Cambridge Water

Water Resources Management Plan 2019

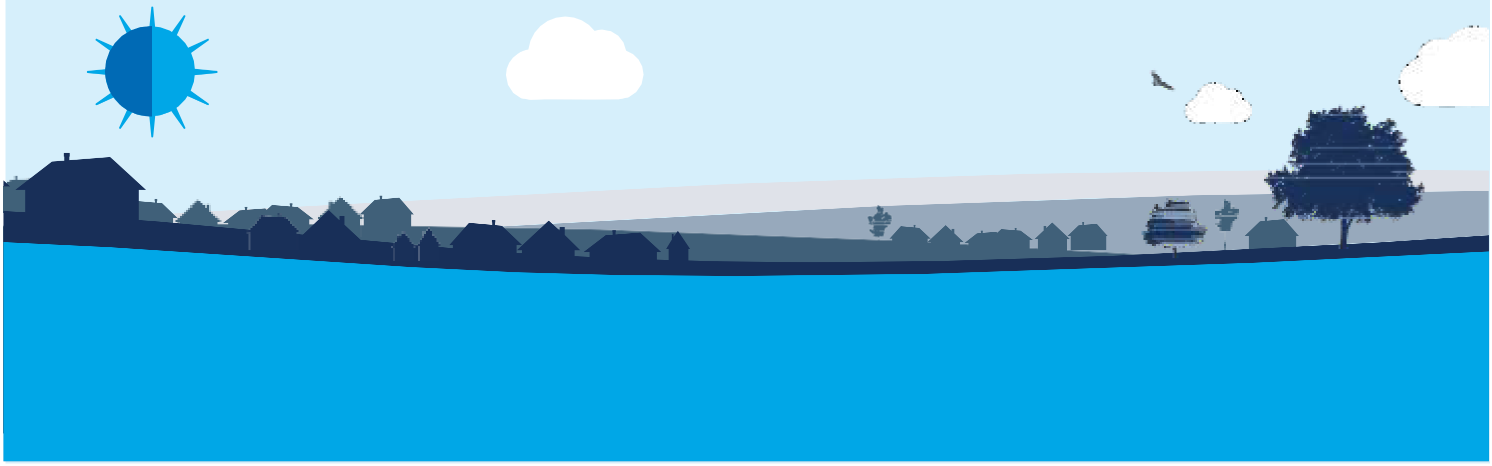
Contents

List of appendices

In accordance with Defra instructions and the Security and Emergency Measures Directive Advice Notes and Guidance, we have made a number of redactions to this document. This is mostly associated with site names, which have been replaced with codes. There are also a couple of appendices which cannot be made generally available because of their content. These appendices are available only to the Environment Agency, Defra and Ofwat.

- We published version 2 of our revised draft Water Resources Management Plan (WRMP) having made the changes that Defra requested in its letter of 24 May 2019. The changes we made to the revised draft WRMP that we published in August 2018 include changes to section 7.6.5 to ensure compliance with WRMP Direction 3(d).
- On 4 November 2019, Defra authorised us to publish our final 2019 WRMP (WRMP19) within one month of receiving its letter. As a result, we published our final WRMP in December 2019.

Section 1:
Executive summary



1. Executive summary

1.1 Purpose of this document

This document sets out Cambridge Water's draft long-term Water Resources Management Plan (WRMP) for the 25 years between 2020 and 2045. It describes how we will continue to meet the demand for water in our Cambridge region – and how we are going to make it count going forward. As such, it considers things like climate change, population growth and the need to protect the environment.

Ultimately, though, everything we do starts and ends with our customers. So, we have shaped our WRMP to meet their needs over time. We know these will certainly change in many ways. But our customers must always be able to rely completely on our ability to supply clean, high-quality water efficiently, consistently and to the highest levels of service they expect while protecting the environment they themselves both rely on and enjoy.

1.2 What is a Water Resources Management Plan?

Along with the other regulated monopoly water companies in England and Wales, we are required by the Water Industry Act 1991 to develop and adopt a WRMP. This plan sets out how we will manage our water resources over the long term and maintain the balance between available water supply and the demand for that water. Under the Water Act 2003, these plans became legal documents that we have to submit to the Secretary of State at the Department for Environment, Food and Rural Affairs (Defra) and consult on. We have to develop and adopt a new WRMP every five years.

The WRMP is an essential part of our integrated business planning and we have to review it each year. It has very close links to a number of other plans, including:

- our **strategic environmental assessment**, which considers whether the proposals within our plan could cause "significant environmental effects" and to assess the potential impacts of the options we are considering;
- our **business plan for the 2019 price review (PR19)**, which will set out our investment and service package for each of the five years between 2020 and 2025 (and what that will mean for customers' bills), and which we will submit to the regulator Ofwat in September 2018; and
- our **drought plan**, which we published for consultation in late summer 2017 and finalised in October 2018.

When developing our WRMP, we also take into account:

- **local authority development plans**, which consider projections for new housing needs in our region;
- **river basin management plans**, which include a range of measures that help to meet the overall objective of improving the environment; and
- **flood management plans**, which consider a number of flood management measures that the Environment Agency has identified Anglian River basin district – in particular, the Cam and Ely Ouse catchment and, to a lesser extent, the Upper and Bedford Ouse and Old Bedford and Middle Level catchments.

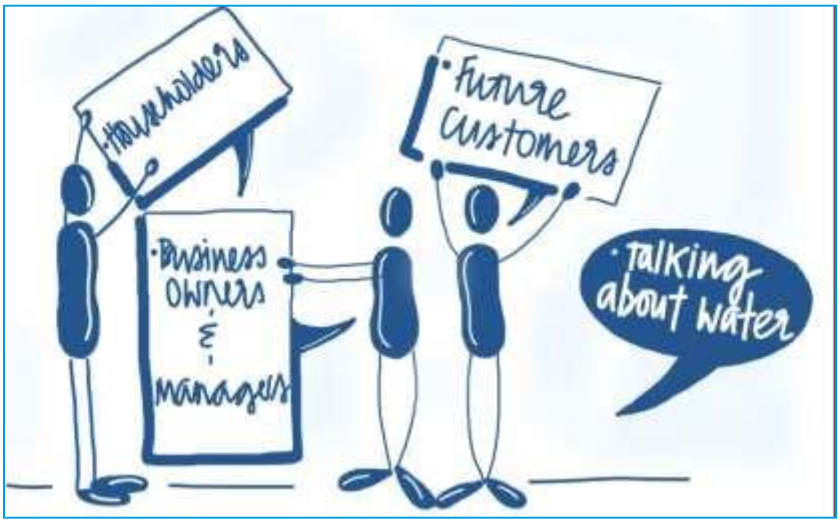
Ultimately, our WRMP is centred on a balanced view of our customers' priorities on a range of important issues. These are set out in section 1.3 below.

1.2.1 WRMP timetable

We submitted our draft WRMP to the Secretary of State at Defra on **1 December 2017** and consulted on it between **2 March and 28 May 2018**. In **August 2018**, we published our Statement of Response (SoR) to the representations we received on our WRMP consultation. We published our final WRMP in **December 2019**. As well as being available on our website, paper copies of this plan are also available at our head office.

1.3 Putting customers at the heart of our plan

At the heart of our WRMP are our customers' and other key stakeholders' preferences and expectations. We have built on the work we did for our 2014 WRMP and have used new techniques to give us even more evidence to support our plan.



To that end, we:

- carried out research to establish and understand our customers' priorities;
- held detailed one-day and half-day workshops with household and business customers to gain feedback on their preferences, service level expectations and things we could do to help customers who may need extra support. We used a range of approaches during these workshops, including an innovative version of the 'Top Trumps' game to help us understand customers' preferences – and the reasons for those preferences;
- had focused discussions with the Customer Challenge Group[1] – the panel set up to represent our customers and challenge our plans ('the independent customer panel'), particularly on the workings of our modelling, for example;
- carried out a study to understand our customers' reasons for not switching to a water meter; and
- used our customer service tracker to understand perceptions of our service performance.

Our engagement reinforced for us our customers' priorities, including:

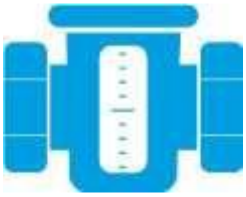
- having clean, high quality water supplies;
- being sure that water will always come out of the tap;
- their bills being fair, accurate and affordable;
- great customer service;
- protecting the natural environment; and
- helping those customers who may need extra support.

Customers are also expecting innovation in:

- helping them monitor and reduce their water usage; and
- investing in our network to make sure we can continue to meet demand for water over the long term.

In addition, our engagement so far shows that customers have particular views about the following issues.

[1] The Independent Customer Panel – what Ofwat calls the Customer Challenge Group (CCG) – is an important part of the regulatory framework. It provides independent challenge to us and independent assurance to the regulator Ofwat on the quality of our customer engagement and the degree to which this engagement is driving decision making in our business planning. We give more detail on the customer panel in section 5.1.



Leakage

Customers said:

Most customers we spoke to want us to do much more to reduce the volume of water that leaks out of our pipe network every day.

We will:

… make addressing leakage a central part of our long-term business planning because this is a key issue for our customers.

Metering

Customers said:

Most customers agree that metering is the fairest way to charge because people pay for how much water they use. But they want to be sure that those customers who struggle financially, or who have a disability or whose circumstances may make them vulnerable, are protected from the possibility of their bills increasing because they have a water meter. There is little support in our region for making meters compulsory for everyone.

We will:

… work with customers to encourage more of them to choose to have a meter fitted. We will also work proactively to provide direct support to vulnerable customers by using home visits and simplified processes to ensure that we engage effectively with them. And we will consider options for ‘smart meter’ devices that would help our customers monitor and control how much water they use – something they said would be useful to them.

Temporary or non-essential use bans

Customers said:

Most household customers are happy with the current levels of service they get from us. This means they should only expect us to have to introduce a temporary use ban (what used to be called a ‘hosepipe ban’) once every 20 years. We know that the last temporary use ban was more than 20 years ago, so a lot of customers in our region may not have experienced this. We also know that any service failure will influence how customers view us overall. Similarly, evidence from business customers we spoke to suggests they are happy with our commitment to only have a temporary ban on non-essential activities (such as washing windows) once every 50 years.

We will:

… maintain our current levels of service in these areas to make sure we continue to deliver what our customers expect now and in the future.

Water efficiency

Customers said:

Most customers agree that they could do more to reduce how much water they use. But more than half think we need to do more to make them aware of the support we can offer to help them save water.

We will:

… do more to educate and inform our customers about the ‘big picture’ reasons why they should think about the need to save water (such as population growth and climate change). And we intend to carry out a comprehensive programme of water efficiency (WE) initiatives to help customers reduce the volume of water they use each day. This includes incentivising developers to build more water efficient homes.

The environment and sustainability

Customers said:

Many customers have told us that it is important to protect the wildlife in our region – and a third of those we spoke to think we are not doing enough in this area. They also think we need to do more to explain to them what impact our activities have on the areas where they live.

We will:

… consider the measures set out in the Water Industry National Environment Programme (WINEP) and the Water Industry Strategic Environmental Requirements (WISER) as part of our long-term business planning.

Our customer engagement has supported this final WRMP to provide an even more rounded picture of our customers’ preferences and expectations. We have completed the following engagement projects.

- Our willingness to pay’ study, which concluded in April 2018, gave us important insight into how much customers want us to invest in things like leakage reduction, more water meters and water efficiency measures.
- Our customer segmentation study, which concluded in April 2018, gave us a more detailed view of how we can engage more effectively with customers.
- During February and March 2018, we asked our customers if they support our proposed package of Performance Commitments and associated Outcome

Delivery Incentives for the five years between 2020 and 2025 as part of our long-term business planning. And we also asked them to tell us what service levels they want around responding to leaks and fitting water meters so that we can continue to deliver the service they expect.
- Finally, during May and June 2018, we asked customers if our business plan for the five years between 2020 and 2025 is acceptable to them, and if the bill level is affordable to deliver what they have told us matters most to them.

In developing our WRMP, we also sought input from other key stakeholders, including:

- the Independent Customer Panel;
- the Consumer Council for Water (CCWater);
- Defra;
- the Environment Agency;
- Natural England;
- Ofwat;
- Anglian Water; and
- Affinity Water.

This is something we are legally required to do under the Water Act 2003.

