Affinity Water

Climate Change Adaptation Report 2021

Glossary

ADO	Average Deployable Output – The annual average output of a source in a dry year
AMP	Asset Management Period – 5 year investment period used for planning purposes
AONB	Area of Outstanding Natural Beauty
CCRA	Climate change risk assessment- National Climate Change Risk Assessment for the UK
Connect 2050	A programme of work linked to network upgrades to allow the movement of water from the Strategic Resource Options across our Central region
CSO	Combined sewage overflow
DI	Distribution Input – the amount of water entering the distribution system at the point of production
DO	Deployable Output – the output of a commissioned source or group of sources assessed under drought conditions
Drought Order	An authorisation granted by the Secretary of State under drought conditions which imposes restrictions upon the use of water and/or allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
Drought Permit	An authorisation granted by the Environment Agency under drought conditions which allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
DMP	Drought Management Plan – Operational plan which sets out how the company will deal with a drought situation
ERT	Emergency Response Team
FRA	Flood risk assessment
GUC	Grand Union Canal
GWL	Groundwater level
In	infrastructure risk from the Water UK template
JESIP	Joint Emergency Services Interoperability principles- emergency response best practice.
LTA	Long term average
mAOD	Metres Above Ordnance Datum – the height of a point in metres above average sea level
Ml/d	Megalitres a day – 1 megalitre equates to 1 million litres of water.
Ofwat	The economic regulator of the water sector in England and Wales
PCC	Per capita consumption – the amount of water typically used by one person in a day
PDO	Peak Deployable Output – The daily peak output of a source in a dry year during a period of high demand (typically summer months).
PR	Price review period (19 or 24) used by Ofwat to review water company charges and business plans.
RAPID	Regulatory Alliance for Progressing Infrastructure Development, it includes Ofwat, Environment Agency and Drinking Water Inspectorate
SESRO	South East Strategic Reservoir Option
SMD	Soil Moisture Deficit – the amount of rain needed to fully saturate the soil
Supply 2040	Programme to transfer surplus water from the south of our Central region to the north of the region.
STT	Severn to Thames Transfer Strategic Resource Option
STW	Sewage treatment works
TCFD	Task Force on Climate-related Financial Disclosures
TUB	Temporary Use Ban – demand management action which temporarily restricts non-essential use of water by customers during a drought (formerly a 'hosepipe ban')
UKCP18	United Kingdom Climate Projections 2018 climate projection data
WFD	Water Framework Directive – a European Union directive which commits EU member states to achieve good qualitative and quantitative status of all water bodies by 2027
WRMP	Water Resource Management Plan – 25 year plan which water companies have to produce to demonstrate how they will meet the supply demand balance in the long term.
WRZ	Water Resource Zone – the largest possible zone in which all resources, including external transfers, can be shared and, hence, the zone in which all customers will experience the same risk of supply failure from a resource shortfall
WSP	Water Saving Programme
MW	Megawatt- unit to measure electricity
WRE	Water Resources East – Inter-organisational group working in partnership to safeguard a sustainable supply of water in Eastern England
WRSE	Water Resources Southeast- Inter-organisational group working in partnership to safeguard a sustainable supply of water for the Southeast England.

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CEO Foreword

As the interim Chief Executive of Affinity Water I am pleased to share our third Climate Change Adaptation Report.

We are facing a climate emergency and must take action to adapt and mitigate against the effects of climate change. As the UK's largest water supply only company we recognise the important role we play, not only in providing an essential service but, also as stewards of the environment.

Our supply area is home to globally rare chalk streams and a mosaic of important habitats from the home counties of Buckinghamshire and Hertfordshire to the coastal communities of Kent and Essex. This includes the Chilterns, Surrey Hills, Dedham Vale and Kent Downs Areas of Outstanding Natural Beauty. The whole of our supply area is at risk from the effects of climate change and this report sets out what we are doing to address these risks.

As a community-focused water company with public and social responsibility, we have a duty to adapt to climate change and reduce our own carbon emissions and have outlined these commitments in our Environment Policy. Our Water Resources Management Plan sets out how we will meet the challenges of supplying water to a growing population, taking into account the impacts of climate change.

We have been working with stakeholders and regulators for more than 20 years to protect and enhance chalk streams in our supply area, making significant reductions to groundwater abstraction, undertaking river restoration and working with landowners and farmers to address water quality pressures. But we recognise that we have more to do, and this is why we have made a commitment to end unsustainable abstraction.

Since writing our last climate change adaptation report in 2015 we have experienced a groundwater drought (2017-19), the 'Beast from the East' in 2018 and prolonged hot summers in 2018 and 2020, as well as a number of intense rainfall events. We have also seen the impacts of COVID-19, which has changed the way in which our customers use water and contributed to a reconnection to the environment. In 2019 the government declared a climate emergency and we put in place our Net Zero Plan.

The COP26 summit has highlighted the importance of collaboration, the need for global action and for us all to play our part.

We have identified six key risks that, without intervention, pose an unacceptable risk to Affinity Water. Changing demand patterns, reduced water availability, changes to raw water quality, more frequent flooding, higher import costs and higher risks to our assets have the potential to impact our core business activities. With our planned interventions through AMP7 and beyond, these risks become manageable. We have set out a series of case studies to illustrate how we are adapting to and mitigating these risks.

We have asked our customers what they think about climate change and what action they expect us to take in response to the key risk areas. Our customers recognise climate change to be a serious problem and want us to deliver our service in a sustainable manner. They look to us to lead the way by taking proactive action to protect both the environment and customer supplies. We look forward to working with customers and regulators through the PR24 process to generate performance metrics that fully recognise the risks posed by climate change and how we need to continue adapting.

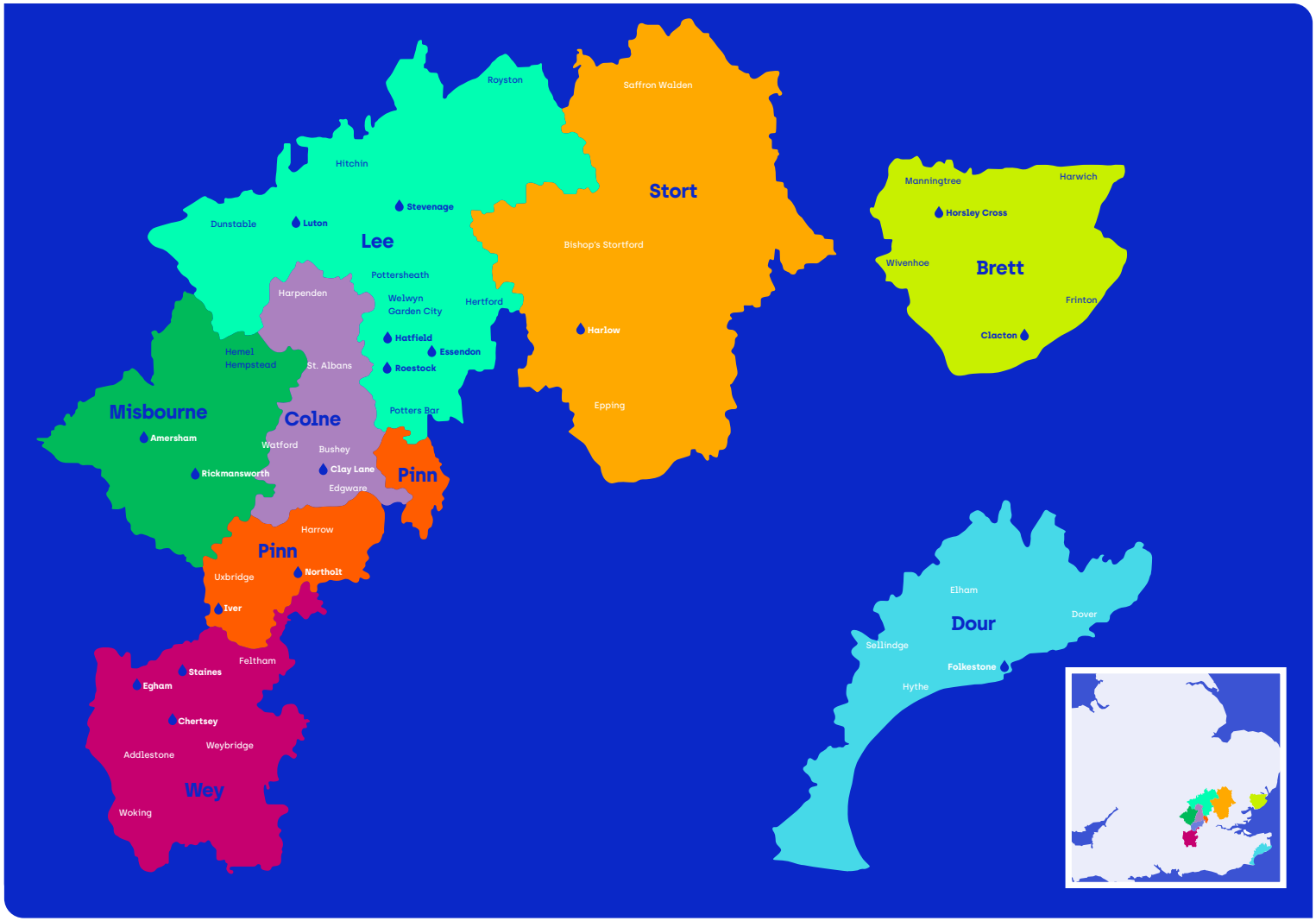
Stuart Ledger
Interim Chief Executive Officer

"The whole of our supply area is at risk from the effects of climate change and this report sets out what we are doing to address these risks."

1. Introduction

We are a water supply company situated in the South East of England, supplying parts of Bedfordshire, Berkshire, Buckinghamshire, Essex, Hertfordshire, Surrey, and North West London. We also supply water to the Tendring peninsula in Essex and the Folkestone and Dover areas of Kent. We provide on average of 950 million litres of drinking water to approximately 3.6 million people, or 1.4 million households, every day. Our supply area also includes 74,000 commercial customers. The communities we serve are shown in Figure 1.1.

Figure 1.1 The communities we serve



The Third National Climate Change Risk Assessment for the UK (CCRA3)[1] and the Intergovernmental Panel on Climate Change Sixth Assessment report[2] highlight that under all scenarios of emissions reduction we will increasingly feel the impacts of climate change and need to adapt to these.

As the UK's largest water supply only company we recognise the important role we play, not only in providing an essential service but, also as stewards of the environment. We have therefore undertaken a risk-based review of the challenges posed by climate change to our business, both now and in the future.

1 Independent-Assessment-of-UK-Climate-RiskAdvice-to-Govt-for-CCRA3-CCC.pdf (theccc.org.uk)

2. ClimateChange | United Nations

1.1 Our approach to climate change risk assessment and adaptation planning

The climate change risk assessment has been used to inform our third adaptation report. This follows submissions in 2015 (Affinity Water) and 2011 (Veolia Water East, Veolia Water Southeast and Veolia Water Central). Our ongoing risk management has been undertaken as follows:

- Review of the climate change risks set out in the CCRA3 and the highlighting of those relevant to Affinity Water identified for further assessment using the template developed by Water UK (ensuring that key infrastructure (In) risks are covered as required by Defra). Included in the assessment were the wider risks and benefits to the environment, society and businesses.
- Use of the latest United Kingdom Climate Projections 2018 (UKCP18) climate projection data, to understand the risks of both a 2°C and 4°C temperature rise.
- Incorporation and review of our risk assessment from 2015 (also see Section 5).
- Identification of interdependencies with other sectors was a consistent theme when considering all risk areas.
- Use of internal expert workshops with key teams across our business run by external stakeholders.
- Alignment of the resultant climate risk assessment with our corporate risk register and future Task Force on Climate-related Financial Disclosures (TCFD) reporting.

