this. An Enhanced Whole System (EWS) approach to adaptation would limit the net increase in risk to approximately £1.1bn even with high levels of population growth.

Fluvial flood risk remains the dominant flood risk type in the UK and will continue to be the main risk in the future. The increase in fluvial flood risk is, however, proportionally less than surface water and coastal flooding. Surface water risks will more than double under a 4℃ high population growth future. Groundwater flooding is the smallest contributor to flood risk in the UK but it is anticipated that the risk will increase by 75% by the 2080s.

The Local Authorities with the largest future flood risk are in coastal areas and flood prone areas in Northern Ireland, Scotland and Wales are more exposed to higher EAD than those living in England per person by the 2080s. Inland South East locations are considered one of the lower risk areas in terms of EAD per person for future flood risk, however, as Figure C-5 indicates, the number of people within London and the South East exposed to frequent surface water flooding increases significantly.



Left: Present-day. *Middle*: 4°C High Growth 2050s; *Right*: 4°C High Growth 2080s. Frequent flooding refers to a return period of 1in30 year return period or more frequent.

Figure C-5 - Number of people exposed to frequent (1 in 30 year) surface water flooding by Water and Wastewater Company region[28]

Risk to infrastructure

It is projected that there will be a significant increase in the exposure of Category A (water treatment, energy and communication infrastructure sites) and Category B (railway stations, landfill sites, hospitals and blue light service stations, public services) across the UK. Metropolitan regions and Category A sites are most exposed the frequent flooding. The protection provided by current flood defences is also impacted by climate change; in the absence of further adaptation, the reduction in the standard of protection provided is significant.

Groundwater flooding

The understanding of current and future groundwater flooding risks remains the same as CCRA2 which was based on the Future Flows project which used UKCP09 data. Extreme groundwater flooding events are a complex function of climate change, taking into consideration changes to annual rainfall, evapotranspiration, rainfall seasonality, rainfall intensity and temperature as well as aquifer characteristics and land cover.

C.4. Wildfires

In a UK context, the term wildfire is defined as *'any uncontrolled vegetation fire which requires a decision, or actions, regarding suppression*'. Wildfires are considered a semi-natural hazard in the UK as they often stem from human activities such as land management practices, accidental or arson ignition. Fire activity is limited by fuel moisture conditioning and availability i.e., amount of dry vegetation, or soil susceptible to burn. Therefore, it does not have to be warm for fires to occur and fires often occur during dry winter spells. There are usually two fire seasons in the UK: one in spring and a secondary one in mid-late summer. The majority of wildfires occur in grasslands and woodlands, a large majority of which are in close proximately to build-up areas posing a risk to humans and infrastructure[23].

It is expected that climate change will increase the likelihood of wildfires occurring with up to over a 590% increase in the number of summer days experiencing a very high fire index under a 4℃ warming scenario (Table C-4). High fire weather indices occur most frequently over central and southern England; into the future these areas are predicted to expand and intensify (Figure C-6).

Table C-4 - Effect of climate change on the percentage of summer days experiencing a very high fire index (2069)

	Baseline	2℃ scenario	4℃ scenario
% of summer days experiencing a very high fire index	9.3%	27%	55%