1.4 Background to the Cambridge region – scope of the plan

We are responsible for the public water supply for Cambridge city and South Cambridgeshire and part of Huntingdonshire, serving a population of more than 330,000 people every day. Our region stretches from Ramsey in the north to beyond Melbourn in the south and from Gamlingay in the west to the east of Cambridge city. It is divided into seven water supply zones.

The map below shows the extent of our region.

Our water resources are supplied from groundwater sources – 97% from chalk aquifers and the remaining 3% available from greensand aquifers. The underground chalk strata is generally a robust water storage aquifer, which is recharged mostly by rainfall during the winter months each year. We take water from this aquifer using boreholes sunk into the ground, at 26 sites across the region. Drinking water is provided to our customers by 36 service reservoirs and water towers.

All our water sources are linked by a highly-connected, integrated and flexible supply system. In a situation where there is a water shortage, for example, we can transfer water between service reservoirs across the region to maintain supplies to all customers. We are also considering plans to improve the quality of water in our network and our long-term resilience. We operate the system 24 hours a day, seven days a week, and monitor and manage the network all the time.

We also provide a number of small bulk water supplies to Anglian Water and Affinity Water, and receive a very small number in return. And we have a number of emergency bulk supply points close to our border so that we can share resources if the need arises.

We face a number of significant challenges over the 25 years covered by this WRMP. These include the following.

- We are facing an increased demand for water because of significant population growth and an increase in the number of properties in our region.
- We need to change the way we use our resources because some of the water we take (or 'abstract') from the environment could lead to a deterioration of that environment. This is having a significant impact on our WRMP and proposed programme.
- Customers expect us to do more to reduce leakage on our network, and to help them save water and manage their bills. We have an important part to play here in educating, informing and challenging our customers – helping them to make water count over the long term.

This WRMP sets out the options we consider will best help us to meet these challenges.

1.5 Our WRMP in the wider context

Our WRMP is set in the context of wider government and regulatory policy, which is that we must be more ambitious in the way we manage demand for water over the long term. In other words, it is about making water count for our customers and for the environment now and in the future.

Our WRMP is also set in the wider context of the challenges and changes that have taken place in the water sector over the past five years. Increasingly, this includes the need to:

- take a long-term view of resilience, particularly in relation to more extreme weather events such as flooding or drought;
- consider the impact of our activities on the environment; and
- reduce leakage and increase water efficiency.

So, we are proposing an ambitious WRMP, based on new and innovative approaches, to reduce demand in our region. This includes:

- a transformational 15% reduction in leakage by 2024/25;
- continuing to increase the number of our customers who choose to have a water meter over the next 15 years. This region already has a high proportion of customers who have a meter (70%); and
- reducing the volume of water every person in the Cambridge region uses each day (known as 'per capita consumption' – or PCC) to an average of 137litres per person per day (l/p/d) in 2024/25. Since publishing our draft WRMP we have increased our ambition in relation to reducing PCC, as described in section 11.1.

In the 12 months to November 2018, we also carried out a trial called 'WaterSmart' with 15,000 households to assess the benefit of tailored water use messages to customers. The aim of this trial was to influence these customers' water use behaviour by giving them information about how much water they use compared with other customers. We are currently reviewing different options for delivering the benefits of this project as part of our wider water efficiency strategy.

In addition, we are looking at ways to incentivise developers to build more water efficient homes and estates. For example, we have been working with the University of Cambridge on its award-winning 3,000-home Eddington development where we are managing a rainwater harvesting system alongside the drinking water supply. This is the largest water recycling system project in the UK.

And we have considered options to balance supply and demand that can be provided by third parties. To that end, we have liaised with several organisations and water companies to explore potential new water sources. We are actively involved in the Water Resources East (WRE) project, which is looking regionally and cross-sector at the long-term (after 2060) needs for water and options to meet demand.

Our WRMP also considers the impact of our operations on the environment. We are committed to making sure that the volume of water we take from the environment is sustainable. We will work with the Environment Agency to determine if there is an impact, and if there is, to identify any measures that we need to take to put a workable solution in place.

1.6 Baseline demand for water

We use the latest forecasts of properties and population in our region, combined with the continuation of existing policies around metering, water efficiency and leakage management to give us a view of what the demand for water would be if there were no changes to policy or strategy. This is our 'baseline demand' for water. It is our starting point for assessing whether we have enough water to meet demand over the long term.

In terms of our baseline demand for household customers (our 'baseline household demand'), we are forecasting an increase in the household population in our region of 79,000, with 44,000 more household properties (excluding voids) from 2017/18 until 2044/45 – roughly a 34% increase in household numbers.

We also forecast that occupancy rates will fall over the same period – from 2.4 to 2.3 on average – and that dry year PCC will fall to 132l/p/d by 2024/25. Overall household dry year demand is forecast to rise by around eight megalitres of water a day (Ml/d) from 2017/18 to 2044/45 (a megalitre is one million litres).

Our baseline household demand forecasts take into account our current metering policies, which are that:

- all new properties have compulsory meters;
- all properties with swimming pools or garden ponds containing more than 10,000 litres of water have compulsory meters;

- all household customers who wish to use unattended garden watering devices (such as sprinkler systems) have compulsory meters;
- all non-household and business properties have compulsory meters where practicable; and
- all household customers who wish to switch to a meter free of charge can switch back to their previous method of charging within two years of the meter being installed.

We forecast that the level of metering (excluding voids) in our region will increase from 75% in 2020/21 to 88% in 2044/45.

In terms of leakage, our baseline demand forecasts include leakage continuing at the current performance commitment of 13.5Ml a day across the period covered by this WRMP.

For non-household and other business customers, we are forecasting a very slow rise in demand over the 25 years between 2020 and 2045.

Our baseline demand forecasts also take into account our target 'headroom'. This is a volume of water added to demand to account for uncertainty around our supply and demand forecasts, including those around population estimates and climate change impacts. Forecast demand plus target headroom is the minimum volume of water we need to plan to maintain supplies to our customers.

We plan for both 'dry year annual average' and 'dry year critical period' scenarios. The dry year annual average is the average demand over one year measured in megalitres a day (Ml/d). It is a dry year when demand averages are higher than in a normal year because the weather has encouraged more people to do things like water their gardens, use paddling pools or take more showers. The dry year critical period is usually in the summer and is related to the weather. It refers to the peak volume of water used for the activities outlined for the dry year annual average.

1.7 Baseline supply forecast

We use 'level of service deployable output' when forecasting our future water supply needs. Deployable output – or DO – is the volume of water we can access under the worst historic drought conditions for our region. It is further constrained by a number of factors, including:

- the volume of water we can legally take from the environment;
- the quality of that water;
- the processes we use to treat the water; and
- how we move the water around our network.

Specifically, our level of service DO is based on those historic droughts where we require additional measures to manage our water resources, and the likelihood of us needing to introduce restrictions on how much water customers can use – that is, every 20 years. For example, the last time we asked our customers not to use hosepipes was in the 1990/91 drought. Typically, we expect to need to restrict customer demand in droughts that extend to three or more dry winters.

That said, we are mindful that there are customers in our region who have little experience of a temporary use ban, and the likely impact it would have on them. But we do know that any reductions in levels of service would be unacceptable to them.

We have a number of measures that we can use to manage our water resources during periods of drought. These include:

- appeals to customers to use less water;
- more leakage detection and repair;
- making sure all our sources are fully operational;
- temporary use bans;
- non-essential use bans; and
- drought permits and drought orders.

We plan for both ‘dry year annual average’ and ‘dry year critical (peak) period’ scenarios (as defined in section 1.6 above).

Since our 2014 WRMP, our year one DO in a dry year annual average scenario has decreased by 14Ml/d. This is because we have included cutbacks of 10Ml/d in volumes to protect against deterioration of the environment. Also, a reduction in the availability of some groundwater sources in our region has reduced DO by a further 4Ml/d, mainly because of water quality issues.

We also take the impact of climate change – and the possibility of more periods of prolonged drought, for example – into account when considering the volume of water we have available to us to meet demand. Our assessment of the impact of climate change is that this will reduce the water we have by 0.8Ml/d by 2045.

Our forecasts of the water we have available to use to meet demand takes account of:

- our assessment of DO;
- climate change impacts; and
- an allowance for when our water sources may be unavailable because we have to do work on them or they develop an unexpected fault.

1.8 Baseline supply/demand balance

The baseline supply/demand balance shows that under the continuation of existing policies we would not have enough water to meet demand plus target headroom at the beginning of the period covered by this WRMP (2020) under average conditions but for peak conditions we do not have a problem.

1.9 Deciding on future options

To help us identify options and develop our proposed programme of work, we followed UKWIR's 'WRMP Methods – decision making process guidance'. UKWIR is the UK water sector's main research organisation, with responsibility for a common water company research framework.

We also carried out a process to define and assess the challenges we face so that we could understand their complexity and scale. This has helped us to develop an approach to decision making that is proportionate and appropriate for our region, our circumstances and our customers.

And we have developed tools to help us model a range of future scenarios. This is so that we can be sure our decisions on future options are well tested.

We considered a range of options to manage both supply and demand over the long term. These include:

- reducing leakage on our network;
- water efficiency measures;
- more metering;
- investing in existing groundwater sources – replacing boreholes or introducing new water treatment processes to improve water quality, for example;
- identifying new ground- and surface water sources; and
- trading water with third parties.

We evaluated all of these to come up with a list of feasible options and carried out a strategic environmental assessment (SEA) to help us understand any potential impact of each option. We also tested all of the options under a range of scenarios to make sure that our plan is robust. Throughout this process, we took into account customers' views on things like:

- resilience over the long term;
- impact on the environment; and
- whether the options are cost effective.

We also carried out a full appraisal of how much each option was likely to cost. This was so that we could be sure we were putting the most cost-effective solutions forward.

As part of the work to consider the options for this WRMP, we decided to take the opportunity to review our existing operations across all the water resources in our region to identify the most appropriate mix of options going forward.

1.10 Our proposed programme

We think that our proposed 25-year programme combines the best mix of options for water supply and demand. We also think that it will deliver what our customers have told us they want us to do. Finally, we think that it shows that we are making water count – for the customers and communities we serve, now and over the long term.

In table 1 below, we summarise the key elements of our proposed WRMP programme.

Table 1 Key elements of our proposed WRMP

Key elements of our plan	What we will do
Leakage	By 2024/25, we will reduce total leakage on our network by 2Ml/d from the 2019/20 performance commitment level of 13.5Ml/d. This is a transformational 15% reduction, which we will achieve through a combination of pressure management and active leakage control. We will consider the benefits of developing a live network where data can help identify leaks more quickly and improve performance.
Metering	We will continue to build on our engagement with customers to educate them around the benefits of having a water meter. We will aim to encourage an additional 500 households a year for the next ten years to switch to a water meter above the number included in our baseline forecasts. This will give us a final plan level of 91% of customers with a water meter (excluding voids) by 2044/45 (compared with our baseline level of 88% by 2044/45). We are looking at options for ‘smart meter’ devices that would help customers monitor and control how much water they use – something our customers said would be useful to them.
Water efficiency	We will reduce average dry year PCC to 132l/p/d by 2024/25. We will work with developers to explore incentives for them to include rainwater harvesting and grey water recycling within new sites. We will continue to work with customers and target water efficiency advice at those who may be concerned about whether they can afford to pay their water bills. We are currently evaluating the findings from the ‘WaterSmart’ trial that we ran in the 12 months to November 2018.

Key elements of our plan	What we will do
Water supply	Our work to develop this WRMP has shown that continuing with our existing base of sources is the most efficient way to operate over the next 25 years. We have already included some reductions in the volume of groundwater we use for our baseline supply forecast. We will make a further reduction in the volume of water are entitled to take from the environment by about 6Ml/d where necessary to manage the risk of causing deterioration to that environment. We will invest in new treatment processes at three of our groundwater sources – at KIPW2, CRPW2 and SIPW (total volume almost 4Ml/d). This will enable all three to be brought back into supply.
Resilience	We will continue to liaise with our neighbours Anglian Water and Affinity Water, and others involved in the WRE project to further explore the long-term resilience of water supplies in the region.
Environment and sustainability	We will continue working with the Environment Agency to achieve objectives around the Water Framework Directive and river basin management plans.

1.11 Final supply/demand balance

By implementing the proposed programme of works outlined above, we will be able to balance supply and demand in our region up to and beyond 2045.