In undertaking this risk assessment, we have sought to:

- Identify current and future options to address climate risks identified, including: engineered solutions, nature-based solutions, new or emerging technologies, behavioural, institutional, financial and data or Research & Development solutions.
- Ensure that plans are consistent with both a 2°C and a 4°C temperature rise and that plans do not prevent adaptation to a greater than 4°C global temperature rise.
- Provide transparency on trade-offs with other objectives such as reducing consumer bills and the implications this has for levels of investment.
- Make clear the implications of any reduced investment on levels of resilience.
- Identify any enablers and barriers.
- Review our mitigation options with key Water Resources Management Plan (WRMP) 24 and Price Review (PR) 24 investment needs to help make the case for resilience – presenting the narrative and getting buy-in.

The assessment included a series of workshops which drew on the knowledge and experience of our technical experts. Together, we charted the progress we have made since our last climate change adaptation report was published in 2015. Our interventions to address climate change risks can be categorised as 'in progress', 'planned' or 'future' actions. These were considered and progress against them assessed against the planned deliverables and risks they are designed to mitigate. This activity highlighted a number of climate related risks. These risks were subject to a prioritisation exercise which identified six headline risk areas which we have focussed on in this report.

The six headline risks identified were:

01 Increase in demand due to higher temperatures throughout the year, exacerbated during summer peak demand periods

02 Equipment and asset failure due to extreme weather events

03 Increase in competition for, and price of, raw water imports

04 Reduced availability of ground and surface water due to drought

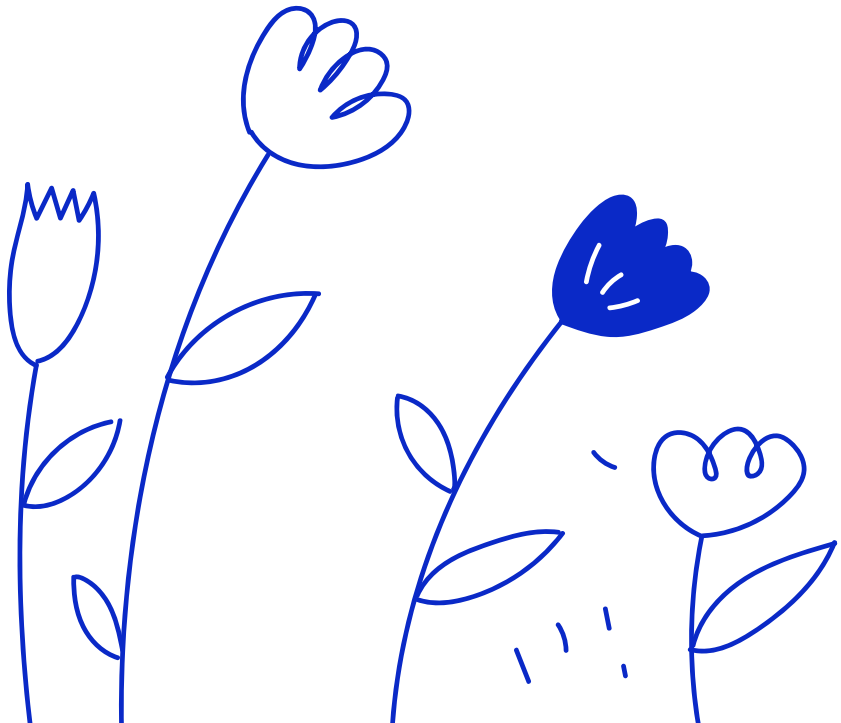
05 Outage due to flooding of sites

06 Deterioration in raw water quality due to changes in rainfall and temperature, leading to loss of sources.

These have then been cross-referenced back to the National CCRA risks and the coverage documented. The relationship of these risks to the national CCRA risks is as follows:

- **In1:** Risks of cascading failures from interdependent infrastructure networks
- **In2:** Risks to infrastructure services from river, surface water and groundwater flooding
- **In3:** Risks to infrastructure services from coastal flooding and erosion
- **In4:** Risks of sewer and surface water flooding due to heavy rainfall
- **In5:** Risks to bridges and pipelines from high river flows and bank erosion
- **In8:** Risks to subterranean and surface infrastructure from subsidence
- **In9:** Risks to public water supplies from drought and low river flows

Affinity Water Headline Risk	Related National CCRA risk(s)
01	In9
02	In1; In2; In5; In8
03	In1
04	In9
05	In2; In3; In4
06	In2; In3



1.2 Report structure

In the remainder of this report, we present for each of the six headline risks a summary setting out the risk, its relationship to the CCRA3 risks highlighted in the Water UK template and an assessment of our current position in relation to the management of this risk.

For each headline risk, we have shown the findings of our risk scoring exercise using a graduated bar graphic. We have scored each risk based on its likelihood of occurrence and the consequence if it does occur in 2050, using a 1-25 scale. We have scored each risk three times:

- inherent risk score in 2050 if we take no action;
- a score that takes account of actions committed in Asset Management Period 7 (AMP7); and
- a target risks score. The gap between the second and third risk scores highlights where we need to target additional action to further adapt to the risk. The full risk assessment is available on request.

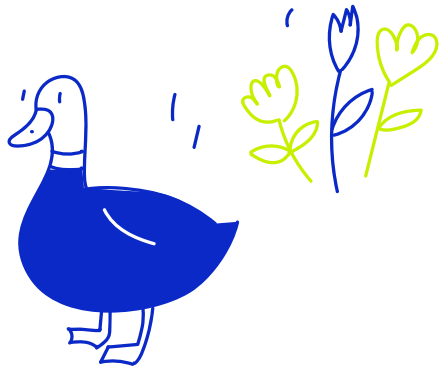
A commentary on the action areas to be undertaken to improve management and future mitigation of the risk identified has also been included. This is then supplemented with a case study demonstrating current examples of actions taken to mitigate the risk and plans for future mitigation. By taking action through AMP7 and beyond, the risks that we have identified become manageable. We also recognise that we cannot do this alone and require action of government and others.

The risk assessment has also been presented in the format of the Water UK template and can be found in Section 4.

This submission is an expansion on the three headline risks which were identified in our 2015 submission. There is overlap with our 2015 submission on the risks posed by climate change to flooding, drought and peak demand conditions. Our 2021 risk assessment provides a more comprehensive review of the likely implications of climate change which is based on the latest climate change projections (UKCP18). The assessment has also been updated to consider the implications of a 2°C and 4°C temperature increase. This assessment has also considered the implications of more up to date flood risk modelling on our asset base.

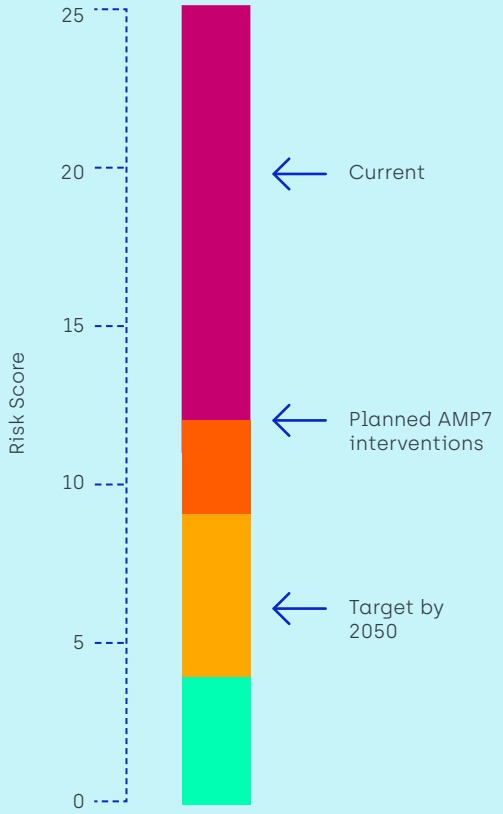
We now better understand how climate change will impact us if left unchecked and this has facilitated the expansion to six headline risks and reassessment of the areas of overlap. This and the move to consider risk implications in 2050 mean that direct comparisons on risk evolution since 2015 are not straightforward. Adopting a longer-term view moves us in-line with other related planning and has increased our ambition to adapt and mitigate the risks to below the 2015 target levels. By understanding the risks better, the mitigation also becomes clearer, and this is set out in this report. Section 5 outlines our progress against the actions identified in our 2015 submission.

The data provided within this report has been audited by both internal and external assessors to ensure accuracy. This report has been subject to internal and external scrutiny to provide assurance.



2. Our headline risks

2.1 Increase in demand due to higher temperature



2.1.1 What is the risk?

Related CCRA3 Risk

In9: Risks to public water supplies from drought and low river flows

Climate change will lead to higher average temperatures throughout the year but particularly during the summer (see Section 2.4 for specific drought risk mitigation). We will also experience more heatwaves – Met Office research[3] found that we can expect to experience the record-breaking temperatures experienced in 2018 (a temperature of 38.7°C was recorded at Cambridge University Botanic Gardens on 25 July) every second summer by 2050.

For Affinity Water, this means an increase in demand for water, particularly peak demand in summer. We are already experiencing an increase in demand for water in summer months, in part due to warmer weather but also other factors such as a temporary rise in population associated with tourism in parts of our East and Southeast supply regions. We have also seen unusual patterns of demand in recent years, as a result of changing behaviour patterns in response to COVID-19 lockdowns.

Our WRMP19 sets out how we will provide a reliable, resilient, efficient and affordable water supply to customers from 2020 to 2080, whilst protecting the environment.

It is also possible that cheaper commodities such as hot tubs and paddling pools combined with a greater desire to invest in gardens will further increase summer peak demand.

We modelled the impact of climate change on demand as part of our WRMP19 and included an allowance of +1.4% by 2055 to account for increase in demand due to climate change. This will be reviewed and updated as part of work on our WRMP24. Our WRMP also considers the long and short term impacts that climate change poses to water availability to ensure that we have enough water to meet the demands of our customers.

2.1.2 What progress has been made in adapting to the risk?

We know from our WRMP19 consultation that our customers expect us to deliver on 'stretching ambitions' when it comes to demand management and leakage reduction, to create a more resilient water supply and leave more water in the environment.

In 2020, we set ourselves a target to reduce per capita consumption (PCC) (the amount of water used by each person, usually measured in litres per person per day) by 12.5% (from a 2019/20 baseline) over the period 2020 – 2025. However, in 2020/21 we saw a rise in demand, with PCC increasing by 14.3 litres per person per day (l/p/d) to 169.3 l/p/d for the year ending March 2021. This resulted from unprecedented demand due to more people staying at home within our supply area as a result of the COVID-19 pandemic, which coincided with a period of hot weather between April and August 2020.