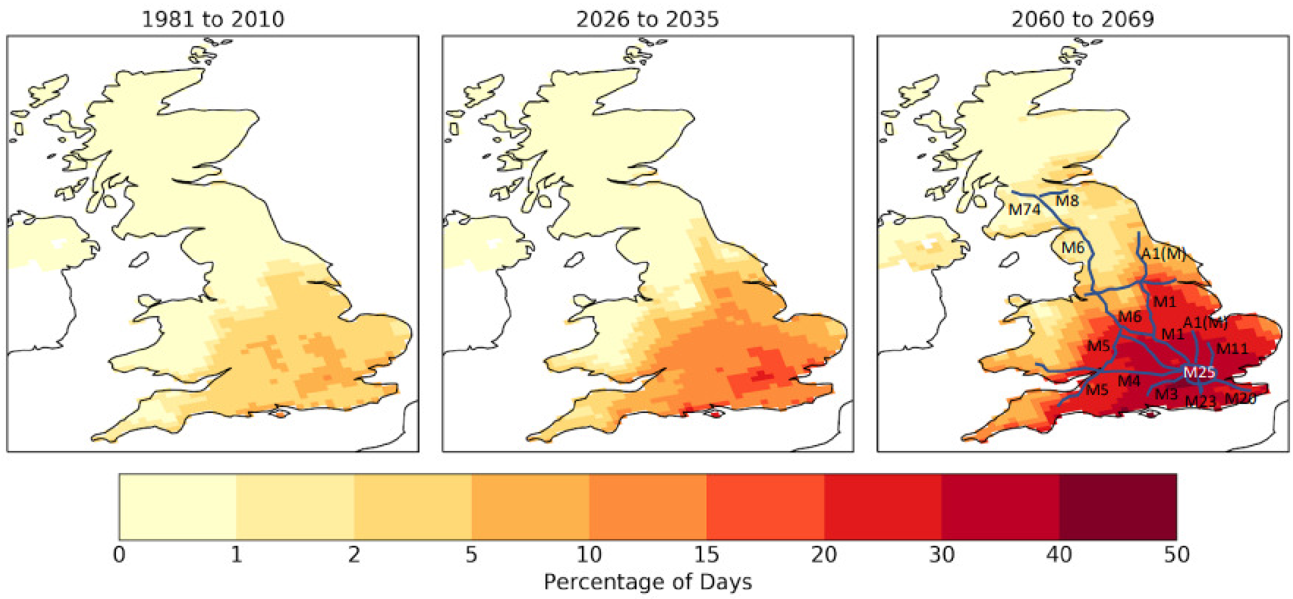


Figure C-6 - The annual occurrence (% of days) with a Fire Weather Index (FWI) > 17.35 (Fire Danger Class 4/5) during Summer from the UKCP18 12km regional model for a) 1981-2010 baseline period, b) 2026-2035 (2 degree warming level) and c) 2060-2069 (4 degree warming level)

Appendix D. Coverage of risks from CCRA2 and the CCC's CCRA3 report

The CCC's third independent report on the UK's climate change risks (CCRA3) was published in June 2021. Table D-1 presents a comparison of the relevant risks and opportunities faced by the Water sector identified in the UK's CCRA2 (as defined in Defra's ARP3 guidance) and the CCC's independent CCRA3 advice report. Where possible, risks and opportunities have been aligned however the CCC have removed or combined some risks and opportunities presented in CCRA2. The table below demonstrates SESW's climate risk assessment provides good coverage of the relevant risks identified in both the UK's CCRA2 and the CCC's independent CCRA3 report.

Table D-1 - A comparison of relevant risks from CCRA2 and the CCC's CCRA3 advice report

CCRA2 Infrastructure Risk/Opportunity	CCRA2 Urgency Score	CCC's CCRA3 report Risk/Opportunity	CCC's CCRA3 report Urgency Score
In1: Risks of cascading failures from interdependent infrastructure networks	More action needed (UK)	I1: Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures	More action needed (UK)
In2: Risks to infrastructure services from river, surface water and groundwater flooding	More action needed (UK)	I2: Risks to infrastructure services from river and surface water flooding	More action needed (UK)
In3: Risks to infrastructure services from coastal flooding and erosion	More action needed (England)	I3: Risks to infrastructure services from coastal flooding and erosion This risk is not relevant to SESW due to SESW not being located near to the coast	Further investigation (UK)
In4: Risks of sewer flooding due to heavy rainfall	More action needed (UK)	[The CCC have removed this risk and combined it with I2 (surface water flooding)] This risk is not relevant to SESW due to SESW not owning or managing sewers	-
In5: Risks to bridges and pipelines from high river flows and bank erosion	Research priority (UK)	I4: Risks to bridges and pipelines from flooding and erosion	Further investigation (UK)
In8: Risks to subterranean and surface infrastructure from subsidence	Watching brief (UK)	I7: Risks to subterranean and surface infrastructure from subsidence	Further investigation (UK)
In9: Risks to public water supplies from drought and low river flows	More action needed (England)	I8: Risks to public water supplies from reduced water availability	More action needed (England)
In14: Potential benefits to water, transport, digital and energy infrastructure from reduced frequency of extreme cold events	Sustain current action (UK)	[The CCC have removed this opportunity] SES Water has not considered this as an opportunity, as	-

		evidence demonstrates extreme cold events cannot be ruled out.	
Ne1: Risks to species and habitats due to inability to respond to changing climatic conditions	More action needed (UK)	N1: Risks to terrestrial species and habitats from changing climatic conditions and extreme events, including temperature change, water scarcity, wildfire, flooding, wind, and altered hydrology (including water scarcity, flooding and saline intrusion).	More action needed (UK)
PB13: Risks to health from poor water quality	Sustain current action (UK)	[The CCC have removed this risk and combined it with H10]	-
PB14: Risk of household water supply interruptions	Sustain current action (UK)	H10: Risks to water quality and household water supplies	Further investigation (UK)

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