Section 2:

Introduction to the Water Resources Management Plan

2. Introduction to the Water Resources Management Plan

Overview of the purpose of the Water Resources Management Plan

Water resources management plans (WRMPs) set out our plans to meet the demand for water over the next 25 years taking into account factors such as population growth and climate change.

WRMPs are statutory requirements and have a defined process for development and publication. The key stages in this process are as follows.

- Statutory pre-consultation to seek views on what to consider prior to developing the plan.
- Customer engagement to find out what customers think is important and what they want the plan to include.
- Engagement with the independent customer panel for them to challenge our approach.
- Engagement with other key stakeholders and regulators.

We submitted our draft WRMP to the Secretary of State at Defra on 1 December 2017 and consulted on it between 2 March and 28 May 2018. In August 2018, we published out Statement of Response (SoR) to the representations we received on our WRMP consultation.

The WRMP has strong links to a number of other plans. It is a key building block of the PR19 business plan which we submitted to Ofwat in September 2018.

2.1 What is a Water Resources Management Plan?

Water companies are required by law to draw up, consult on and maintain a water resources management plan (WRMP), which sets out how they will manage resources in order to meet the requirements of the Water Industry Act 1991. This WRMP covers the period 2020 to 2045 and takes into account factors such as population growth and climate change. The plan is subject to annual review and companies need to write a new plan where circumstances change or the Secretary of State (SoS) for Defra requires them to. A new plan must be prepared every five years.

Our WRMP shows how we intend to maintain the balance between available water supply and the demand for water over the next 25 years. While Cambridge Water is now merged with South Staffordshire Water, this WRMP applies only to the original Cambridge Water region and a separate plan has been prepared for the South Staffordshire Water region.

2.2 The process of developing a Water Resources Management Plan

The Water Act 2003 made WRMPs statutory documents which must be submitted to the SoS (Secretary of State) at Defra. Once the draft WRMP has been submitted the document is made public and there follows a period of consultation where comments on the plan can be sent to the SoS. We then consider the comments received and make any necessary changes to the WRMP before it is submitted to the SoS again for approval for final publication.

In addition to the statutory requirement to consult specified stakeholders the Environment Agency's 'Water resources planning guideline' specifies a pre-consultation stage and early engagement with regulators, customers and interested parties.

We recognise that we must ensure our plans represent a balanced view of customer priorities and views on key issues. We have built on the approach to customer engagement which we used for the 2014 WRMP and have integrated it more with the wider regulatory business plan (PR19) engagement process. Our activities relevant to the WRMP include the following.

- In line with statutory requirements, we contacted a range of stakeholders to invite views on what the WRMP should consider.
- We held regular meetings with Environment Agency staff during the development of the draft WRMP.
- Between May and June 2017, we appointed Accent Research to carry out foundation research on our behalf exploring customer priorities.
- The Independent Customer Panel has been kept informed and in particular consulted on the customer engagement.
- We met with Ofwat in July 2017 to present an overview of our approach to the WRMP and the potential supply/demand balance position.
- In July 2017, we carried out a metering study to understand customer reasons for not switching to a water meter.
- We carried out customer engagement on our WRMP and long-term plan during July and August 2017 to gain customer views of service levels and where we should invest to meet demand for water. Independent consultants Community Research facilitated the process;
- Community Research also facilitated an online survey with 200 customers in our Cambridge region and 300 customers in our South Staffs region.

A detailed discussion of our customer engagement is included in section 5.

2.3 Statutory pre-consultation

There is a statutory requirement to consult the Environment Agency, Ofwat, the SoS and any licensed water supplier that provides water to premises in our area through our supply system before preparing a draft plan.

We sent pre-consultation letters to key stakeholders in February 2017 notifying them of our work to develop a new draft WRMP and asking them for initial views on issues to be considered. Letters were sent to the following.

- CCWater.
- Ofwat.
- The Environment Agency.
- Defra.

- Natural England.
- Cyfoeth Naturiol Cymru (Natural Resources Wales).
- The Independent Customer Panel.
- Anglian Water.
- Affinity Water.
- Local councils.
- Local interest groups.

There are no licensed water undertakers who supply water via our supply system.

Ofwat responded, inviting us to meet with them to present an overview of our proposed draft WRMP. We also received responses from:

- the Environment Agency;
- CCWater;
- Historic England;
- the National Farmers Union;
- Affinity Water;
- Huntingdonshire District Council;
- Middle Level Commissioners (IDB);
- RSPB;
- Cam Catchment Partnership;
- Cam Valley Forum;
- Cambs, Beds and Northants Wildlife Trust;
- the Global Sustainability Institute at Anglian Ruskin University; and
- a domestic customer.

The main points raised in these responses fall into a number of categories, as shown in the following table.

Table 2 Responses to the statutory pre-consultation

Category	Response content
General principles	• We should follow Defra's guiding principles. • We should outline the challenges we are facing and address issues of long-term resilience. • We should follow WRPG methodologies. • We should consider the Water UK long-term planning framework project. • We should have regard to the Blueprint for Water, published in summer 2017.

Category	Response content
Customers	• We need to demonstrate how customers' views have influenced and shaped our plan. • We need to communicate with customers and stakeholders through a clearly written and accessible document. • We should produce a non-technical summary suitable for a wide audience. • We should use outreach techniques to consult customers. • We should demonstrate a clear understanding of customer priorities and show evidence of research and engagement. • We should include a comprehensive demand management strategy. • We should explain our approach to household metering.
The environment	• We should use an SEA in the development of the WRMP. • We should refer to the historic environment records for heritage assets. • We should protect, conserve and where possible enhance the historic environment. • We should include sustainability changes to help protect and improve the environment. • We should include a robust climate change assessment fit for purpose. • We should address issues such as flooding and drought. • We should look for alternative sources of water. • We need to protect and improve the water environment.
Third party options	• We need to widen third party involvement and water trading. • We should explore opportunities for developing shared supplies with the agricultural sector. • We should incorporate any outputs from WRE in the plan. • We should engage in collaborative working with neighbouring companies for optimal use of resources and long-term planning.
Demand	• Our demand updates need to reflect the latest population and housing projections. • We should have a comprehensive demand strategy to engage with household and non-household customers. • Where policies are proposed for compulsory metering and/or tariffs, we need to demonstrate a clear case for this and explain how customers will be supported through any transition to new charging structures. • We should explain our approach to leakage over the short and longer term and explore options for reducing leakage. • We should consider the impacts of demand-side measures on the amenity, horticulture, dairy and livestock sectors. • We should use robust and clear water efficiency messaging.

Category	Response content
Other	• Our outage allowance needs to be reviewed in light of high recent reported outage values. • We should consider opportunities for grey water use.

Our WRMP has taken these comments into account.

2.4 Public consultation on draft WRMP

The Water Act 2003 states that companies must publish their draft plan within 30 days of notification that Defra is not proposing to give any direction (under section 37B(10) of the Water Act 2003) to amend the plan on the grounds of national security.

We published our draft plan on our website as soon as possible after receiving notification from Defra. We notified key stakeholders (as specified in 'The water resources management plan regulations 2007') of the consultation period, directing them to the website and advising that a paper copy of the plan was available if required. These stakeholders include:

- the SoS;
- the Environment Agency;
- Ofwat;
- licensed water suppliers within our area of supply;
- Regional Development Agencies within our area of supply;
- Regional Assemblies within our area of supply;
- local authorities within our area of supply;
- Natural England;
- the Historic Buildings and Monuments Commission;
- Canal and River Trust;
- Anglian Water;
- Affinity Water; and
- CCWater

A non-technical summary accompanies the publication of this plan on our website.

2.5 Environment Agency liaison

The water resources planning guidelines specify that water companies should consult with their local Environment Agency team regarding methods to be used when developing a plan.

We held regular meetings with Environment Agency staff during the development of the draft WRMP. These meetings provided the Environment Agency with early sight of particular areas of the plan and gave opportunity to seek clarification on any issues. Draft supporting documents, such as those prepared by consultants on our behalf, were shared with Environment Agency staff.

Feedback during these meetings and in response to draft supporting documents has helped shape our WRMP.

2.6 Timetable

We adopted the following timetable for our WRMP.

- We submitted our draft WRMP to the SoS on 1 December 2017 and consulted on it between 2 March and 28 May 2018.
- We published our SoR in August 2018.
- In November 2019 the SoS granted permission to publish our final plan within a month
- We published our final plan in December 2019.

2.7 Links to other plans and context

2.7.1 Strategic environmental assessment

In accordance with the strategic environmental assessment (SEA) directive[2] water companies have to consider whether the proposals within their WRMP could cause "significant environmental effects" and if so carry out an SEA to assess the potential impacts of options being considered.

This can then be used to inform the selection of WRMP schemes. The short-listed measures/options, including demand management, leakage reduction and resource development measures can be assessed against SEA criteria and the resulting water resource management plan programme selected on the basis of a reasonable balance between cost and environmental and social impact.

An SEA must therefore be carried out at the same time as a WRMP is developed and be integrated into the development of the plan.

We decided that it was appropriate for us to carry out an SEA in conjunction with this WRMP. The SEA report and post-adoption statement are included as **appendix A** and the associated annex. A summary of the SEA process and the results of the SEA are included in section 11.

[2] Directive 2001/42/EC of the European Parliament and of the Council of the European Union of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment.

2.7.2 Business plan

Our WRMP has been integrated into the process of developing our business plan for the five years from 2020 to 2025, which we submitted to Ofwat in September 2018.

We have carried out customer engagement to inform the WRMP as part of a wider programme of engagement covering all aspects of the business plan.

Our approach to modelling options for the WRMP has been developed to ensure that expenditure arising from WRMP drivers can be integrated with other aspects of expenditure – for example, on capital maintenance of existing assets.

2.7.3 Drought plan

The WRMP planning guideline identifies strong links with water company drought plans. Our latest draft drought plan was published for public consultation in late summer 2017 and finalised in October 2018.

Our WRMP has been prepared to be consistent with our latest drought plan.

We have considered potential links between our plan and Environment Agency drought plans, and identified river support schemes managed by the Environment Agency that might affect our ability to abstract water and whose operation may be restricted in a drought. There are two schemes of note – the Lodes Granta Groundwater Development Scheme and the River Rhee Groundwater Support Scheme.

The Lodes Grant scheme in particular supports a number of rivers that may be affected by our abstractions, and although licence conditions will be in effect to mitigate these impacts – and are included in our baseline deployable output (DO) – we will work closely with the Environment Agency in dry conditions to monitor the effectiveness of these measures and the river support.

The River Rhee scheme supports tributaries including sites of special scientific interest (SSSIs), all of which have been investigated in the National Environment Programme (NEP), and are complete. The reduction to DO for Water Industry National Environment Programme (WINEP) ‘no deterioration’ measures will maintain the agreed level of abstraction at sources that are close to these features and ensure these are not affected. We will work closely with the Environment Agency in dry conditions to monitor the effectiveness of these measures and the support scheme.

2.7.4 Local authority plans

Our population and property forecasts are based on the latest local authority development plans taking account of their projections for new housing needs.

2.7.5 River basin management plans

River basin management plans (RBMPs) include programmes of measures to comply with environmental legislation and meet the objective of improving the environment. Of particular relevance to WRMPs are the measures required to comply with the Water Framework Directive (WFD) 'no deterioration' clause. This is accounted for in the WINEP obligations, which the Environment Agency compiles and provides to water companies.

All existing sources of water which are at risk of causing deterioration to the environment have the potential for the allowed volumes to be reduced and or capped. We have considered the potential impact of the uncertainty that this raises for us in understanding how much water we will have available to use in the future and also the impact of our operations on the environment and have decided to include the potential reductions in our baseline supply forecasts. The Environment Agency has advised that this is the most appropriate action to take for this region and we have considered it appropriate to do the same for our South Staffs region.

The WINEP and the impact on our water supply is described in section 7.

2.7.6 Flood management plans

Our supply area covers the river catchments of the Cam and the Ouse and we have considered flood management measures identified by the Environment Agency and the other statutory partners (lead local flood authorities) for the following areas.