We have responded by investing significantly in an extensive Demand Management programme. As a result, our PCC trend is now moving downwards, with the 12-month rolling average having reduced by around 6 l/p/d for the reporting year to date (April – September 2021). We are currently delivering an ambitious programme of 21 demand management projects which include:

3 McCarthy et al. 2019. Drivers of the UK summer heatwave of 2018. Weather. Available at Drivers of the UK summer heatwave of 2018 - McCarthy - 2019 - Weather - Wiley Online Library, last accessed November 2021

- **Behaviour change** – incentivising customers to reduce their water demand through comparing their water use to others when they receive their bills.
- **Education and engagement** –Save Our Streams (Figure 2 1) is a multi-disciplinary campaign that sees us appear on billboards, in newspapers, on the radio, on social media, in local town centres and in many other places. Save Our Streams aims to help our customers understand the link between local rivers, streams, and their own water use. We used humour to help our customers understand why reducing their water wastage is important and also give them practical advice on how to do so. The campaign is aimed at helping customers to waste less water, whilst also explaining how we are playing our part as a company to minimise the environmental impacts of our actions. Over 175,000 customers have engaged in Save our Streams, representing over 10% of properties we serve. The measured impact of this campaign to date is a saving of 5 million litres of water per day.
- **In-home water efficiency** – in a normal year (before COVID-19), we visited 22,000 customer properties to carry out water efficiency audits and install water-saving devices such as cistern bags and eco shower heads. During the lockdown periods, these home water efficiency checks have been carried out virtually (2,800 in the January 2021 to March 2021 period). A mixture of in-person and virtual visits have been carried out in 2021-2022 to date.
- **Automation** – we are investing to provide customers with metered data relating to water use in their locality. Automatic meter reading means that we can increase the accuracy and frequency of meter readings, allowing us to communicate better with customers about water use and improving water efficiency.
- **Non-per-capita consumption measures** – as part of our Demand Management programme, we are working with external partners to drive down consumption, such as the Water Smart Holiday Parks project (page 13).
- **Campaigning** – our '#WhyNotWater' campaign sets out a call to action, asking for key changes to legislation and policy to help ensure long-term water sustainability. Some of the "asks" we set out are being incorporated into legislation, with mandatory water efficiency labelling on all goods and the target of restricting water use to 110 l/p/d in water-stressed areas now on the Government's action list.

The results of these measures will be especially important during times of drought (See Section 2.4).

Figure 2-1 Save our Streams campaign

175,000

customers have engaged in Save our Streams

22,000

customer properties visited annually

2.1.3 What else will be done to further adapt to the risk?

Our AMP7 Demand Management programme to deliver a 12.5% reduction in PCC is targeted to deliver by March 2025. This target equates to a PCC (in a 'normal year') of 129 l/p/d. This compares to our 2016/17 average consumption of 152 l/p/d, and would move us towards industry leading levels. We additionally propose to continue to further reduce PCC through concerted action on water efficiency and smart metering. This 'concerted action' is focused around developing wider collaboration to achieve a more challenging goal. It includes aspirations to reduce PCC (potentially as low as 110l/p/d), depending on industry wide and policy support for demand management, involving measures such as mandatory water efficiency labelling and retailing of white goods and fittings.

12.5%

reduction in PCC is targeted to deliver by March 2025

We share the water industry wide ambition to reduce leakage by 50% before 2050. Our WRMP19 details our ambition to reduce leakage by 18.5% between 2020 to 2025 through increasing the intensity of leakage activities, innovation, efficiency and reducing customer side leakage. This represents an overall leakage reduction of 30% compared to our 2015 position. In the longer-term we will aim to achieve an overall level of 50% leakage reduction between 2015 and 2045. This timescale of leakage reduction is currently five years earlier than the industry target of 2050. We have also included ambition to reduce leakage by a further 7% (to 57% from our 2015 position) so that we achieve 50% reduction from our 2020 target, by 2050. This ambition is very challenging and will mean we need to find and adopt innovative approaches to addressing leakage across the lifecycle (prevention, awareness, location, mend) as traditional approaches reach the limit of their applicability or become non-cost effective.

50%

reduction of leakage by 2050 (in line with the water industry wide ambition)

To minimise disruption in our communities, we have a proactive approach to replacing our underground assets based on age, condition, and burst history. We replaced 13.6km of pipes in year 1 of AMP7, in line with our business plan. It is likely that we, along with the rest of the industry, will need to increase the rate at which we replace our water network pipes to make these challenging levels of leakage reduction possible and sustainable.

13.6km

of pipes replaced in year 1 of AMP7, in line with our business plan

We continue to campaign to involve water companies more in planning applications involving large scale developments. We want to increase our influence within the planning system to ensure that new developments are as water efficient as possible. This is vitally important in our region where significant new development is planned against a backdrop of existing water stress.

To facilitate our ambition to end unsustainable abstraction from chalk aquifers and to improve the resilience of our supply to customers, our WRMP19 identified the need for a major strategic import to the Affinity Water supply area in the mid to late 2030s (Section 2.3). This will help alleviate the pressures of increased demand for water.

"We want to increase our influence within the planning system to ensure that new developments are as water efficient as possible"

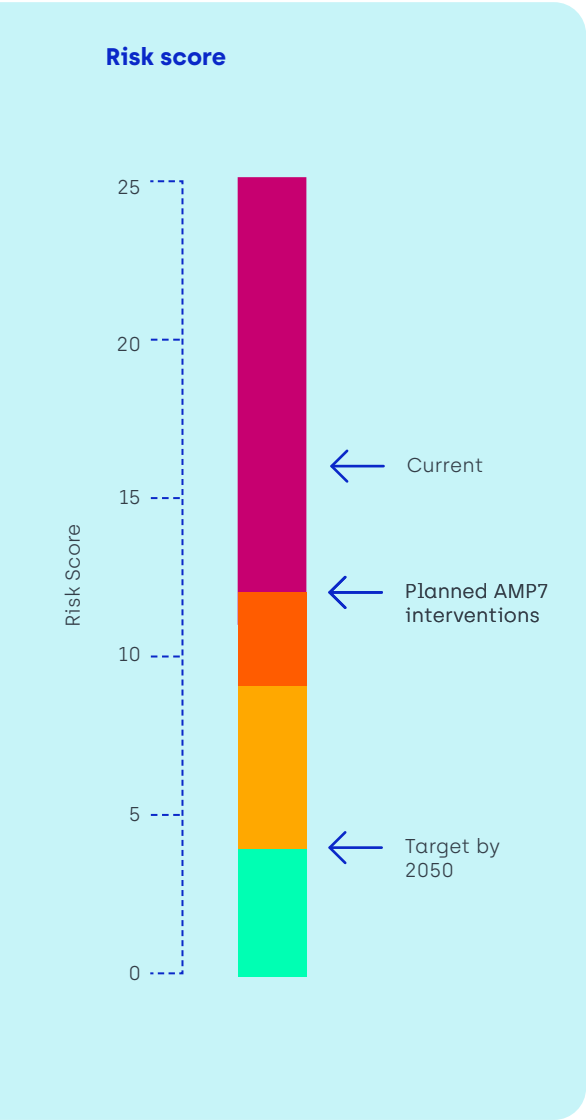
Case Study:
Water Smart Holiday Parks

The Clacton area is already water stressed but water resources come under even greater strain during summer when there is an influx of holiday makers. Through the Water Smart Holiday Parks project, we have been working with several large holiday parks to improve water efficiency and manage peak demand by:

- Reaching out to retailers and sites to form partnerships
- Surveying sites to understand water consumption, the layout of the network and areas of water inefficiency
- Creating a plan of works to improve water efficiency
- Installing water efficiency measures to reduce consumption

Since starting the project in June 2021, we have reduced water consumption at the holiday parks we engaged with by over 40%. This has significantly helped to sustain supply in the area and reduce interruptions to supply.

2.2 Equipment and asset failure due to extreme weather events



2.2.1 What is the risk?

Related CCRA3 Risk

In1: Risks of cascading failures from interdependent infrastructure networks

In2: Risks to infrastructure services from river, surface water and groundwater flooding

In5: Risks to bridges and pipelines from high river flows and bank erosion

In8: Risks to subterranean and surface infrastructure from subsidence

Climate change will lead to more frequent and more intense extreme weather events, including extreme rainfall events, heatwaves and storms. The assets and equipment that underpin the service we deliver to customers are exposed to a range of direct risks associated with these extreme weather events, including:

- Overheating of mechanical and electrical equipment during heatwaves.
- Inundation of assets and equipment by floodwater (because of surface, fluvial, groundwater and coastal flooding) leading to damage or contamination (see also section 2.5).
- Pipe bursts as result of shrink-swell events (as well as sporadic freeze-thaw events), leading to increased leakage.
- Damage to pipes crossing major rivers because of higher flows and increased scour. We have 343 pipe crossings of large rivers, of which 103 are trunk diameter pipes.
- Higher and more prolonged peak demand (as described in Section 2.1) can place additional pressures on assets, increasing the risk of failure.

Further to this, many of our assets are interdependent with other infrastructure systems, such as energy and communications, as well as supply chains for inputs such as chemicals, which are themselves exposed to risks from climate change. For example, our assets and equipment are at risk of failure during power outages which could be caused by extreme weather events such as flooding, heatwaves or high wind.

The knock-on effect of asset and equipment failure to our customers is the potential for loss of service, disruption to their water supply and increasing leakage.

Figure 2-2 Wintery conditions such as 'Beast from the East' can lead to enhanced leakage

2.2.2 What progress has been made in adapting to the risk?

We have taken the following steps and invested in measures which improve the resilience of our assets and equipment to the flood risks described in section 2.2.1:

- In AMP5, actions were taken to protect the security of supply of 800,000 people against a 1 in 100 year flood event, including an allowance for the risks posed by climate change, exceeding our legal obligation.
- In 2016 we invested £300k in temporary flood defences which included flood gates and removable barriers, to reduce the risk of inundation to critical equipment by flood water.
- We installed sump pumps to drain surface water ingress at critical sites.

We are also investigating the role that nature-based solutions can play in reducing flood risk. In addition to mitigating the risks posed by climate change, these interventions increase the overall resilience of our pumping stations and distribution network.

Climate change may increase the risk of leakage due to damage to pipes from more shrink-swell events, making it more challenging to meet our leakage targets without further investment. Pipe damage due to freeze-thaw events may become less frequent under climate change but will remain a risk. We met our 15% leakage reduction target for 2015-20 (the water industry's largest percentage leakage reduction target for AMP6) through a major transformation programme, better use of data, investing in the latest technologies, innovating to improve our productivity, and working closely with other companies to share ideas and best practice. However, we know that we need to do more to meet our leakage targets in 2020-2025 and our longer-term ambitions, as set out in Section 2.1.3.

Figure 2-3 Demountable flood barrier

15%

leakage reduction target for 2015-20 achieved

To minimise disruption in our communities, we have a proactive approach to replacing our underground assets based on age, condition, and burst history. We replaced 13.6km of pipes in year 1 of AMP7, in line with our business plan.

One of the key risks from climate change to our assets and equipment is loss of external power as a result of extreme events such as flooding, storms and heatwaves. This risk is increasing as we experience more intense and more frequent extreme weather events. We depend on third parties to supply most of our power, and therefore to address this risk, we have installed back up power (diesel generators) at critical sites and are currently investing in a solar power programme to self-generate. Reducing our dependency on electricity from the grid through self-generation builds resilience to the risk of power outages associated with extreme weather events (more details on our solar programme in the case study below) whilst also contributing to our net zero strategy and reducing energy consumption costs. We can also mitigate this risk through managing and reducing our demand for energy and are working to do so wherever it is feasible to improve.

Whilst we are working to build resilience to the risks listed in section 2.2.1, we also have plans in place to respond to emergencies, such as extreme weather events. Together, the Emergency and Crisis Management Plans describe the structure, and define the roles and responsibilities, that form the basis for our emergency response. An emergency response will invariably result in the formation of the Emergency Response Team (ERT). The ERT is a trained and experienced response team which assembles in a dedicated Incident room to take coordinated decisions. The ERT meets frequently until the objective is achieved or the escalated response is no longer required. The group defines an agreed way of working to resolve an issue, mitigate the impacts of an incident, and manage a situation back to business as usual. Our plans have been written to align with emergency response best practice (Joint Emergency Services Interoperability Principles (JESIP)).

The plans are designed to be generic so that they can be applied to any incident, including an extreme drought. This flexibility in our approach allows us to adapt and apply the same response structure whatever the situation. The generic plans are supported by a suite of emergency plans that provide guidance on how to respond to a specific incident, for example a pandemic event or widespread power outage.