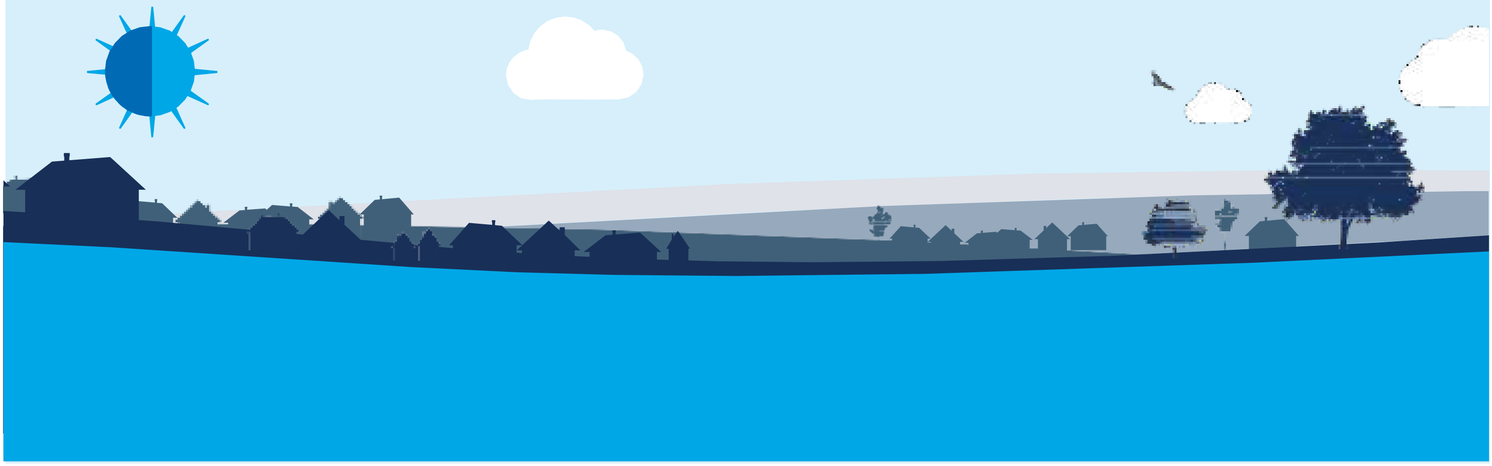
- **Anglian:** Cam and Ouse Catchment (including South Level).

We have identified the following activities within our WRMP and have incorporated appropriate measures.

- **Protection in areas of flood risk:** we will continue to design and install water supply infrastructure such that public water supplies are resilient against major flood events.
- **Flood storage and conveyance:** where new infrastructure is planned in the flood plain we will agree and put in place measures to mitigate against any loss of flood storage or conveyance.
- **Discharges to surface water:** we will continue to adhere to the appropriate environmental permitting process to ensure that all our discharges are sited appropriately so as not to increase flood risk in the receiving water body.

Section 3:

Plan scope



3. Plan scope

Overview of plan scope

Our challenges

We are facing a number of challenges.

- We forecast an increase in demand driven by growing population and properties, and need to make sure we have enough water to meet this demand.
- Some of our abstractions present a risk of deterioration to the environment and we need to address this by changing the way we use our resources.
- Customers expect us to do better on leakage reduction and helping them to save water and manage their bills.

We have reviewed the challenges we face and the scale and complexity of them, and have taken the opportunity for this WRMP to review the whole of our existing operations across all sources and not just to look for options to address a supply/demand balance deficit. We have adopted a multi-criteria approach to decision-making and have consequently identified the most appropriate mix of supply and demand options going forwards.

Planning period

Our WRMP covers the 25 years planning period from 2020/21 to 2044/45 and includes dry year annual average (DYAA) and peak week scenarios.

Resource zone integrity

Our area of supply is a single resource zone with the risk of shortages of water being equal across the whole area.

Climate change

We have accounted for the potential impact of climate change in our supply and demand forecasts and included the uncertainty around these estimates within our assessment of target headroom.

Third parties

We have engaged with others within our area of supply to understand our interactions with them. In particular, we have liaised with Anglian Water and Affinity Water, the WRE group and with retailers providing customer services to non-household water customers.

Testing our plan

We have considered uncertainty within the plan in the assessment of our headroom component and in our multi-criteria modelling scenarios.

Assurance

Independent assurance of our WRMP has been provided by Jacobs.

3.1 Challenges for Cambridge Water

Cambridge is one of the fastest growing regions in the country. It is also one of the driest. This presents us with significant challenges, including:

- substantial growth in population and properties driving demand upwards;
- environmental pressures to ensure that our abstractions do not cause deterioration to the environment; and
- customer expectations regarding our approach to demand management.

So we have taken the opportunity with this WRMP to review the whole of our existing operations across all sources and not just to look for options to address a supply/demand balance deficit. We have reviewed the challenges we face and the scale and complexity of them through an exercise of problem characterisation and have adopted a multi-criteria approach to decision-making. We have identified the most appropriate mix of supply and demand options going forwards.

Our forecasts for baseline demand are described in section 6.

Customer views are described in detail in section 5.

The environmental impact of our abstractions is described in section 7.

Our problem characterisation exercise and multi-criteria approach to decision-making is described in detail in section 10.

3.1.1 Water stress

The Environment Agency developed a water stress classification methodology for water companies in 2007 for the purposes of Regulation 4 of the Water Industry (Prescribed Condition) Regulations 1999. If a water company is classified as 'water stressed' it must consider compulsory metering to balance supply and demand. If a company is not classified as water stressed it cannot impose compulsory meters on customers without seeking direct approval from Defra under separate water scarcity legislation.

The Environment Agency published an initial consultation on identifying areas of water stress in 2007 and followed this with a response in August the same year. It later updated its approach in 2012.

Each water company is classified as being not water stressed, in moderate water stress or in serious water stress. The assessments are carried out by the Environment Agency and are based on a Water Exploitation Index (WEI) linked to the status of water bodies within the area. The last time the classification was reviewed by the Environment Agency was in 2013[3]. Under this classification, Cambridge Water moved from 'serious water stress' (2007 definition) to 'not water stressed'. The Environment Agency has no plans to carry out a further review in the near future.

Since our classification has not been updated for some time, we considered it appropriate to review whether it would be different if it were revisited using latest available information and data. We have not been able to complete a full re-evaluation as significant

[3] 'Water stressed areas – final classification', Environment Agency, July 2013.

data relating to water body status is required to enable this and we have not been able to obtain it all. We have also been unable to clarify the requirements for all components of the complex WEI calculation with the Environment Agency.

But the work we have been able to complete leads us to believe that our status would remain as not seriously water stressed. We do not feel this is fully reflective of the environmental and demographic pressures in our area.

Despite this, we have explored the potential for compulsory metering as an option to understand whether it would prove to be the most cost-effective way to balance supply and demand going forward. It is included in our decision-making framework (DMF) modelling, but does not get selected as there are other options with lower costs which can achieve the balance. In any event, customers do not support compulsory metering and it does not form part of our proposed programme.

3.2 Planning period

This plan covers the period 2020/12 to 2044/45. The year 2017/18 is the base year for the WRMP. Actual data for the base year as reported in the 2018 2018 Annual Review[4] has been normalised to remove the impact of year-on-year climatic variation.

3.3 Water resource zone integrity definition

Our region of supply is defined as a single water resource zone (WRZ) with the risk of shortages of water being equal across the whole area of supply. This assessment is unchanged from the 2014 water resources management plan (WRMP14).

The region is supplied by 26 groundwater sources which are linked by a highly interconnected and integrated pipe network. Storage reservoirs are linked with large diameter mains, booster stations and remotely controlled valves to allow the transfer of water throughout our supply area.

The network comprises five supply zones – the Cambridge zone is the largest of these, in terms of both supply and demand. Sources which supply water direct into this zone provide more water than is needed there to meet demand, so the surplus water is transferred to other zones as required.

Supply zones in the north of our area do not have direct supplies and rely solely on this transfer. Other supply zones have direct input from sources and only rely on transfer from Cambridge zone at times of peak demand or outage. Some zones are highly flexible in terms of transfer options and connectivity, with a number of options to transfer water in and out.

[4] Water companies must submit to the Environment Agency an annual review of their WRMPs.

We also provide a number of small bulk water supplies to our neighbouring water companies and receive a small number in return. These are small volumes supplying clusters of properties directly and are less than 1Ml/d.

We operate a Control Room that is manned 24 hours a day. The primary purpose of this is to monitor and manage the supply system on a day-to-day basis. All zonal transfer boosters and control valves can be operated remotely from the Control Room.

In a resource shortage situation, the highly interconnected supply system allows us to transfer water between service reservoirs such that supplies can be maintained to all customers through balancing the fall in all water storage reservoirs.

Figure 1 Cambridge region supply area and WRZ

3.4 Planning scenarios

The Environment Agency's water resources planning guideline details the range of planning scenarios which a company may need to consider. In accordance with this we use the dry year annual average (DYAA) scenario for water resources planning purposes. A normal year demand forecast is developed initially and the key components of this demand which are influenced by dry weather are then adjusted to derive the DYAA demand forecast.

We have also developed supply and demand forecasts for the peak week or critical period scenario to ensure that we can meet short-term peak demand that cannot be entirely supported from storage.

The base year data for 2017/18 has been normalised and this is then used as the starting point of the demand forecasts for all planning scenarios.

We have presented a baseline forecast for each scenario and a final planning forecast for each scenario.

The WRMP does not include scenarios of very prolonged periods of high demand and reduced supply such as droughts. Droughts require additional measures and are planned for in our drought plan. There are strong links to the drought plan as described in section 2.7.

In urban areas when many customers wish to take large volumes of water at around the same time usually for discretionary purposes such as garden watering pressures in the system can drop and customers can experience low pressure and occasionally no water. This is defined as supply stress and is not a water resources problem. However, some of the strategies designed to manage the overall supply/demand balance, in particular metering, will also benefit those areas specifically suffering from supply stress.

It should be noted that our WRMP is at the supply system overview level. Local transfer capacity difficulties as described above for example, may still require investment. These issues are not considered within the WRMP, but where they required investment we included them in our final business plan.

3.5 Climate change

We have included an assessment of the impact of climate change on the availability of water supply in this WRMP. The best estimate for this impact is included directly in the supply forecasts and the uncertainty associated with estimating the impact is included in the assessment of headroom uncertainty.

A component for the impact of climate change on demand has been included within the household demand forecast. The uncertainty around this has been included in the headroom assessment.

We have followed the approach to assessing the impacts of climate change as set out in the Environment Agency's water resources planning guidelines.

3.6 Other licensed water undertakers in our area of supply

At the time of preparing this plan there are no licensed water undertakers who supply water through our supply system. There is one inset appointment in our area of supply held by Anglian Water for a development at Northstowe. We provide a bulk supply for this.

3.7 Anglian Water and Affinity Water

Anglian Water borders our area of supply on the north, east and west. Affinity Water borders us on the south. We have met with both of our neighbours as part of the preparation of this WRMP to discuss and agree a number of issues, including bulk supplies and WRE options.

For example, we have discussed the optimal use of our Thetford sources (located in Anglian Water's operating area) in the future. We will continue to explore the feasibility of trading or exchanging source ownership to enhance our operational resilience and efficiency. We note that in Anglian Water's adaptive planning scenario it included an export to Cambridge Water. This is a scenario that Anglian Water has run but does not represent its preferred 'central case' WRMP. So we have not included it within our plan.

3.8 Bulk supplies

We export a number of small bulk supplies to Anglian Water and Affinity Water and receive a number of very small bulk imports across the border. We also have a number of emergency bulk supply points in case of localised operational events close to our border.

We have liaised with both Anglian Water and Affinity Water to agree planning assumptions on the scale of the imports and exports for the planning period.

3.9 Water trading and other options

During the pre-consultation stage of the development of the draft WRMP we have had contact with neighbouring water companies to explore opportunities for water trading in terms of being a recipient of a trade. Many of these options are common to the options being explored as part of the WRE project. These options are included in section 10.

In addition, we have studied in detail all abstraction licence arrangements that exist in and around our areas of supply to understand how we can work with other parties (farmers, breweries and industry) to meet our differing needs while minimising environmental impact, enhancing resilience and optimising efficiency.

To assist third party trading in the future we published our Water Resources Market Information (MI) in tables alongside our draft WRMP. We invited any interested third parties to contact us with details of proposals for supply- or demand-side schemes. We have not received any proposals through this route to date, but this channel remains open. As described in section 10.4, the bid assessment framework (BAF) that we have produced as part of our PR19 business plan submission provides useful information on how we assess proposals from third parties. In addition, we have included a log in section 10.4 that provides information for how we have assessed third party options.

3.10 Retailers

Since April 2017 non-household customers have been able to switch water retailer – that is, the company which bills them and provides customer service. We have engaged with the retailers who operate within our area of supply seeking views on their plans to offer water efficiency to their customers.

While we did not receive responses from all the retailers we contacted, those that did respond suggested that, at this stage, they are not in the position to define a water saving target to include in our demand forecasts. Most retailers propose working with their customers on driving water efficiencies through providing water audits and promoting the effective and sensible use of water. These are all additional services for which customers are charged; so customer uptake is yet to be established.

Since publishing our draft WRMP we have continued to work hard to build excellent relationships with our retail partners. This ambition was reflected in the positive responses that we received from retailers during extensive survey work carried out in March 2018 in support of the creation of retail satisfaction measures. While we strive to offer excellent customer service and engagement with retailers, water efficiency does not appear to currently be a key priority for them.

During November 2017 we contacted retailers to enquire about their water efficiency initiatives with non-household customers, directly associated with the development of our WRMP. We contacted the following retailers, which account for more than 99% of market share by volume.

- Pennon Water Services.
- Water Plus.
- Anglian Water Business;
- Everflow.
- Business Stream.
- SES Business Water.
- Water 2 Business.

We received a limited response (only two updates) and these confirmed no specific retail targets within this area and that any activity would be a commercially focused additional service. This was recognised as a challenge within the water sector and, in 2017, wholesalers came together and formed the Waterwise Leadership Group for Water Efficiency and Customer Participation.

During late June 2018 retailers held their first meeting of the equivalent group – the Retailers Leadership Group for Water Efficiency. It is now expected that, as an output of this group, retailers will work up a form of public commitment to both water efficiency and to working with wholesalers to consider customer incentives and joint messaging. At this stage, however, these timelines are not clear. Within the context of water resources and water efficiency we remain open and committed to support any enquiries from retailers or directly from non-household customers.

3.11 Sensitivity analysis

When developing their WRMPs, water companies have to make assumptions, affecting almost every part of the plan. Therefore, it is important to demonstrate the sensitivity of the plan to these assumptions. We have looked at sensitivity in two areas.

- The sensitivity of the supply/demand balance to data uncertainty is accounted for within the assessment of headroom, which is described in section 8.
- The sensitivity of the proposed actions in the plan to assumptions or changes in the supply/demand balance is accounted for in our multi-criteria modelling approach described in section 10.

3.12 Governance and assurance of the plan

We have employed the services of consultants Jacobs to carry out an independent assurance review of our WRMP. Jacobs' staff attended our offices to review key aspects of the plan and the overall proposals. A report was produced following the audits and presented to our Board of Directors.

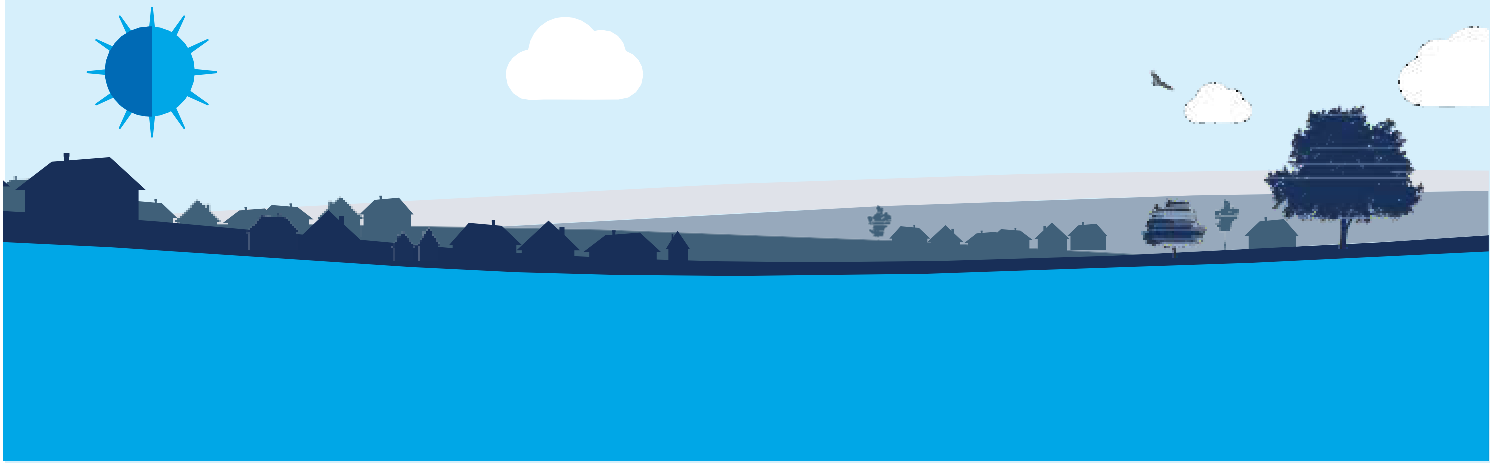
The audit report identified a small number of areas where further explanation or amendments could be considered. These were generally of a minor nature and presented no material impact to the overall supply/demand balance. We reviewed these areas and made amendments where appropriate. The audit report concluded that the WRMP meets the legal requirements, demonstrates a secure supply of water and complies with the Environment Agency's water resources planning guideline.

We also set up a Directors steering group, which met monthly to discuss progress with the development of the draft WRMP and approve relevant policy decisions. The detail of the draft WRMP was presented to the Board of Directors for approval at the October and November 2017 meetings.

During August 2018 our Board of Directors have reviewed and endorsed our proposed Statement of Response and revised draft WRMP. We have revised our Board assurance statement accordingly and published it on our website alongside our Statement of Response and revised draft WRMP. We have published an updated version of this alongside our final WRMP19 documents.

Section 4:

Our WRMP in the wider context



4. Our WRMP in the wider context

Overview of context

Demand management

Government and regulators' policy is clear that water companies must be more ambitious with demand management. Customers echo this view. We have taken this on board and have set out ambitious plans to reduce demand. Our proposed programme includes:

- a 15% reduction in leakage by 2024/25;
- more effective engagement around the benefits of opting to be metered to drive greater meter installation; and
- a commitment to reduce reported per capita consumption (PCC) to 137l/p/d by the end of 2024/25.

The environment

We have considered the impact of our operations on the environment and have included reductions in the amount of water we can take from those sources considered by the Environment Agency to present a risk of deterioration to the environment.

We have taken the opportunity with our multi-criteria modelling of options to review our whole supply portfolio to identify whether there are alternative sources or options to balance supply and demand and reduce environmental impact.

Drought resilience

Our proposals for leakage reduction, more metering and engagement with developers for more water efficient properties will assist with our resilience to more extreme drought events in the long-term.

Our analysis shows our supplies are resilient for a range of droughts across the 25-year planning period – including those more severe, or less frequent than our design droughts. We will continue to review our drought resilience through our work with the Environment Agency on ensuring no deterioration. This may require us to develop additional drought measures, such as drought permits to abstract licensed volumes no longer available following no deterioration precautionary limits. These would include any local mitigation required to ensure we can abstract in a sustainable way that would not cause permanent deterioration.

Options

We have considered options to balance supply and demand that can be provided by third parties and included them in our feasible list of options.

Innovation

Our proposals are based on new and innovative approaches. Our 'WaterSmart' trial and the rainwater harvesting development at Eddington are firsts for the UK. We will review our approach to leakage reduction and plan to explore the costs and benefits of implementing a live network to aid more effective and efficient leakage reduction. We are also exploring how to give our customers a smart meter in their homes to help them monitor and control how much water they use.

Overview of context continued

Partnership working

We will continue to work collaboratively to identify multi-sector and cross-border solutions where appropriate. We will continue to develop our approach to catchment management to improve raw water quality.

4.1 Links to other policies and programmes

This WRMP is set within the context of some significant challenges and changes which have taken place in the water sector over the past five years. The table below summarises the key aspects of the framework within which we have developed our WRMP.

Table 3 Context for the WRMP

Statement or document	Owner	Key points of relevance for WRMPs	Publication date
Guiding Principles setting out Government expectations for WRMPs	Defra	**Resilience** – take a long-term view of resilience. Test resilience of systems to events more extreme than historic events – droughts, flooding and freeze-thaw. Test levels of service and support with customer views. **Options** – consider all options including those outside the boundary of supply and work collaboratively with neighbours and other sectors. **Environment** – consider RBMPs and manage risks associated with WFD 'no deterioration'. **Water efficiency and leakage reduction** – demand-side options to be part of preferred programmes wherever likely that benefits outweigh costs. Expectation that PCC will reduce. Expectation that downward trend in leakage will continue.	May 2016

Statement or document	Owner	Key points of relevance for WRMPs	Publication date
Water industry strategic environmental requirements (WISER) setting out statutory and on-statutory expectations for PR19	Environment Agency and Natural England	Regulators expect: • excellent environmental performance; • enhancement of the environment; and • improving resilience through innovation, understanding environmental valuation and partnership working. A range of statutory requirements are included such as addressing environmental impacts from abstraction and ensuring the risk of spread of Non-Native Invasive Species (INNS) is controlled.	October 2017
Final water resources planning guidelines specifying approach to WRMPs	Environment Agency	What to include in WRMPs and approach to take. Changes since WRMP14 include links to drought plans, uncertainty around risk of deterioration to water bodies and new risk based decision-making methodologies.	May 2016 and subsequent releases of supporting information and updates
PR19 methodology	Ofwat	Specific water resources guidance as follows. • Companies are to publish market information requirements alongside WRMPs and to submit their bid assessment framework (BAF) as part of the business plan. • Forecasts of supply/demand balance and capacity (as defined by water resources yield) are to be submitted with business plans (assumptions and outcome to be consistent with WRMP). • Companies are to develop their own risk-sharing arrangements if planning significant investments in new water resources. Clear themes for PR19 include innovation, resilience, customer service and affordability.	July 2017

Statement or document	Owner	Key points of relevance for WRMPs	Publication date
DWI long-term planning guidance	DWI	The DWI expects that companies always plan to meet their statutory obligations for drinking water quality using a source to tap approach to risk assessment for water supplies and ensuring compliance with the 'no deterioration' principle within Article 7 of the WFD. They will continue to actively encourage catchment management schemes where appropriate and to mitigate any risks to drinking water quality at source. The Inspectorate has requested written assurance in the form of a signed statement from the Board Level Contact for each company that the company's WRMP takes account of all statutory drinking water quality obligations, and that it includes plans to meet their statutory obligations in full.	
Other relevant events/ documents/ studies	Water UK	**Water Resources Long-Term Planning Framework** – research modelled possible effects of climate change, population growth, environmental protection measures and trends in water use and found that in some scenarios we are facing longer, more frequent, more acute droughts. To contain the risk of drought we need more extensive measures to manage demand (smart metering, leakage reduction, improved building standards), enhanced supplies of water (moving water from one region to another, building new reservoirs, treating more water for reuse and building more desalination plants).	2016
	Defra/Ofwat	**Market separation** – retail and wholesale operations separated for non-household customers. Engagement with retailers operating in area of supply required to understand their water efficiency aspirations and commitments.	April 2017
	WRE	**WRE** – collaborative project looking at strategic regional solutions for water resources in the long-term.	On-going

	Customer expectations	**Customer research** – both company and wider industry research shows customers want more leakage reduction, more help to save water, are generally in favour of metering and support current levels of service.	On-going

4.2 Customer expectations

We have carried out extensive customer research as part of our preparations for the PR19 business plan and our WRMP. We have triangulated the available research to develop a rounded view of customer expectations. This is described in detail in section 5 of this plan and the associated appendices. We have developed our WRMP to take account of customer views.

4.3 Response to context

4.3.1 Demand management

Government and regulators' policy is clear that water companies must challenge themselves more and be more ambitious with demand management. Customers echo this view. We have taken this on board and have set out ambitious plans to reduce demand. Our proposed programme includes:

- a 15% reduction in leakage by 2024/25;
- more effective engagement around the benefits of opting to be metered to increase meter penetration more quickly than would otherwise happen; and
- a commitment to reduce average PCC to 137l/p/d by the end of 2024/25. (see also section 11.1.3 for details)

We expect this reduction to be sustainable thereafter and will seek the most effective way to deliver this.