We work closely with our suppliers and other water companies to improve our resilience to supply chain risks. For example, we maintain chemical supplies and have agreements in place with our suppliers to hold additional supplies.

2.2.3 What else will be done to further adapt to the risk?

We will update our Flood Risk Assessment (FRA) in AMP7 (see section 2.5.3) which will include a review of investment in flood defences at critical sites. We will also investigate opportunities for improving flood warning arrangements (Section 2.5.2).

To achieve our ambitious targets on the backdrop of increased risk of leakage due to changes in ground conditions, we will continue to invest to reduce rates by increasing intensity of activities, innovation and efficiencies in distribution network leakage control, and customer supply pipe leakage reduction.

Our solar programme will continue throughout AMP7, aiming to provide 10% of our total energy requirement by 2024. The business case for our second phase of solar includes a further 28 sites. This is targeted at sites where we both own the land and have high energy consumption, which together justify the installation of solar panels. A third phase of solar installation is already undergoing feasibility analysis, with a fourth phase planned. We will continue to look for solar and other renewable energy opportunities with a view to increasing our capability in future years. In the long term, we are also looking at on site battery storage as a resilience measure, preserving power quality and also offsetting cost at peak tariff times of day.

10%

of our total energy requirement to be from solar by 2024

We know we have more to do to better understand the impact of extreme weather events on assets, particularly the impacts of high temperatures and heatwaves. In order to mitigate the risk of asset failure, it is important for us to understand how those assets operate as part of a system to abstract, treat and distribute safe potable drinking water to customers. We are currently developing and testing an approach to measure the "resilience" of this system for each of the communities that we serve (see Section 2.5).

Case Study:
Affinity Water Solar Programme

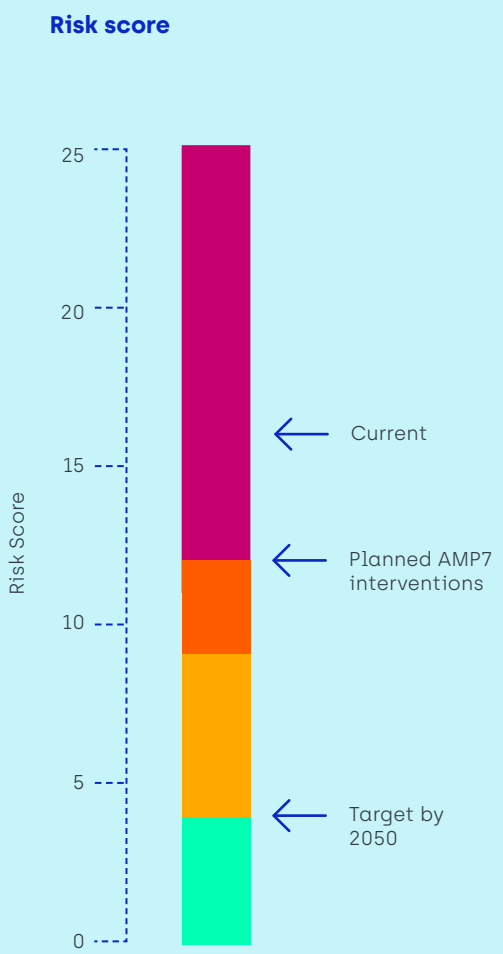
Affinity Water is currently investing £29 million in solar power, with the first two sites in the programme currently in construction. The initial installations will generate 1Megawat (MW) and 0.5MW respectively and are due to be completed in 2022. These first sites will allow us to understand the costs, complexities and risks associated with solar installations on our sites as well as testing ground mounted, roof mounted and ballast mounted solutions.

A second phase of solar installations at a further 28 sites has now been approved. This phase will increase our total solar generation to 10% of our power consumption by 2024.

£29m

investment in solar power

2.3 Increase in competition for and price of raw water imports



2.3.1 What is the risk?

Related CCRA3 Risk

In1: Risks of cascading failures from interdependent infrastructure networks

We are not alone in facing risks from climate change to water supply, these risks associated with drought (Section 2.4) and changing water quality (Section 2.6) will also affect neighbouring water companies with whom we trade both raw (untreated) and potable (treated) water every day. Currently we import and export water from other companies through bulk transfer agreements and emergency connections. There is little consistency to the commercial and legal arrangements between companies which means that pricing policies differ and the basis of the supply can vary from a "right to take" to a "best endeavours" basis that may be suspended in times of drought or emergency.

In 2020/21 (under average groundwater level conditions), at a company level we had an average import capability of 66.27 megalitres of water per day, approximately 7% of our daily distribution input. This ability to transfer and trade water across company boundaries is an important part of our water resources management strategy and increases resilience whilst minimising environmental impact.

Our reliance on inter-company transfers will increase significantly in the medium term. To facilitate our ambition to end unsustainable abstraction from chalk aquifers and to improve the resilience of our supply to customers, our WRMP19 identified the need for a major strategic import to the Affinity Water supply area in the mid to late 2030s. Six Strategic Resource Option (SRO) schemes that provide a combination of treated and raw water transfer from three other companies are currently being developed. Each of these SRO schemes will increase the risk associated with inter-company transfers.

With the expected increase in the frequency and length of drought conditions (see Section 2.4), as well as changes to water quality (Section 2.6) because of changing temperature and rainfall patterns across southeast England, there is potential for greater competition for raw water imports in the future as well as lower headroom in the wider region. The price we pay for water imports will likely increase, alongside the requirement for companies to consider higher cost and higher carbon solutions.

Whilst importing water is an important part of our current strategy, this approach to water resources management is likely to become more uncertain as the climate changes. However, we have to balance this risk against risks to the environment locally and importing water from areas where there is surplus water plays an important role in reducing the impact of unsustainable abstraction. We are therefore working to reduce water use by all customers and increase the resilience of our network (as set out in Section 2.1), lessening the need to import water and help us to reduce groundwater abstraction locally.

2.3.2 What progress has been made in adapting to the risk?

Through WRMP19, we have modelled the impact of climate change (and other drivers) on the supply demand balance and have set out a range of supply and demand measures for addressing the deficit.

Through our two regional planning groups Water Resources East (WRE) and Water Resources South East (WRSE) and the Regulatory Alliance for Progressing Infrastructure Development (RAPID) programme, we are developing six SROs during the period 2020 – 2025, including imports, reservoirs, pipeline transfers, canal transfers and wastewater reuse schemes.

We are currently working on progressing our technical understanding of the schemes, their costs and delivery lead times, and stakeholder views. We are progressing these SROs in close partnership with neighbouring water companies and we are actively involved in the two water resources regional groups. These are aiming to achieve a sustainable and coordinated solution for the regions, thus minimising the risk of competition between water companies. At this stage, the evaluation has been focused on the engineering and technical aspects of these schemes rather than the commercial and legal agreements that would be needed for these schemes to be feasible. Large scale transfers of this sort introduce new risks including water chemistry, biodiversity and invasive species as well as increasing the energy and carbon impacts of replacing local groundwater sources with water that is pumped long distances across regional boundaries.

Our Supply 2040 programme will transfer surplus water from the south of our Central region to the north of the region where we will have a deficit when we reduce our abstraction from chalk aquifers. This programme will build the pipe infrastructure to allow these transfers to happen and to build resilience in our distribution network.

2.3.3 What else will be done to further adapt to the risk?

As we continue to develop the SROs between now and 2025, we will work to understand which the 'front runner' is to be selected as the first SRO in the regional plans. This will be informed by best value modelling and stakeholder engagement and will be done in collaboration with the regional water resource planning bodies. The risk of increasing price and competition for raw water imports due to increasing water scarcity will also be considered.

A further way of reducing our need to import water is by increasing the amount of surface water we capture and store. In addition to the SROs, we will be looking at options to increase storage capacity, for example, through bankside storage that can support our groundwater abstractions, potentially reducing their impact on chalk streams by taking more water during the winter months (See Section 2.4 on drought risks/mitigation).

Building on the Supply 2040 concept in WRMP19 which will help connect our areas of surplus with our areas of deficit, we are now developing a further programme of work that will be necessary for us to distribute the water from at least one SRO scheme. Connect 2050 is driven by population growth, sustainability reductions, new strategic imports and the requirement for greater resilience. Whilst our reliance on cross-company transfers will increase the risk associated with us being more reliant on a smaller number of larger sources, Connect 2050 will mitigate the risks associated with moving this water across our region. We will develop the Connect 2050 transfer options for inclusion in WRMP24 and PR24 so they can be funded and delivered.

We are in the process of, and will continue to, review our abstraction in light of sustainability reductions and the Environment Agency's abstraction licensing strategy. This will allow us not only to be resilient to drought risk but leave more water in sensitive catchments during dry periods (Section 2.4). One of the aims of the review is to increase the degree of flexibility we have over the management of water resources within environmental limits. By grouping licences at a catchment level or by investigating the introduction of five-year rolling licences, we hope to be able to leave more water in the environment when it is most needed. This aligns with our company objectives whilst also meeting the ambitions of the National Framework for Water Resources[4] and associated environmental destination.

'One of the aims of the review is to increase the degree of flexibility we have over the management of water resources within environmental limits'

RAPID have set up a water transfer pricing sub-group alongside the option development work (that the companies attend), to ensure that appropriate bulk supply contracts principles are agreed. The principle of fairness in pricing is part of that sub-group work.

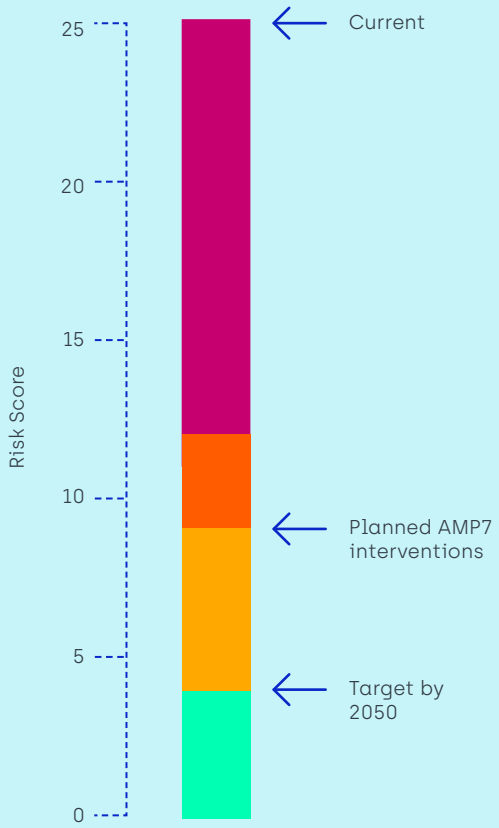
4 Meeting our Future Water Needs: a National Framework for Water Resources (Environment Agency, 2020).

Strategic Resource Options (SROs) under development

Along with Severn Trent Water, the Canal and Rivers Trust, Thames Water and Anglian Water we are developing six strategic water resource options to deliver social, environmental and economic benefits for the region and communities we serve. The six SROs under development are:

- **Minworth:** A source of raw water flow augmentation to support either the Severn to Thames Transfer (STT) SRO, the Grand Union Canal (GUC) SRO, or a combination of the two.
- **The Grand Union Canal (GUC):** An option that utilises the existing canal infrastructure to transfer treated wastewater from Minworth (STW) in the Midlands to Affinity Water in Hertfordshire and North West London.
- **The South East Strategic Reservoir:** a proposed new reservoir located near Abingdon (Oxfordshire) that offers storage and a resilient supply of raw water to the River Thames during periods of low flow, for subsequent re-abstraction in London.
- **The Thames to Affinity Transfer:** A raw water transfer that could use a variety of potential source waters (three possible source options SESRO, Severn Thames Transfer or different London- reuse options). Three possible 'corridors' have been identified – 1) the fluvial Thames, 2) West London Re-use and 3) East London Re-use, all would include new treatment works and conveyance routes.
- **The South Lincolnshire Reservoir:** a proposed new reservoir expected to be located in Lincolnshire. When river flows allow, water would be sourced from the River Witham supported by a transfer from the River Trent. Water could be transferred to the reservoir either by a pipeline or an open water transfer. Local flows from the South Forty Foot Drain will also be incorporated into the design where possible.
- **The Anglian to Affinity Transfer:** a proposed new piece of infrastructure that would transfer water from the Anglian Water region to supply Affinity Water customers. The transfer would source water from a new supply to be developed in the Anglian Water region, which could be the South Lincolnshire Reservoir, the Fens Reservoir or a new source from the River Trent.