We have included an indicative programme of water efficiency activity which will achieve this reduction. However, we will continue to review the most effective options as new information and opportunities arise. Hence the exact mix of actions may be different to that presented in this plan.

We undertook a trial with 15,000 households to assess the benefit of tailored water use messages to customers. 'WaterSmart' is a bespoke customer engagement portal which aims to influence water using behaviour by giving information about a household's water use in comparison to other similar households. The trial commenced in November 2017 and ran for 12 months. We are currently evaluating the benefits of this trial in comparison with similar systems and products.

We are also exploring ways to engage with developers to incentivise them to build more water efficient homes and estates. We have been working with the University of Cambridge on their Eddington development where we are managing the rainwater harvesting system alongside the potable water supply. We will monitor the water saving benefit of this dual supply system and continue to explore ways to incentivise developers to design more sustainable developments.

Our engagement with retailers operating in our area of supply suggests it is too early to be certain of any reductions in water use that their additional services to non-household customers might bring. At this stage, we have not included in our demand forecasts any explicit projections for savings in demand by these customers. However, as the retail market matures we will review this and update our demand forecasts if required.

4.3.2 Environmental protection

We have considered the impact of our operations on the environment. We have included reductions in the amount of water we can take from those sources included in the WINEP as at risk of causing a deterioration of the environment. This has reduced our baseline DO.

We have taken the opportunity with our multi-criteria modelling of options to review our whole supply portfolio to identify whether there are alternative sources or options to balance supply and demand and reduce environmental impact.

Defra, Natural England, the Environment Agency and water companies have identified the transfer of raw water as a potential pathway for the spread of Invasive Non-Native Species (INNS) as noted in WISER. As part of our plan we have considered how our current and future operations may cause the spread of INNS. Current operations do not involve the transfer of any raw water that could pose an INNS risk, but we have considered them in the assessment of options included within the plan to ensure risks from any new transfers are fully mitigated in scheme details.

4.3.3 Options

We have considered options to balance supply and demand that can be provided by third parties. A number of third party options have been included in our feasible list of options described in section 10.

We continue to identify and progress any further options for trading or provision of alternative demand management options during and after the public consultation for our WRMP.

4.3.4 Resilience and droughts

In 2016 Water UK, the trade body for the sector, published a report looking at the long-term water resources planning framework. It took a view of possible effects of climate change, population growth, environmental protection measures and trends in water use and found that in some scenarios we are facing longer, more frequent, more acute droughts.

Our proposals for leakage reduction, more metering and engagement with developers for more water efficient properties will assist with our resilience to these events.

Our assessment of drought resilience throughout the planning period (detailed in section 7) shows our supplies are resilient for a range of droughts across the 25-year planning period – including those more severe, or less frequent than our design droughts. We will review this assessment when we have certainty on the impact of measures to ensure 'no deterioration' of the Water Framework Directive (WFD). This review may require us to develop additional drought measures, such as drought permits to abstract licensed volumes no longer available following no deterioration precautionary limits. These would include any local mitigation required to ensure we can abstract in a sustainable way that would not cause WFD deterioration.

4.3.5 Innovation

Our ambitious demand management plans are based on developing new and innovative approaches. Our 'WaterSmart' trial is the first time this approach has been deployed in the UK and the rainwater harvesting development at Eddington, in North West Cambridge, is the largest in the UK. We have committed to reduce leakage over the entire 25 years of the planning period. We plan to explore the costs and benefits of implementing a live network to aid more effective and efficient leakage reduction. We are also exploring how to give our customers a smart meter in their homes to help them monitor and control how much water they use.

4.3.6 Partnerships and collaboration

On a local scale we are actively engaging with the agricultural sector, working with farmers and landowners to educate and encourage appropriate use of chemicals in catchments that provide public water supplies. We started this work in 2015, focusing on priority catchments where we had identified the most potential benefit. We are rolling this out to more of our groundwater catchments over the next few years.

It is clear that, for the UK as a whole, water companies will need to look wider than our own boundaries to balance supply and demand. Cross-boundary, regional and multi-sector partnerships will be needed to maintain water supplies and minimise our impact on the environment in the long-term.

We have worked with a number of collaborative groups throughout the production of this WRMP. We have been active participants in the WRE group. We have also been members of the Trent Working Group and the Severn Working Group which are relevant to WRE through the link in potential for transfers from these resources to facilitate WRE options. These groups have been considering the needs of different sectors and regions for water from those catchments to identify solutions which best meet the needs of all in the long term.

4.4 Links with Water Resources East

WRE is a pioneering multi-sector water resource planning initiative. Using the first application of shared vision planning and robust decision making in the UK, it is creating a more integrated approach to long-term water resource management and planning, looking ahead to 2080. The project aims to understand the challenges and opportunities of a multi-sector regional approach to decision making that supports economic growth, protects and enhances the environment and is resilient to future climate change. Strong stakeholder support is driving the WRE forward, delivering key building blocks for resilience, economic growth and environmental gain in the east of England.

Combining outputs from previous WRMPs for water companies in the east of England indicates that as a whole, supply/demand deficits could be widespread beyond the 2030s as a result of future pressures on water use and availability because of impacts from climate change and growth.

Figure 2 The WRE vision

The WRE vision is to provide an integrated long-term strategy, prepared through multi-sector collaboration and planning, that takes account of the needs of all of those in the WRE region with an interest in the management and use of water. WRE's overall aim is to deliver a reliable, sustainable and affordable system of water supply to meet multi-sector requirements (including the environment) across the East of England for the next 50 years and beyond towards the end of the century. Within this overall aim, the objectives for the WRE project are to:

- Provide a framework for **collaboration and shared decision making** by stakeholders from across key sectors (Water Companies, Agriculture, Energy and Environment) together with Regulators (e.g. Environment Agency, Natural England).

- Deliver a water resource strategy to meet **unprecedented threats from growth and climate change**. The challenge is to provide reliable, affordable supplies of water from sustainable sources which are resilient to the effects of severe drought.

- To **protect and enhance the environment** beyond statutory requirements such as the Habitat Regulations and the Water Framework Directive to provide where possible a net gain in biodiversity

- Develop a strategy that supports the policy objectives of Government described in the water white paper "Water for Life"; in particular, **supporting economic growth** while simultaneously protecting the environment.

Particular areas of vulnerability for all key water sectors – public water supply, energy, agriculture and the environment – have been identified, and water companies have provided potential solutions or options. The project has then utilised robust decision-making techniques, and advanced regional options modelling to test future possible portfolios of options against future scenarios, with the aim of recommending an overall long-term strategy for the region from the 2060s.

The emerging WRE strategy will increase resilience, deliver economic growth and protect the environment.

There are multiple solutions to the future problems of rising population, and climate change and the increased risks to customers and the environment these pose. Among the range of solutions that have been identified there are common themes emerging. Broadly, these indicate that strategically:

- groundwater abstraction will reduce greatly to improve the environment;
- public water supplies will be less reliant on groundwater, to increase groundwater support to agriculture;
- a more inter-company connected network, with larger transfer capacities will be needed;
- storage will increase regionally, by enhancing existing reservoirs and developing some new resources; and
- ambitious demand management savings will be required.

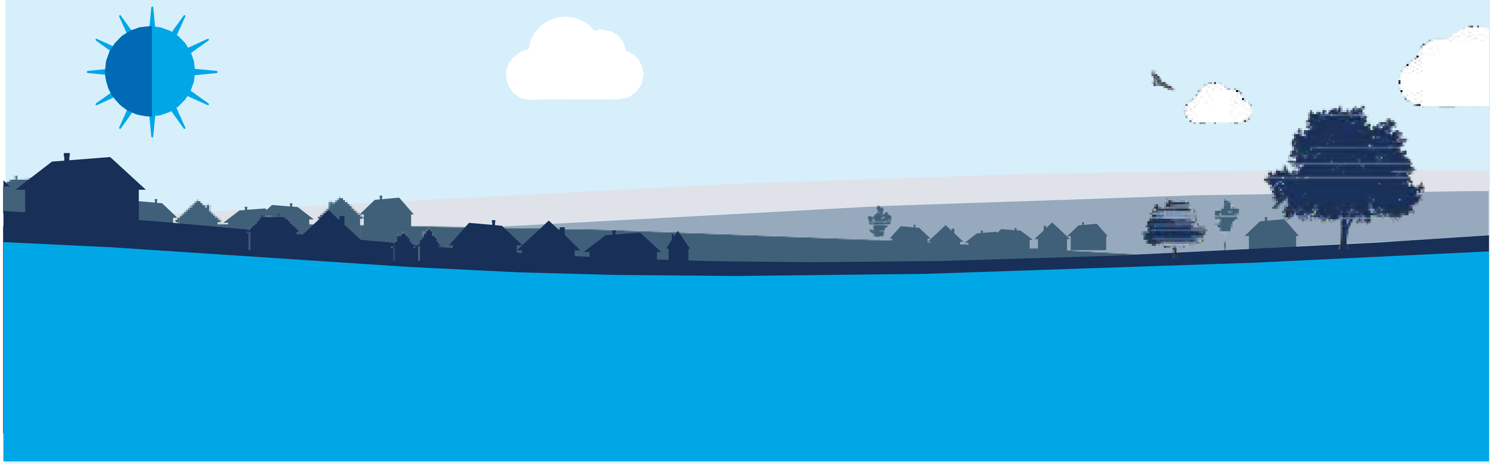
Some of the feasible options we have developed for this WRMP are also included in the WRE project portfolios, while other feasible options rely on WRE options provided by neighbouring companies to supply the resource for a transfer. None of these have been selected by our modelling for the planning period, although our models do indicate that some of these could begin to get selected when a longer time horizon, or additional supply stresses are included.

We will continue to work with WRE stakeholders from all sectors (agriculture, industry, power generation etc) to come up with long-term solutions that could result in the development of shared assets and innovative financing models, which in turn result in a fairer way of sharing the costs involved in developing new supply- or demand-side options. We hope that this work shows what the most cost-effective and sustainable solutions are to meet the needs of all regional stakeholders. Reporting on the first phase of WRE completed in September 2018. Currently, the schemes being discussed in the WRE group rely on resources that have not yet been developed and that are not in any final business or WRMP. We describe this further in section 10.4.

We will continue to be an active member of the WRE group and will collaborate with our neighbours to help shape the long-term sustainability of water resources in the east of England.

This WRMP is consistent with the WRE vision for the region and considers a range of options, which have been identified through that group.

Section 5:
Customer engagement



5. Customer engagement

Overview of customer engagement findings

The key findings from our customer engagement work underpin our WRMP submission and evidence that our plans have been built around our customers' and other key stakeholders' preferences and service level expectations.

Customer priorities

We have carried out independent research to understand what our customers think is most important to them about the service we provide now and in the future. Across two in-depth studies the main priorities areas they want us to focus on are:

- ensuring the continuity, quality and reliability of their clean water supply;
- offering fair and accurate bills;
- reducing leakage from pipes;
- delivering excellent customer service;
- protecting the natural environment; and
- looking after vulnerable or hard-to-reach customers.

Customers are also expecting innovation to:

- help them monitor and reduce their water usage; and
- ensure resilience of the network in the face of population growth, climate change and energy challenges.

Views on metering

Most of our customers agree that a water meter is the fairest way to charge a household or business for the water they use. But they want us to make sure that customers who struggle financially or who have a disability are protected from the possibility of having a higher bill as a result of having a meter.

There is not widespread support among customers, who are not on a metered supply for making meters compulsory for everyone, so we are not going to do this. Instead, we are thinking about the best ways to encourage more customers to have a meter. We are also reviewing options for how we can give our customers a smart meter device in their homes – something many said they would like to help them monitor and control how much water they use.

We have included additional meter optants in our preferred metering strategy described in section 11.

Views on leakage

Our customers and other key stakeholders said they want us to do much more to reduce the amount of water that leaks out of our pipe network every day. They also told us that if we want them to use less water, then we have to lead the way and reduce leakage. So, we are making this area a central part of our business plan.

We have adopted a 15% reduction in leakage in our preferred leakage strategy described in section 11.

Overview of customer engagement findings continued

Views on levels of service

Most of our customers told us they were happy with the level of service they currently get from us. That means they would only expect us to have to introduce a temporary use ban once every 20 years.

There was evidence from the business customers we spoke to that they are happy with our commitment to only have a temporary ban on non-essential activities once every 50 years. So, for now, we are not going to make any changes to the level of service we offer our customers.

Customers have been clear that they will not accept any severe water supply restrictions, such as the use of stand pipes.

Views on water efficiency

Most of our customers agree they could do more to reduce how much water they use. But more than half of them said we needed to do better at making them more aware of the support we can offer to help save water.

Many customers also said they did not appreciate the 'big picture' reasons around why they need to use less water, such as climate change or population growth. So we are going to look at how we can better explain to every customer why we all need to work together as 94% of customers said water is a precious resource.

We have committed to reduce average PCC to 137l/p/d over the AMP7 period by carrying out a comprehensive programme of water efficiency initiatives, including incentivising developers to build more water efficient homes.

We describe our plans for water efficiency in more detail in section 11.

Views on the environment and sustainability

Many customers have told us that it is important to them that we protect wildlife (plants and animals) in our region. However, a third of our customers say they do not think we are doing enough in this area. They also said that we need to do more to explain to them what impact our activities have on the areas they live in.

We will work closely with the Environment Agency to understand the impact of our abstractions on key water courses and water bodies and will identify mitigation measures or changes in our abstractions to address this.

See section 7 for more detail about the WINEP.

5.1 How we have engaged with our key stakeholders

We have gained the views of more customers and other key stakeholders than at 2014 and used new techniques to engage with them to ensure we have an even greater level of detailed evidence to support our plans.

Table 4 Stakeholder engagement for WRMP19 compared with WRMP14

Stakeholder engagement to support WRMP 2014	Stakeholder engagement to support WRMP 2019
Statutory pre-consultation with key stakeholders	Statutory pre-consolation with key stakeholders
Ran an all day workshop event with 30 customers to gain feedback on preferences and service level expectations	Ran an all-day workshop event with 30 customers (household and small business owners) to gain feedback on preferences and service level expectations. Invited the same customers (27 attended) to another workshop to understand their views of which strategic demand- and supply-side options open to us. This workshop also included the use of an interactive exercise where customers were asked to become an advisory board and build a strategic plan based on demand- and supply-side options to hit a volume and cost target. This allowed us to assess their views and preferences to the options open to us. Gained the views of 207 customers through an online survey to validate and build on the insights from the customer workshops. Eleven big business and industry stakeholders attended a roundtable workshop to gain their views on preferences, service level expectations and to understand their views of which strategic demand and supply-side options open to us. This is supported by a 'triangulation' exercise of customers' preferences and service expectations across a range of internal and external insight data sources to develop a robust customer priority index of supply and demand side options. Triangulation means using more than one method to collect data on the same topic. This is a way of making sure the research is valid. Refer to the table below for full details of our core WRMP and wider customer engagement programme.
Focused discussion with our CCG	Focused discussions and input from the Independent Customer Panel to challenge our customer engagement approach, how well these priorities and reflected in our plans and the key assumptions in our overall WRMP. See below for more details.
Public consultation on the draft WRMP	Public consultation on the draft WRMP will include more publicity of the consultation process to try to engage wider feedback.

The Independent Customer Panel scrutinised our customer engagement for this WRMP. We have been transparent with members of the panel throughout the engagement we have carried out to allow them to effectively challenge every aspect of our programme. The panel has been involved in:

- helping with the selection of research agencies in terms of evaluating the methodology used;
- attending project start-up meetings to challenge the methodology and sample sizes;
- critiquing consultation materials and questionnaires to ensure they are clear, fair and not leading in any way;
- user testing online surveys for ease of completion and functionality;
- observing customer co-creation workshops, focus groups and deliberative events and
- challenging our suppliers at project de-briefs on key findings and conclusions.

We have also invested a significant amount of effort in responding to the challenges relating to our engagement programme raised by the panel. These are diverse in nature, from the 11 strategic challenges they raised about engagement and our overall approach to the many project-specific challenges raised from being closely involved in the areas outlined above. We have made many changes as a result of their suggestions or criticisms and, if we decided not to act on a suggestion, we provided a rationale.

When we made changes we also frequently offered a further opportunity for the Independent Customer Panel to influence the outcome at a later stage. We believe our approach to working with the panel and the independent input it has given has helped to provide a better outcome for our customers. We are fully committed to maintaining and further improving this open, transparent relationship.

5.2 Overview of customer engagement activities for this WRMP

The table below details the sources of feedback used to shape our WRMP.

Table 5 Sources of customer engagement feedback

Engagement work stream objective	Methodology used to engage customers	Insights collected
Foundation research to establish customers' priorities	Qualitative study covering 39 customers (covering household and non-household by key demographic split).	May – June 2017
	Quantitative survey of 166 household customers from an online survey run from our website (random, non-representative sample, analysis weighted to regional demographics).	Dec 2018 – Jan 2018

Engagement work stream objective	Methodology used to engage customers	Insights collected
WRMP and long-term plan customer engagement to gain customer views on service levels and where we should invest to meet demand for water	Qualitative study over two facilitated reconvened workshop events with 30 customers (covering household and non-household by key demographic splits). The qualitative gamification* element of the reconvened workshop involved providing customers with cost targets with associated bill impact, if customers went over budget with their plan options. 11 large corporate customers and key industry stakeholders attending round-table discussion event. 207 domestic customers (quotas set to key demographic splits) reached through an online survey.	July – August 2017
Metering uptake study to understand customer reasons for not switching to a water meter	Quantitative telephone study with 101 household customers in the region with an unmeasured water supply and a rateable value (RV) of more than £250.	July 2017
Willingness to Pay Studies to understand customer priorities and preferences for service charges and investments across a range of 17 attributes	Wave 1: 6 reconvened focus groups to co-create a quantitative survey with 560 household customers and 130 business customers (covering all key demographic splits and weighted to regional demographics).	Nov – Oct 2017
	Wave 2: quantitative survey with 206 household customers and 57 business customers (covering all key demographic splits and weighted to regional demographics).	Feb – Apr 2018
Engagement to understand how different groups of customers respond to propositions around water efficiency and other retail services	Stage 1: online and phone interviews with 290 household customers to understand the different views of customers based on their views and attitudes to water and the wider world (covering all key demographic splits and weighted to regional demographics). Stage 2: two focus groups to explore differing customer views in greater depth. Stage 3: online and phone interviews with 150 household customers to understand responses to selected propositions (covering all key demographic splits and weighted to regional demographics).	Nov 2017 to Mar 2018
	Additional follow up quantitative survey of 258 household customers from an online survey run from our website (random, non-representative sample).	Jan – Apr 2018

Engagement work stream objective	Methodology used to engage customers	Insights collected
Customer journey engagement to understand the ideal experience for customers, including reporting a leak and having a meter installed	Qualitative study with facilitated 4 workshop event with 32 customers (covering household and non-household by key demographic splits). Followed by a quantitative phone survey with 386 household customers (Covering all key demographic splits and weighted to regional demographics.)	Feb – Mar 2018
Engagement to understand if customers support our proposed customer promises and outcome delivery incentives plans for 2020-2025	Qualitative study with facilitated all-day workshop event with 28 customers (covering household and non-household by key demographic splits). Followed by a quantitative survey with 224 household customers and 24 business customers (covering all key demographic splits and weighted to regional demographics). The quantitative study included customers being exposed to an 'in the moment' bill impact when improving or decreasing level of service for 11 of our performance commitments. Sensitivity tested with 19 household customers (random, non-weighted sample).	Feb – Apr 2018 June 2018
Testing customer acceptability of our business plan and associated bills for 2020-2025	Qualitative study of 4 focus groups with 31 customers (covering household and non-household by key demographic split). Followed by a quantitative survey with 375 household customers and 79 business customers (covering all key demographic splits and weighted to regional demographics).	May – Jul 2018
Customer forums to understand views of our service and discussions around how to build more water efficient homes	Half-day forum with 12 customers in the new connections market covering developers, self-lay providers, NAV and other key stakeholders. Full-day forum with 14 customers in the new connections market covering developers, self-lay providers, NAV, business retailers and other key industry stakeholders.	Nov 2017 Jul 2018

Engagement work stream objective	Methodology used to engage customers	Insights collected
'WaterSmart' platform used to understand how customer engagement, customer satisfaction, and water efficiency can be influenced by providing customers with access to more detailed information about their water usage and advice on how to use water more wisely	Participant group of 15,000 of metered household customers in the Cambridge region randomly selected to use the 'WaterSmart' platform. • 2,500 customers with 6x meter reads a year. • 13,000 customers with 2x meter reads a year. • Welcome letter and initial water report sent as start of trial, followed by five cycles of a water report sent by email only. • Access to a customer portal to view water consumption history and comparisons and access to water saving messages/advice. • Leak and threshold use alerts. 33,500 metred household customers in the Cambridge region not using the 'WaterSmart' platform randomly selected to act as a control group. Satisfaction feedback survey among 3,072 'WaterSmart' users and 306 customers in the control.	Dec 2017 – Nov 2018 July 2018
Customer service tracker to establish customer perceptions of our service performance	Quantitative telephone study covering 100 household and 49 business customers (covering all key demographic splits).	Apr 2017 – Mar 2018
	296 household customers from an online survey run from our website (random, non-weighted sample).	Feb – April 2017
Daily customer contact data	Analysis of relevant customer contact data.	2017/18 going back 3 years
Consumer Council for Water (CCWater) reports	'Water Restrictions' report. Water Matters Annual Survey and 'Water Saving' Report (all household customer research). Water, water everywhere? Delivering a resilient water system.	2012 2017 2017
PR19 data triangulation study	Developing a robust customer priority index with respect to water resources management plan (WRMP) supply and demand supply options.	Apr – Jun 2018

* Gamification is a way of making an exercise into a game.

For full details of our customer engagement refer to **appendix E**.

5.3 Customer priorities

In April 2017, we commissioned the independent specialist Accent Research to carry out a qualitative study – both unprompted and then prompted after being informed about our responsibilities – to better understand our customers' priorities for service delivery now and over the longer term. It was also important for us to check these against previously established priorities from the engagement work conducted for the 2014 price review – PR14 (see **appendix B** for sample, approach and methodology). While the study was qualitative in nature, the in-depth discussions with 39 customers sampled to be representative of the wider customer base, provided a reliable output – particularly as customers' views were consistent in terms of the key priority areas identified.

The most relevant key findings from this study are as follows.

Unprompted, customer priorities focus on:

- the continuity, quality and reliability of their clean water supply;
- customer service; and
- the fairness and accuracy of the bills they receive from us.

These priorities, also identified in the PR14 customer feedback, are now seen as basic 'hygiene' factors. Customers told us that they are not willing to accept any deterioration in service levels. We tested this finding in a robust quantitative way in our willingness to pay research for the PR19 business plan.

Prompted information shown by Accent's facilitators encouraged customers to reassess these priorities to some extent. Customers are also expecting innovation to:

- help reduce wastage (leakage);
- help them monitor their usage; and
- ensure resilience of the network in the face of population growth, climate change and energy challenges.

This places even more emphasis for customers on the need to reduce wastage through education, technology and investment in infrastructure. These are new areas not previously identified by customers in the PR14 priorities research.

While current bills are seen as value for money once the scale of our activities is outlined and we are perceived to be financially responsible, customers said it was important that current and future investment plans incorporate the need to ensure future affordability for them in an economically uncertain future.

Across all these areas above there was a consistency in responses by customer type – for household by age, life stage and social grade; and by company size and sector for SME business customers (albeit with the caveat that each customer has their own individual list of priorities).

Over the longer term, there is also an emerging trend for more investment in technology and service innovation. In particular, younger customers (who are not yet bill payers) want us to help them manage their own water usage through smart technology, devices and real-time information. Offering an easy to use and immediate service is now a basic 'hygiene' factor for our future customers.

The following table summarises the findings from this research.