2.4 Reduced availability of ground and surface water due to drought



2.4.1 What is the risk?

Related CCRA3 Risk

In9: Risks to public water supplies from drought and low river flows

On average we supply around 950 million litres of water a day. Approximately 65% of water we supply comes from groundwater sources whilst the remainder comes from surface water and imports. All types of sources are at risk from climate change, including an increase in drought events. Our operational response to drought is managed through our Drought Management Plan.

65%

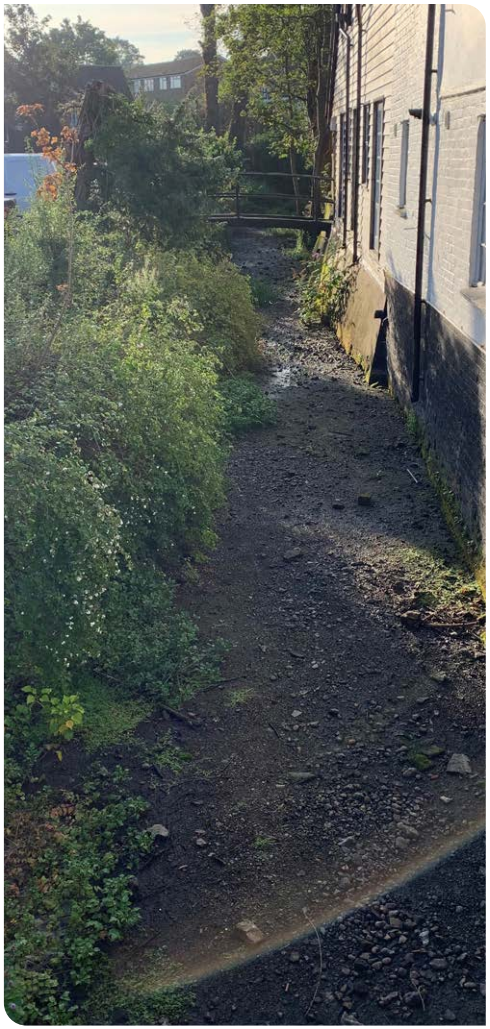
of water we supply comes from groundwater sources

Groundwater sources are at risk from more frequent and longer droughts and warmer temperatures earlier in the calendar year, shortening the recharge season. Increasing rainfall intensity (more rain falling in short, sharp extreme rainfall events) also poses a risk to groundwater recharge as it increases runoff and reduces infiltration – this would work to exacerbate drawdown of aquifers due to drought. Reduced river flows associated with drought and changes in rainfall patterns can affect how much groundwater we are able to abstract due to constraints on certain abstraction licences which are triggered by low river flows.

Drought also poses an indirect risk to water supply where we abstract water directly from surface water sources, such as the River Thames. Although our river intakes are drought resilient (due to our preferential status in the legal and commercial agreements), lower river flows could impact other abstractors and their ability to supply our import requirements (as discussed in Section 2.3).

Without intervention, this risk may impact our ability to meet our performance commitment that no customer is at risk of experiencing severe restrictions from a 1-in-200 drought on average over 25 years. We are investing in improving resilience to drought and addressing the risk from climate change.

Figure 2-4 Low flows in our chalk streams due to drought



2.4.2 What progress has been made in adapting to the risk?

We are seeking to mitigate this risk by reducing our reliance on sensitive groundwater and surface water sources, restoring sustainable abstraction through reductions in abstraction from our existing sources, and through managing abstraction during periods of drought.

Our WRMP19 modelled the impacts of climate change on water resources, including related changes to ground and surface water source availability. The outputs of the climate change assessment were factored into our supply-demand balance calculations, and the associated risks are being managed through our investment programmes, including our Supply 2040 scheme to transfer water from areas of our Central region where we have a surplus to areas where there is a deficit, and an extensive demand management programme (see Section 2.1). In addition, we are developing six SROs in the period 2020 – 2025 (see Section 2.3). These are sensitive to both water supply needs as well as water quality and energy consumption considerations.

WRMP19 provides the strategic framework within which our current Drought Management Plan sits as an operational plan. We recognise that climate change has the potential to exacerbate the impacts of drought both on the environment and on availability of supply. With this in mind, we have made several improvements to our new draft drought plan (final plan to be published in 2022) which reflect an increased focus on the environment.

We have:

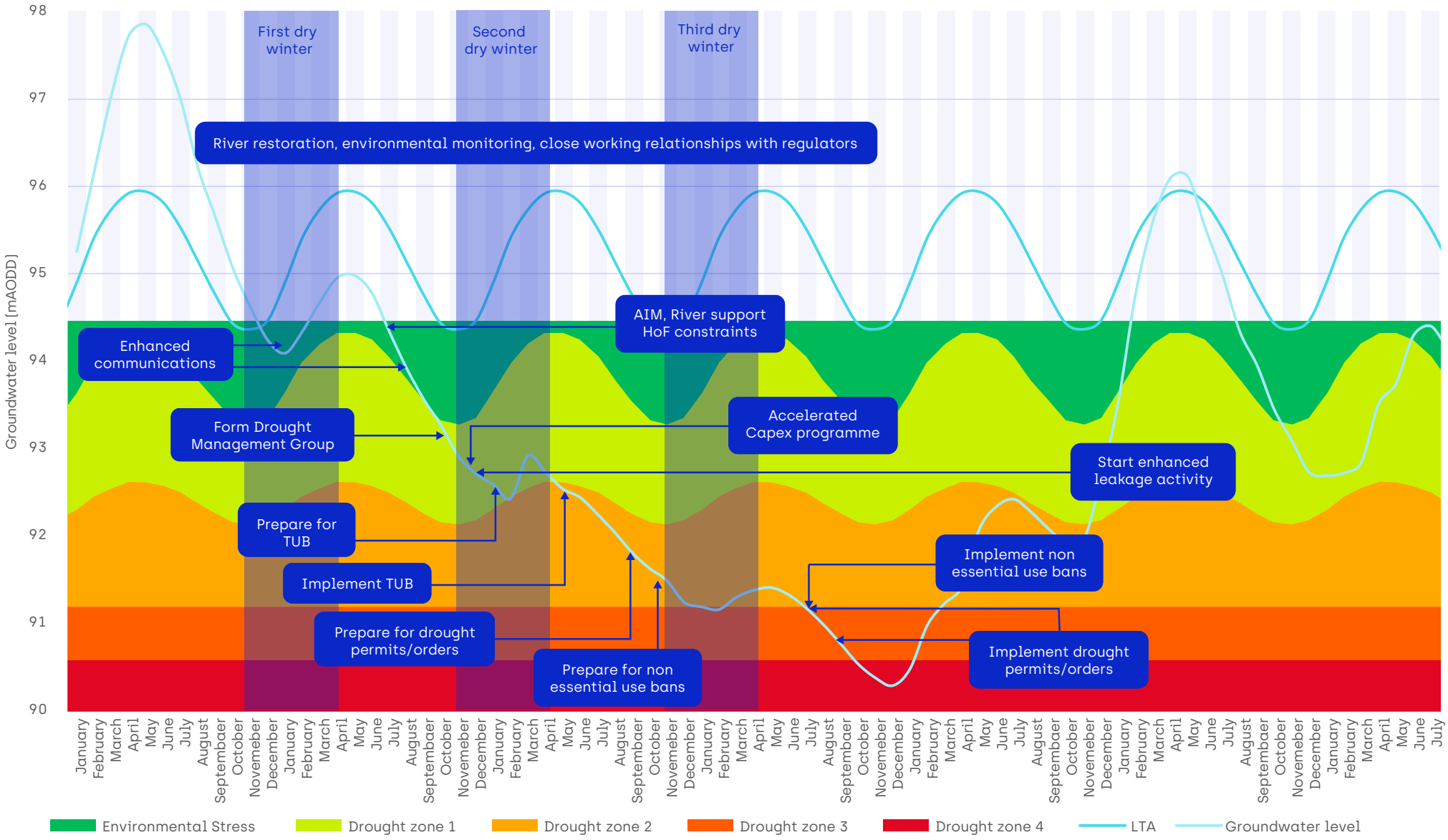
- Invested in improving our planned levels of service for drought permits from 1 in >40 years to greater than 1 in >200-year return period events after March 2024, reducing our reliance on some of our more environmentally sensitive drought permit options.
- Reviewed our drought triggers and included a new 'environmental stress' trigger' which is linked to environmental conditions (including river flows).
- Included additional environmental monitoring to ensure we are informed of conditions locally as well as regionally – helping us to act in a timely manner to protect both security of supply and the environment.
- Committed to do more to reduce demand in the very early stages of a drought to try to mitigate the need for further interventions, leaving more water in the environment at a time when it is most needed.

Figure 2.6 on the next page shows when we will take action during drought to protect security of supply and the environment.

As well as updating our plans and investing in infrastructure schemes to address climate change risks to water supply, we have invested significantly in catchment management to improve water retention for crop growth during droughts (see Section 2.6). Our Catchment Team works with farmers and other land managers to improve catchments to benefit water quality, water resources and the wider environment. We do this in partnership with various groups including Catchment Sensitive Farming, the Wildlife Trusts, other water companies and the agricultural industries.

Figure 2-5 Dry ground (Soil moisture deficit) reduces the amount of rainfall that infiltrates to reach the aquifer

Figure 2-6 Simulated drought event including the actions we would take during Environmental Stress to protect the environment



5 Affinity Water draft Drought Management Plan. [2021]

2.4.3 What else will be done to further adapt to the risk?

Our future plans will set a pathway to further mitigate this risk based on our assessments of how best to manage our existing and future abstractions during a drought and evaluating our water resources against more extreme drought return periods. Through our drought planning process, we have taken steps to ensure we will be resilient to greater than a 1 in >200-year return period drought event without the need for drought permits beyond 2024. We have the ambition through the National Framework for Water Resources to increase this to 1 in > 500-year return period drought events by 2040.

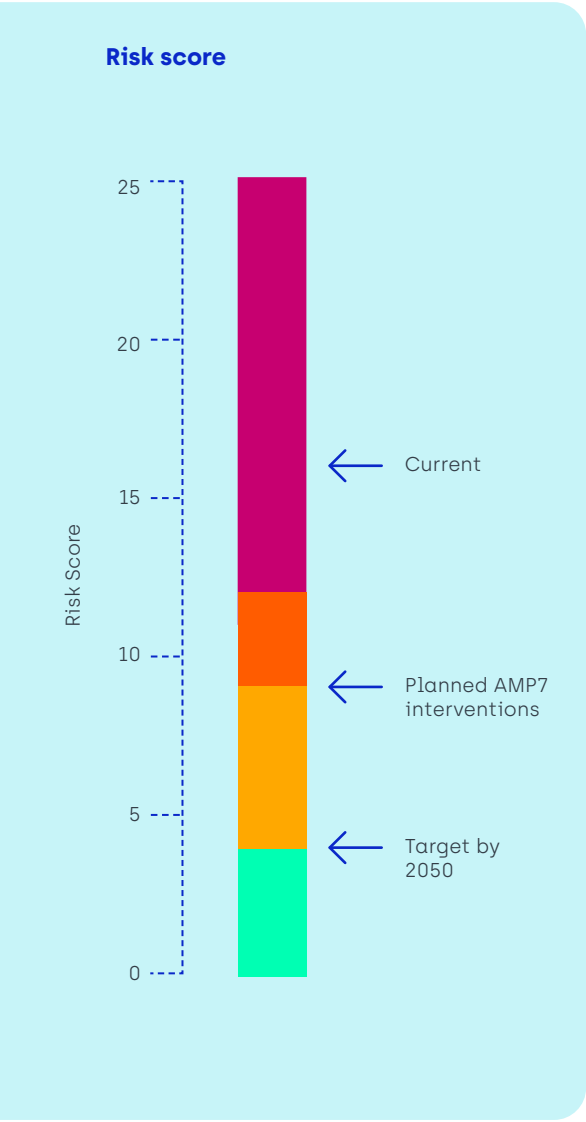
As we continue to develop the SROs between now and 2025, we will work to understand which of the projects is to be selected as the first SRO in the regional plans, as set out in Section 2.3. This will be informed by best value modelling and stakeholder engagement and will be done in collaboration with the regional water resource planning bodies. A further way of reducing risk to water supply from drought is to increase the amount of surface water we capture and store. In addition to the SROs, we will be looking at options to increase storage capacity, for example through bankside storage to support our groundwater sources.

We are in the process of, and will continue to, review our abstraction in light of sustainability reductions and the Environment Agency's abstraction licensing strategy. This will allow us not only to be resilient to drought risk, but leave more water in sensitive catchments during dry periods. One of the aims of the review is to increase the degree of flexibility we have over the management of water resources within environmental limits. By grouping licences at a catchment level or by investigating the introduction of five-year rolling licences, we hope to be able to leave more water in the environment when it is most needed. This aligns with our company objectives whilst also meeting the ambitions of the National Water Resources framework and Environmental Destination.[6]

We recognise our catchments as our primary asset and will be investing in additional catchment management interventions and targeting implementation in the most appropriate locations within catchments to improve soil health and water resources. This will also help protect our sources from water quality deterioration during all periods (including droughts – see section 2.6).

6 Meeting our Future Water Needs: a National Framework for Water Resources (Environment Agency, 2020).

2.5 Outage due to flooding of assets



2.5.1 What is the risk?

Related CCRA3 Risk

In2: Risks to infrastructure services from river, surface water and groundwater flooding

In3: Risks to infrastructure services from coastal flooding and erosion

In4: Risks of sewer and surface water flooding due to heavy rainfall

Supplying our customers with clean, safe drinking water relies on a network of sites and assets, including water treatment works, pumping stations, booster stations and depots. Several of our sites are already at risk of flooding from a range of sources – rivers, the sea, groundwater and surface water. Changing rainfall patterns, more extreme rainfall events and sea level rise as a result of climate change will exacerbate these risks, as well as potentially putting more sites at risk of flooding.

Surface water flood events present a particular challenge for us as they happen quickly and lead times for reacting operationally are short. An increase in precipitation during heavy rainfall events means that surface water flooding is likely to happen more frequently, representing a significant risk to our operations.

For our coastal sites in Essex and Kent, flooding as a result of sea level rise presents a risk. Other potential risks associated with sea level rise include saline intrusion into groundwater sources, leading to increased treatment requirements or loss of sources. Our environmental monitoring will provide an early warning of saline intrusion.

Flooding can cause damage directly to equipment and assets at our sites (See Section 2.2), but it can also prevent staff from accessing sites. This can affect our ability to put in place emergency responses or make emergency repairs, potentially increasing the length of disruption to services.

Flooding of our sites has the potential to cause operational outages, which could interrupt supply to customers.

Figure 2-7 Flooding in 2014 prior to installation of site level flood defences

One of the ways this can happen is if the floodwater impacts raw water quality (discussed in Section 2.6). If several sites are impacted concurrently, our ability to mitigate supply risks by redistributing water in our network is reduced. Such an event would result in transition to our emergency plan, as described in Section 2.2.2. The increased risk of flooding at our sites because of climate change therefore poses a risk to a number of our performance commitments.

2.5.2 What progress has been made in adapting to the risk?

Our last region-wide FRA, conducted in 2014, focussed investment in flood defences at critical sites assessed as being most at risk of flooding. This protected the security of supply of 800,000 people against a 1 in >100-year flood event, including an allowance of the risks posed by climate change, equating to a 20 % uplift on peak flow level. Where suitable, additional mitigation consideration was given to the risks posed by wave action.

We have invested in temporary flood defences, including flood gates and demountable barriers which can be deployed to reduce the risk of flood water ingress and damage to assets. We purchased the same type of barrier as our neighbouring water companies and the barriers are available to be shared if needed through the water company mutual aid agreements. Where suitable, (for example at sites at risk of surface water flooding), we have invested in sump pumps to drain surface water ingress.

Key to successful deployment of these temporary flood defences is receipt of accurate and timely flood warnings. We receive flood warnings in relation to fluvial flooding from the Environment Agency, but rainfall warnings and pluvial flood warnings are highly variable. We are working to understand our catchments better, particularly in terms of understanding surface water flooding, and are looking into enhanced forecasting methods.

We have site-based flood management plans and will update these following the update to our regional FRA, including additional recovery measures if necessary.

In addition to mitigating the risks posed by climate change, these interventions increase the overall resilience of our pumping stations and distribution network.

2.5.3 What else will be done to further adapt to the risk?

We know that flooding is a significant risk to our business and customers, and we have several actions planned to improve our resilience further.

Our last region-wide FRA was completed in 2014 but since then, updated climate change projections for the UK (UK Climate Projections 2018, or UKCP18) have been published, along with updated climate change flood allowances published by the Environment Agency. We will update our regional FRA with the latest information, to better understand how climate change will affect flood risk for our sites. Additionally, our previous FRA focused on fluvial flood risk, but we know that it is important that any update to our FRA considers risk from all sources of flooding – rivers, the sea, pluvial and groundwater.

An updated FRA will help us prioritise where we need to invest further in permanent and temporary flood defences, as well as improving our understanding of how best to use the equipment we have. This will involve updating our site-based emergency plans and protocols for sites at greatest risk of flooding. It is important that the appropriate training on deployment of the temporary flood defences is correctly rolled out.

We are currently developing a framework for measuring resilience to customers and communities. This approach has been used by other companies and will be tested in our Dour region in 2021/22. We intend to roll-out this approach across our region to give an understanding of the resilience in each of our communities. Flooding and the extent to which it will affect our assets and our service is part of the framework approach. As a result of this work, we will be able to identify which assets, at risk of flooding, will have the biggest impact on our communities and customers. These assets will be proposed for inclusion in our PR24 business plan.

'We have invested in temporary flood defences, including flood gates and demountable barriers which can be deployed to reduce the risk of flood water ingress and damage to assets'

Case Study:
improving site resilience to fluvial flooding in our Lee community

A pumping station located in our Lee community, experienced flooding from the adjacent watercourse following heavy rainfall in 2014, which backed up from a road culvert to the southwest of the site. This resulted in a complete site outage for 17 days.

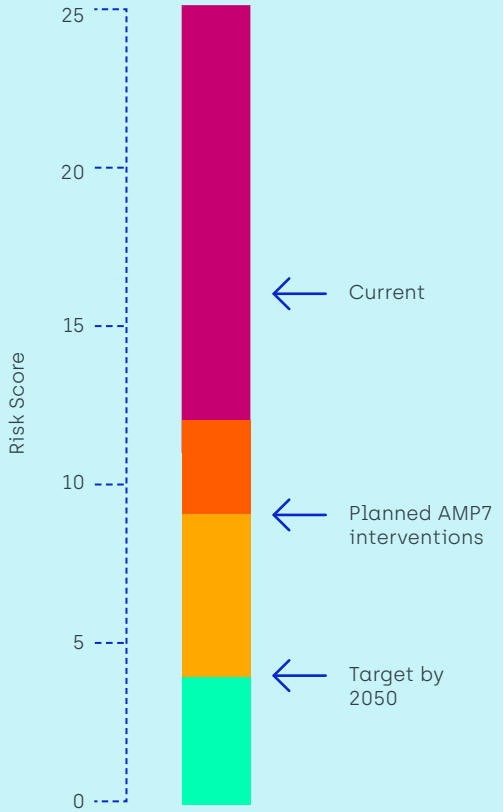
Since 2014, the criticality of the site has increased, as other pumping stations in the area reduced abstraction for environmental reasons. As a result of its criticality, the site was fitted with site level flood protection in 2015/16. This included fitting wickets, raising the height of critical assets and fitting flood alarms. These measures were designed to allow the site to continue to operate during a flood severity of 1 in 100-year event including an uplift factor to account for climate change.

In early 2021, high rainfall once again resulted in flooding of the site. Although access was limited by floodwater, the site remained operational. We attribute this to the slightly lower flood flows and the site level flood protection.

Following the recurrence of flooding in 2021, we investigated the mechanisms behind the flooding of the site. This has highlighted several further actions we can take to improve resilience of the site and these actions will be reviewed for inclusion in our next business plan:

- **Natural flood management** - leaky dams and upstream floodwater retention to stagger the release of floodwater.
- **Improved farming practices** - working with farmers to improve rainfall infiltration and reduce runoff (Section 3.6).
- **Asset maintenance** - work with landowners to ensure assets are not blocked and are properly maintained
- **Flood modelling** - work with the Environment Agency to improve the quality of available flood modelling at the site.
- **Improve access** - improve site access for operational reasons during flooding.
- **Forecasting** - monitor water level at the downstream with culvert and work with third parties to investigate options for site level flood forecasting to improve flood response.
- **Flood defences** - review existing flood protection to determine whether the design flood level is adequate.

2.6 Changes to raw water quality



2.6.1 What is the risk?

Related CCRA3 Risk

In2: Risks to infrastructure services from river, surface water and groundwater flooding

In3: Risks to infrastructure services from coastal flooding and erosion

We take water from the environment and treat it to meet drinking water quality standards, before supplying our customers. The treatment requirements for our sources are influenced by the quality of the raw water we abstract.

Changes in rainfall and temperature patterns could affect raw water quality of both groundwater and surface water sources in different ways at different times of the year, meaning that it can be difficult to determine the overall impact of climate change on raw water quality. Potential impacts include:

- Wetter winters and flood events leading to increased nutrient and pesticide runoff resulting in changes to nitrate concentrations and the mobilisation of contaminants in groundwater sources. Conversely, wetter winters could lead to greater dilution of pollutants in aquifers.
- Wetter winters leading to increased urban runoff which introduces metals and fuel contaminants into watercourses and increased Combined Sewage Overflows (CSO) affecting the quality of surface water sources.
- Extreme rainfall following a period of long, dry weather results in a 'first flush' effect with high concentrations of nutrients and pollutants entering surface and groundwater sources.
- Flooding leading to contamination
- Sea level rise potentially leading to saline intrusion at coastal sources

We are already seeing some of these risks occurring across our region. For example, in the water we abstract from the River Thames we have observed higher levels of suspended solids and pollutants from land in the catchment, and also the effects of saline intrusion on our coastal sources in our Southeast region. Increased erosion, nutrients and road runoff is leading to pollution of rivers and in particular our precious chalk streams. Climate change will impact existing risks to raw water quality including those associated with changes in groundwater levels.

2.6.2 What progress has been made in adapting to the risk?

We know that climate change (and other factors) will change the raw water quality and we are taking a holistic approach to addressing the challenge through catchment management initiatives as well as treatment solutions. Many of our catchments are dominated by agricultural land, predominantly used for arable crop production. Working with farmers to address water quality challenges is at the forefront of our catchment management programme. Our Catchment Team (in partnership with Catchment Sensitive Farming, the Wildlife Trusts, other water companies and the agricultural industries) works with farmers and other land managers to promote good land management which benefits water quality, water resources and the wider environment, including chalk streams.

Our catchment management work is a targeted way to address specific water quality challenges such as pesticide and nutrient pollution, as well as promote landscape scale approaches such as regenerative agriculture to improve biodiversity, implement

Figure 2-8 Cover cropping can also provide biodiversity benefits

natural flood risk management and help address climate change. Over three cycles of our cover crop funding scheme (see case study below), we have seen an increase in the number of farms we work with, from 11 farms in year one (2018/19) to 23 farms in year three. Over 2500 hectares of farmland has been cover cropped during the three years of the scheme, preventing an estimated 119 tonnes of nitrogen reaching watercourses and aquifers.

2.6.3 What else will be done to further adapt to the risk?

We recognise that catchments are our primary assets. Building on the success of our cover crop programme, we will identify additional catchment management interventions for investment, looking also to target interventions more precisely within catchments. We are also clear that nature-based solutions play a critical role in reducing risks from climate change to water quality and will be investigating a wider range of measures such as arable reversion, chalk grassland restoration, year-long cover crops, building of carbon into soils and companion cropping. In combination with our SROs (Section 2.3) and future abstraction activities we will also re-evaluate the benefits of these activities upon the future quality of our water sources and the wider environment.

We are improving our understanding of how climate change will affect water quality and the knock-on effect of changing water quality on water resources. Our Drinking Water Safety Plan references climate change risks but we are reviewing this with the aim of improving our understanding of climate change risks to water quality at a site level. This will enable us to prioritise interventions and investment at sites and sources most at risk of a changes in water quality.

Figure 2-9 Cover cropping to increase carbon retention and reduce runoff

Case Study: cover crop funding scheme

We started a cover crop funding scheme in collaboration with Cambridge Water in 2018. The scheme focuses on an area of North Hertfordshire where our groundwater catchments are vulnerable to nitrate leaching. Cover crops are grown by farmers in-between the crops that they harvest. They are mainly grown to cover and protect bare soil, build fertility, and control pests and diseases. They also benefit groundwater as cover crops retain excess nitrate and reduce leaching which protects the aquifer. Cover crops also store carbon, aid infiltration and have benefits for farmland biodiversity. However, they are not very common as there are additional costs to the farmer and they do not get any immediate financial return.

The scheme uses an on-line environmental trading platform, EnTrade, to run a reverse auction which asks farmers to bid their price for growing cover crops. The farmer chooses from a predefined list of cover crops species and when to plant them. Earlier planting dates and certain species, such as oil radish, typically retain more nitrate in the field and prevent it being lost to groundwater.

We have run three annual auctions to date. The 2020/21 auction was the most successful yet, with pledges from farmers to grow over 1,000 hectares of cover crops. This will retain an estimated 54 tonnes of nitrogen in the field, preventing it from leaching into the aquifer or being washed into a river or chalk stream.

3. Concluding remarks

We are all facing a climate emergency and must take action to mitigate against the effects of climate change. This update of our Climate Change Adaptation Report is timely and has allowed us to re-evaluate risk.

The risk assessment and prioritisation process has identified a variety of risks to our assets and operations. These have been grouped into six interlinked 'key risk areas', which if unchecked, have the potential to have an unacceptable impact on our core business functionality by 2050, alone or in combination. As the UK's largest water supply only company we recognise the important role we have to play. Our customers look to us to lead the way by taking proactive action to protect both the environment and customer supplies. Doing nothing is therefore not an option.

Our planned interventions post AMP7 reduce the forecast risks posed by climate change, but they still have the potential to have a significant impact on our business. For this reason, we know we need to do more. The additional interventions which we plan to implement make the risks posed by climate change in 2050 more manageable. For all but one of the six key risks, our plans reduce the impact on our business to acceptable levels. The exception to this (Increase in demand due to higher temperature, Section 2.1), is being closely managed through our WRMP, a process which intrinsically considers climate change impacts.

By the end of AMP7, our planned achievements to benefit the environment and manage the risks posed by climate change will see:

- Reduction in PCC by 12.5 % by March 2025, to a resultant water use of 129 l/p/d.
- Ambitious abstraction reductions in chalk stream catchments equating to almost 100Ml/d from 1990 abstraction volumes.
- Reduction in leakage by 18.5% between 2020 to 2025. This represents an overall reduction of 30% leakage compared to our 2015 position.
- A review of our company-wide Flood Risk Assessment, to account for UKCP18 scenarios and factor in all forms of flooding.
- 10 % of our energy base to be self-generated by solar power by 2025.
- Continued development of Strategic Regional Option schemes to provide long-term resilience to water resources.
- Publication of our updated Drought Management Plan and Water Resource Management Plans to provide better protection to the environment and to our customers.
- Investment to improve our planned levels of service for drought permits from 1 in >40 years to greater than 1 in >200-year return period events after March 2024, reducing our reliance on some of our more environmentally sensitive drought permit options.
- Additional investment in catchment management activities, which provide a range of climate related benefits.
- Development of Connect 2050 network reinforcement schemes for inclusion in PR24.
- Progress in our commitment to end unsustainable abstraction with consideration to the National Water Resources framework and environmental destination strategy.

But we need to go further. We are working to deliver the following to further reduce the risks posed to us by climate change by 2050:

- Account for climate change impacts in our long term demand projections as part of our WRMP process.
- Development of strategic resource option(s) to be available from the mid to late 2030s.
- Supply 2040 programme will transfer surplus water from the south of our Central region to the north of the region where we will have a deficit when we reduce our abstraction from chalk aquifers.
- Further reduce our reliance on drought permits post 2024, aiming for resilience to 1 in > 500-year return period drought events by 2040.
- Deliver a 50% reduction in leakage between 2015 and 2045.
- Develop our energy strategy to 2050, including a significant expansion of our self-generation solar portfolio.
- Revision to our region-wide Flood Risk Assessment.

We are proud of the role we play, not only in providing an essential service but, also as stewards of the environment. We will incorporate the latest climate change scenarios into our PR24 submission and will look to make further improvements to our climate change resilience as more information becomes available.

7 Meeting our Future Water Needs: a National Framework for Water Resources (Environment Agency, 2020).

1990-date
Ambitious abstraction reductions in Chalk stream catchments of almost 100Ml/d.

2015
Programme of work to protect critical sites from risk of flooding plus climate change finished.

Last climate change adaptation report published.

2017-2019
Groundwater drought

2019
#Whynotwater campaign. A campaign that went beyond our usual water efficiency messaging, with the aim of influencing and changing legislation and highlighted water as a critical element in the climate change debate.

2020-2025
Review of our company-wide Flood Risk Assessment, to account for UKCP18 scenarios and factor in all forms of flooding.

Additional investment in catchment management activities, which provide a range of climate related benefits.

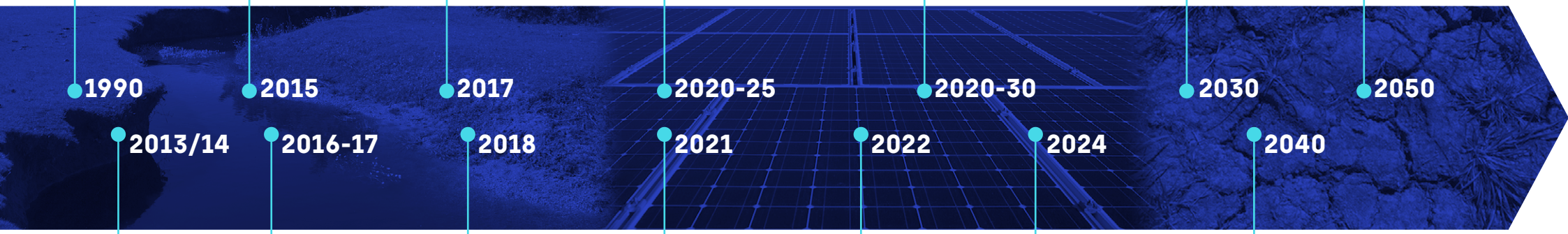
Reduce PCC by 12.5%.

2020-2030
Progress in our commitment to end unsustainable abstraction with consideration to the National Water Resources framework and environmental destination strategy.

Continued development of Strategic Regional Option (SRO) schemes to provide long-term resilience to water resources.

2030s
Development of SROs to be available from mid-late 2030s.

2050
Ambitious energy strategy to 2050, which includes significant expansion of self-generating solar portfolio.



Winter 2013/14
Floods.

2016
Purchase demountable flood barriers.

October 2017
Started Keep Track of the Tap campaign to reduce water use of customers during groundwater drought.

Feb 2018
Beast from the East.

June/July 2018 and April/May 2020
Hot summer/spring periods with record demand in terms of duration and magnitude.

2021-2023
Development of Connect 2050 network reinforcement schemes for inclusion in PR24.

2021-2025
10 % of our energy base to be self-generated by solar power.

2022
New Drought Management Plan to be published.

March 2024
Improve our planned levels of service for drought permits from 1 in >40 years to 1 in >200-year return period events.

2040
Ambition to further reduce reliance on drought permits post 2024, aiming for resilience to 1 in > 500-year return period drought events by 2040.

50% leakage reduction between 2015 and 2045.

4. Water sector template

The following table shows how the National Climate Change Risk Assessment risks have the potential to impact Affinity Water, our progress to date in mitigating these risks and how we are ambitious to increase our levels of resilience.

CCRA Risk	Risk to Affinity	Directly relevant to WoC?	Likelihood of risk occurring to WoC	Magnitude of impact on WoC service	Risk under standing	Controls [AMP7 and planned]	Further actions	Metrics/reporting
In1: Risks of cascading failures from interdependent infrastructure networks	Risk of interruptions, outage and higher costs due to loss of external power, Information & Telecoms (IT) and communications or disruption to supply chain (e.g. chemical supply) as a result of more frequent and severe extreme weather events (floods, heatwaves, storms).	Y	M	H	L	Working with other water companies to secure supplies of chemicals. Investment in resilient power supplies, including solar power, back-up generators. Backup generators at key sites.	Further investment in solar power and onsite battery storage which will increase self-generation capacity and reduce dependence on the grid. Reduce operational complexity and increased interconnectivity of the network. Developing and testing an approach to measure the resilience of the system for each of the communities that we serve.	Number and duration of interruptions and outage Site criticality rankings.
In2: Risks to infrastructure services from river, surface water and groundwater flooding	Risk of interruption, outage and higher costs as a result of flooding (fluvial, groundwater and surface water) of our sites and assets. Deterioration in raw water quality due to high rainfall leading to loss of sources. Limited access to sites leading to longer outages	Y	M	H	M	Investment in site-level flood defence measures such as flood gates and barriers, staff awareness and training in deploying temporary measures Working to better understand local surface water flood risk and exploring enhanced forecasting methods. Investment in natural flood risk management e.g. 'Slowing the Flow'.	Update region-wide FRA to include latest climate change projection data and Environment Agency allowances for climate change. Focus on understanding surface water and groundwater flood risk in addition to fluvial flood risk. Investigate opportunities for increased surface water storage. Reduce operational complexity and increased interconnectivity in the network.	Number and duration of interruptions and outage Cost of flood damage.
In3: Risks to infrastructure services from coastal flooding and erosion	Risk of saline intrusion at coastal sources leading to loss of source.	Y	M	M	M	Additional blending used at coastal sources Coastal sources are currently protected by flood defences.	Monitor saline intrusion risk Consider need for further flood defences in future.	Water quality standards Projected resource deficit due to climate change.

CCRA Risk	Risk to Affinity	Directly relevant to WoC?	Likelihood of risk occurring to WoC	Magnitude of impact on WoC service	Risk under standing	Controls (AMP7 and planned)	Further actions	Metrics/reporting
In4: Risks of sewer and surface water flooding due to heavy rainfall	Risk of storm drain capacities being exceeded during extreme rainfall events, leading to site flooding cess pits and septic tanks.	Y	M	L	L	Working to better understand local surface water flood risk and exploring enhanced forecasting methods. Investment in natural flood risk management e.g. Slowing the Flow.	Update region-wide FRA to include latest climate change projection data and Environment Agency allowances for climate change. Focus on understanding surface water and groundwater flood risk in addition to fluvial flood risk. Reduce operational complexity and increased interconnectivity in the network	Number and duration of interruption and outages Cost of flood damage.
In9: Risks to public water supplies from drought and low river flows	Reduced availability of ground and surface water due to drought, as well as increased competition for and price of raw water imports. Deterioration in raw water quality leading to loss of sources.	Y	H	H	H	Drought risks managed through Drought Management Plan 2019. Detailed modelling of impact of climate change on water supply and demand in the Water Resources Management Plan 2019 (WRMP19). Imports from outside of impacted supply regions Investment to improve planned levels of service for drought permits from 1 in >40-year to greater than 1 in >200-year return period events post March 2024. New 'environmental stress' trigger linked to environmental conditions (including river flows). Environmental monitoring to ensure awareness of conditions locally as well as regionally Supply 2040 scheme to transfer water from areas of our region where there is a surplus to areas where there is a deficit Developing understanding of six strategic resource options (SROs) during the period 2020 – 2025 Catchment management to improve water retention for crop growth during droughts. Chalk stream restoration projects.	Continue to develop and deliver SROs Review of abstraction licensing and group licensing strategy to use current resources efficiently and minimise impact on the environment. Investigate opportunities for increased surface water storage, in particular to support groundwater abstractions. Lobby to be statutory consultees on planning applications involving large scale developments. Reduce operational complexity and increased interconnectivity in the network. Connect 2050 scheme allowing transfer of water across the existing supply area and accommodating different combinations of SROs and chalk groundwater abstraction reductions.	Number and duration of drought restrictions. Supply demand balance. Environmental metrics. Water quality standards.

CCRA Risk	Risk to Affinity	Directly relevant to WoC?	Likelihood of risk occurring to WoC	Magnitude of impact on WoC service	Risk under standing	Controls [AMP7 and planned]	Further actions	Metrics/reporting
In8: Risks to subterranean and surface infrastructure from subsidence	Risk of ground movement including heave or subsidence, leading to increased number of bursts.	Y	M	M	M	Reactive repairs Proactive approach to replacing our underground assets based on age, condition, and burst history Network resilience policy and grid re-zoning.	Continue our programme of proactive underground asset replacement.	Leakage metrics / number of bursts
In14: Potential benefits to water, transport, digital and energy infrastructure from reduced frequency of extreme cold events	Reduction in volume of pipe bursts due to freeze thaw events.	Y	H	L	H	Whilst cold events may become less frequent, they continue to be planned for Reactive repairs Proactive approach to replacing our underground assets based on age, condition, and burst history.	Continue our programme of proactive underground asset replacement.	Leakage metrics / number of bursts

5. Update on actions from 2015 Climate Change Adaptation Report

The following table provides an update on the actions identified in the climate change risk assessment that we undertook in 2015.

Actions planned	Description	Risks addressed by action	Timescale for new/further actions planned	2021 update on action
Increase Adaptive Capability of Organisation	Giving Climate Change Adaptation clear leadership through a dedicated role, or clear inclusion within an existing related role.	Not being organisationally prepared to respond to changing climate and increased extreme weather events.	Jul-15	There is a dedicated Asset Specialist role at Affinity Water leading on climate change adaptation.
	Update our Climate Change Action Plan to address climate change issues, and continue to regularly review and assess progress at the 'Our Environment' Working Group.		On-going.	Our Climate Change Adaptation Report 2021 sets out the steps that we will take to mitigate the impacts of climate change to Affinity Water. It also sets out our progress against the actions highlighted in the 2015 Climate Change Adaptation report. Our Net Zero plan sets out the steps that we will take to meet Net Zero carbon emissions as part of our climate change impact mitigation.
	Consider repeating an assessment method such as PACT or similar, to evaluate how our organisational capability has changed.		Throughout AMP6	Repeat assessment undertaken for 2021 adaptation report.
	Promote climate change awareness and implications for implementation of adaption measures through team briefings of work programmes within the company to raise awareness at all levels, technicians to senior managers and directors.		Throughout AMP6 and AMP7	We are continuing to raise awareness throughout the organisation via toolbox talks, blogs, publication of internal articles and through presentations.
	Establish an Organisational Resilience Strategy, Flood Resilience Action Plan and Drought Resilience Action Plan to build on existing flood protection work undertaken. Aim to have a programme of work for each of the Resilience Rs (Resistance, Reliability, Redundancy, Response and Recovery).		Early on in AMP6 – 2015	Our drought management strategy is covered by our Drought Management Plan (DMP) 2019 and is being further refined in our DMP 2022. Our DMP was put into action during the groundwater droughts of 2017-2019. We reviewed our flood resilience in 2014 taking into consideration climate change. Since the publication of our 2015 Climate Change Adaptation Report we have developed a framework for responding to groundwater and surface water flood events using learnings from the 2013/2014 flooding events which was deployed during the winter of 2020/2021. We have developed the framework for a Flood Resilience Action Plan but this needs to be further developed. We will update the FRA undertaken in 2014 and use it to inform our PR24 submissions.

Actions planned	Description		Risks addressed by action	Timescale for new/further actions planned	2021 update on action
Understanding customer appetite for resilience investment	Undertake cost benefit analysis for flood resilience measures to a range of return periods for sites to determine which level of flood resilience, above that already implemented is achievable, proportionate or desired.		Failure to safely, efficiently and effectively deliver investment in our assets.	2015 – 2017 to feed into PR19	This was reviewed as part of PR19 and was not taken forward as the level of flood resilience was assessed to be sufficient. This will be reviewed for PR24 and any necessary investment included in our draft business plan submission.
	Undertake customer focus groups to understand the willingness of customers to pay for future resilience measures which may be required to adapt to climate change.			2016 – 2017 to feed into PR19	We undertook customer focus groups to understand the willingness to pay in key areas of risk posed by climate change (leakage, bursts, water use restrictions, river flows during drought and river restoration) and there was a good level of support for the proposals. The research questions and analysis could have linked these proposals to climate change risks more strongly and this will be improved upon for PR24.
Targeted Projects to Address Specific Climate Change Risks	Sustainability reductions	Affinity Water has announced in its latest Business Plan 70 Ml of sustainability reductions, 42 Ml of which will be delivered within AMP6 so prior to 2020. This is water we are licenced to abstract that we are voluntarily giving up to return to the environment. Affinity Water has been proactive in proposing to introduce these sustainability reductions to maintain more water in the environment to mitigate against possible abstraction impacts on the environment during droughts which may possibly be a result of or worsened through climate change.	Mitigation against the possible impact of Affinity Water's abstractions on the environment, particularly under drought conditions	AMP6 and AMP7	We implemented sustainability reductions of 42Ml/d in AMP6 and are working to deliver further reductions in AMP7. We are developing our strategy to meet the ambitions of the National Water Resources Framework. A range of reductions for implementation between 2025 and 2050 are being modelled in the regional Water Resources in South East (WRSE) plan and where appropriate reflected in our dWRMP24.
	Met Office Demand Prediction Tool	Further discussions with the Met Office regarding bespoke CC predictions which can feed into the WRMP, Drought Plans etc. and tailored bespoke weather forecasts of greater detail to assist daily operations and preparedness.	Greater extremes in weather leading to supply issues	Mar-17	Weather occurs on a short timescale whereas changes to climate occur over a number of years, typically exceeding 30. We use the Met Office Demand Prediction service for short term (10 days max) weather forecasts. Longer term weather forecasts (up to 1 month) are being procured from Met Office to support our operational strategy. UKCP18 climate change scenarios were considered intrinsically in our WRMP19. Included within this was an assessment of the likely implications on deployable output at each of our sources.
		Graduate placement underway to look at actions that should be triggered based on predicted demand levels or multi-day weather occurrences	Greater extremes in weather leading to supply issues (dropping res levels etc.).	Oct-15	Graduate placement completed and produced a set of outputs which have been incorporated into business as usual seasonal readiness activities.

Actions planned	Description		Risks addressed by action	Timescale for new/further actions planned	2021 update on action
Targeted Projects to Address Specific Climate Change Risks	Site Auto Restart	Gap analysis of coverage of site auto-restart. Proactive scheme to roll out improvements to key sites identified i.e. high risk or remote to reduce frequency of staff call-outs to site.	Interruptions in the power supply network – with predicted increased intensity / frequency of electrical storms (summer) and winter storms (lightning), then the frequency of both brief and prolonged power supply failures may increase.	Mar-16	All sites that do not require manual supervision have the software in place to facilitate automatic restarts following outage.
	Pesticide Programme	Undertake a Pesticide Programme to enhance our pesticide treatment capability in accordance with our DWI regulatory requirements. The projects included in this programme are to install additional pesticide treatment at 2 key treatment works, undertake trials on existing processes at another key site, and to undertake maintenance and enhancement of the existing processes at a strategic reservoir. This works in conjunction with our catchment management approaches in these high risk abstraction areas.	Increased pesticides including metaldehyde due to increased rainfall and storm intensity.	Phased delivery 2017-20	Our Pesticide Programme delivered treatment solutions at two strategically important sites, with a number of additional treatment trials completed at one of our biggest water treatment works. Catchment management has continued in the Mimmshall Brook and River Thames catchments respectively and continues to deliver promising results.
	Thresholds	Define thresholds for triggering investment beyond that which is currently planned as part of preparation of our next Water Resources Management Plan	Failure to safely, efficiently and effectively deliver investment in our assets.	Mar-18	We are currently developing a framework for measuring resilience to customers and communities. This approach has been used by other companies and will be tested in our Dour region in 2021/22. We intend to roll-out this approach across our region to give an understanding of the resilience in each of our communities. Flooding and the extent to which it will affect our assets and our service is part of the framework approach. As a result of this work, we will be able to identify which assets, at risk of flooding, will have the biggest impact on our communities and customers. Work to address the risks posed to these assets will be proposed for inclusion in our PR24 business plan.

Actions planned	Description		Risks addressed by action	Timescale for new/further actions planned	2021 update on action
Targeted Projects to Address Specific Climate Change Risks	DO Assessment	Undertake DO assessment for SDNG sources when sufficient information is available.	Reduction in groundwater level leading to reduced abstraction.	When sufficient information available.	The existing Source Reliable Output methodology is not appliable for gravel aquifers. The Deployable Output has been calculated based on operational experience and the volumes that have been achieved during drought events.
	Groundwater model updates	Request climate change scenarios from EA for all groundwater models in our supply area based on updated UKCIP projections when available.	Reduction in groundwater level leading to reduced abstraction.	When updated UKCIP projections available.	To date, groundwater models have not been linked to source outputs as the groundwater models have not been an appropriate tool for this. We have run climate change scenarios using the WRSE stochastic datasets into our lumped parameter models, at key observation wells including Lilley Bottom, Chalfont. The EA regional groundwater model covering the majority of our Central region is in the process of being updated. When this is completed the climate change scenarios can be run and we will review the appropriateness of linking the model runs with source output. We are working with the EA to support the refinement of the regional models, utilising data from our extensive environmental monitoring network to help calibrate the model and validate modelled output.