Table 6 Customers' priorities

Important areas we need to continue focusing on now	Important areas we need to focus on in the next 5-10 years and beyond
Providing high-quality water supply	Making sure we have enough water for the growing population
Making sure water always come out of the tap	Investing in new technology and ways of working that help customers better control their water usage
Offering fair and accurate billing	Making sure we offer affordable bills but invest in our network to meet growing water needs
Offering great customer service	Managing the impact of climate change – such as increased heavy rainfall leading to flooding, burst pipes because of extreme temperatures
Reducing leakages from our network of pipes	Protecting and improving the natural environment
Educating customers and providing information and advice on our products and service	
Investing in our network and pipes to ensure we can meet demand	
Ensuring we manage our company finances carefully	
Assisting customers who need extra support	

5.4 WRMP engagement

We also commissioned the independent specialist Community Research to run a comprehensive programme of qualitative and quantitative engagement with a broad range of customers and stakeholders to understand views on areas specific to our WRMP and long-term supply- and demand-side options. They ran this study during July and August 2017 (see **appendix C** for sample, approach and methodology) and covered:

- levels of service;
- leakage;
- water efficiency;
- metering; and
- environmental impact of our activities.

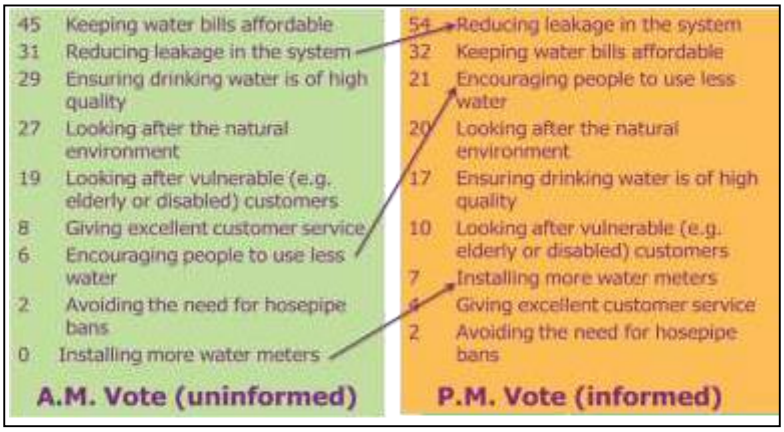
At the first all-day WRMP workshop, household (HH) and SME business (NHH) customers were given a list of the main challenges that we face and asked to rank the top three in order of importance. The list was provided to them by us in contrast to the Foundation Research work detailed above when it was developed in conversation with customers.

The top three priorities (among uninformed customers) were broadly consistent, both in this study across the range of customers who took part and also with the findings detailed in the Foundation Research. These were:

- ensuring water quality;
- reducing leakage; and
- keeping bills affordable.

At the end of the first workshop (that is, after the information was given to participants) customers' priorities were reassessed. This resulted in reducing leakage becoming the area with the highest number of votes with encouraging people to use less water also showing a noticeable rise in the number of 'top three' votes received.

Figure 3 Voting highlighting customers' top three priorities

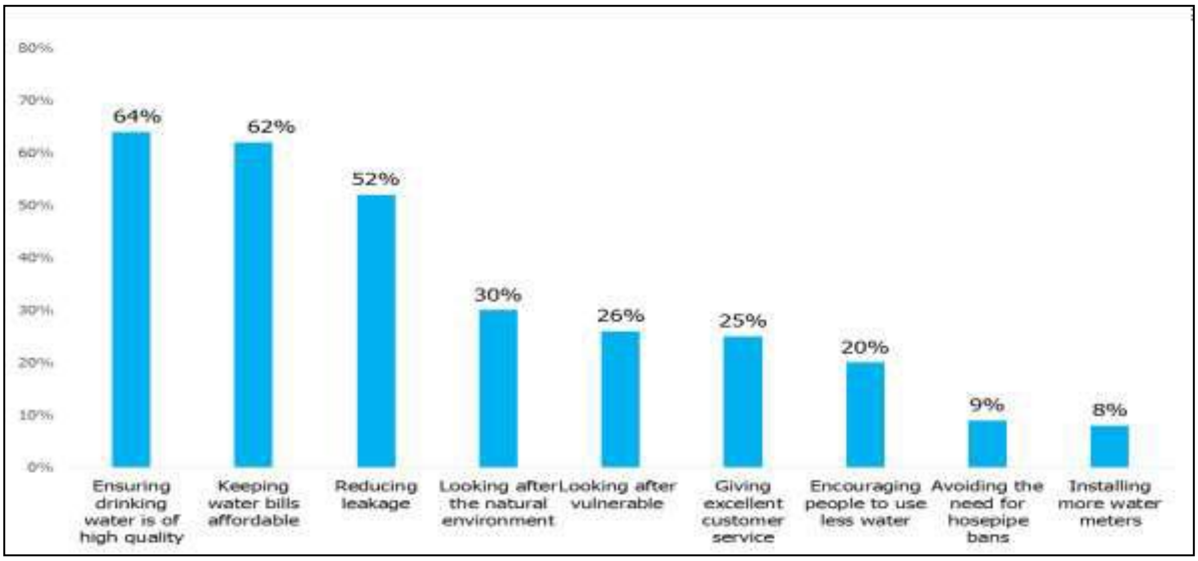


Base: 30 customers attending workshop.

Stakeholders and larger business customers' spontaneous priorities mirrored these, but often came from a more informed position because of their job remit. They were also concerned about us planning for the future and ensuring the resilience of water supplies.

The online survey asked household customers to rate their preferences from the same list shown to customers at the WRMP workshop. The results show the same priorities in terms of the top three, but the more representative online sample puts 'ensuring high quality water' as number 1 – this is likely to be a truer reflection of the importance the wider population of customers would place on this area. Also, 30% of survey respondents placed 'looking after the natural environment' in their top three priorities.

Figure 4 Results of online survey highlighting customers' top three priorities



Base: 207 Cambridge HH customers.

There were also some variations to note among different types of customers.

- Those with a disabled person in their household were less likely to choose 'encouraging people to use less water' in their top three priorities – 12% versus 20%.
- Those aged 60 or above were more likely to choose leakage in their top three – 65% versus 52%.

5.5 Summary of customer priorities

Reviewing the recent customer feedback across all our engagement projects it shows a clear and consistent view of customer priorities before they are informed of a water company's activities. (It should be noted that this is a combined list based on a review of all the feedback as there were differences in the methodologies and the way that the priorities were tested.) Household and SME business customers' top priorities are detailed in the table below.

Table 7 Summary of customers' priorities

The most important areas the majority of customers say we need to continue focusing on	Other important areas we need to focus on – more variations in customer support
Providing a high-quality water supply	Offering excellent customer service
Making sure water always come out of the tap	Protecting the natural environment
Keeping bills affordable, while ensuring investment in our network so that we can meet future challenges	Looking after vulnerable or hard-to-reach customers (a particularly strong view held by household customers)
Reducing leakage from pipes (which was a particularly strong view among household customers aged 60 or above)	Educating customers and providing them with services to help them reduce their water consumption
Customers also want us to innovate and improve operational performance and service delivery	

There is strong evidence to suggest that, when customers are informed about the challenges we face around meeting a growing demand for water, metering and activities to encourage people to use less water become key priorities for us to address. Feedback from the workshops shows that customers viewed them as obvious, fair and simple ways to help reduce demand for water. When informed about the level of leakage, many customers at the workshop moved this area higher up their priority list, highlighting strong views around the need for us to reduce wastage from our pipe network.

With preferences indicating that many customers want more information, advice and education from us, it highlights the pressing need to build stronger, more proactive relationships with customers where they can use knowledge to help them make better choices about their water consumption. Further details of the specific options customers would prefer we take are detailed in **appendix E**.

A key learning point from CCWater's 'Water Saving: helping customers to see the big picture' (October 2017) is that people need to also see the wider context as to "why they should save water" rather than just the messages focused on their individual water use behaviour, which water companies mainly use. The fact that many of the customers who attended our WRMP workshop had no idea of the 'big picture' challenges around water highlights that a dual messaging approach would be worth trialling to assess its impact in helping customers to understand and change their behaviour to use less water.

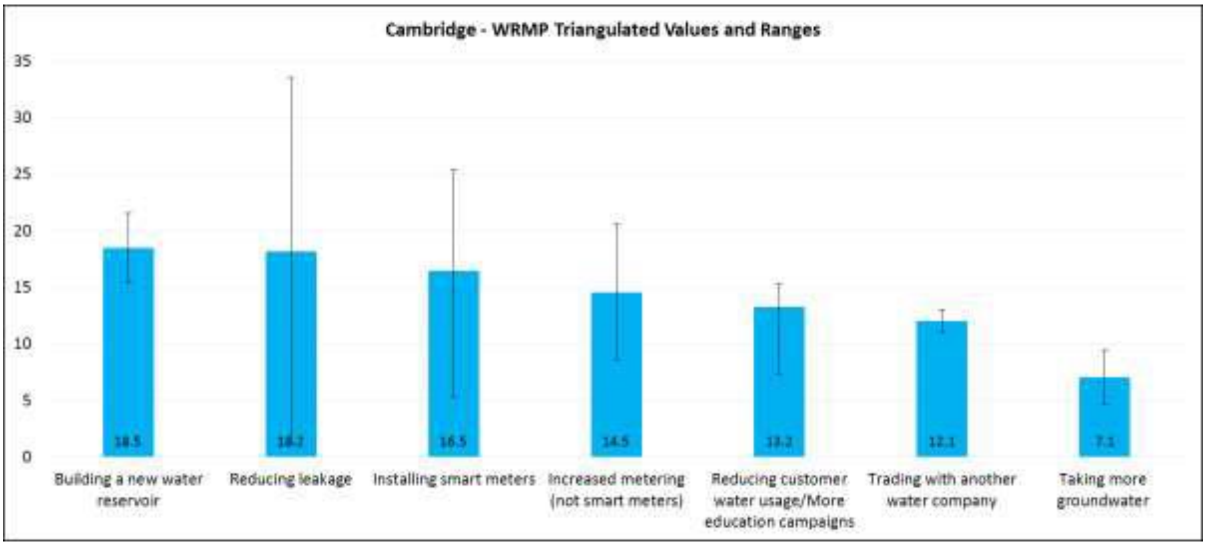
In addition to our wider priorities engagement, we also commissioned independent, expert support from one of our research agency partners, Accent and PJM Economics, to review all our customer engagement activity related to our WRMP to develop an index.

We fed the output of this into our multi-criteria analysis (MCA) investment tool that drives the selection of preferred supply and demand side options in our WRMP. This has ensured that our customers' priorities play a key role in shaping our investment plans.

An important step in the 'six-step SMARTS' triangulation approach involved applying weights to each of the data sources (our core WRMP, willingness to pay and customer priorities engagement) based on their overall rating and combining the measures to derive a robust priorities index. Figure 5 shows our final WRMP priority values, which have been re-scaled to sum to 100, and their associated ranges.

This highlights that 'building a new reservoir' and 'reducing leakage' are the highest priority among our Cambridge customers with little between the two options. This is followed by the two metering options. 'Taking more groundwater' is the least desired option for customers, although it is important to note that this is only in the context of drilling new boreholes.

Figure 5 Final WRMP priority values and ranges – scaled to 100



We also sensitivity tested the scenarios being considered and it is clear that customers, with the exception of 'building a new water reservoir', prefer demand-side options to supply-side ones. However, there was recognition that there would need to be a blend of both supply- and demand-side options to meet the future challenges we face.

Whilst there is an obvious preference towards building a new reservoir, this is in part driven by the engagement activity approach – in that this option provides a large volume of water to hit a cost/volume target we set them. Extensive follow-up engagement with customers and stakeholders would be needed, if and when this option is required by us to meet customer demand in the future.

Based on the sensitivity testing the 'Main' values shown above are the preferred values to use within our MCA as part of the process of setting investment levels for our supply and demand side options. It provides the most well rounded, balanced view of our customers' priorities across all our relevant engagement work to support our WRMP.

For more details of our approach to develop our priorities index please refer to **appendix E**.

5.5.1 Using willingness to pay research to shape our plans

We used our triangulated willingness to pay (WTP) customer valuations for reducing leakage, increased metering and installing smart meters as an input to develop our priority index.

In October 2017, Impact Utilities carried out a robust customer valuation research study for us among both household and non-household customers. This is known as Wave 1 and the study followed an innovative ‘seven-step’ approach, which included involving customers in the development of the survey content and structure to overcome the challenges raised at PR14 around the use of Stated Preference (SP) surveys. Seventeen attributes were included in the study with three levels of service tested: current, and two improved levels of service (+1 and +2). Six hundred and ninety household and non-household customers took part. We have a report that provides full details and findings from this study. This report is available on request.

To support the 2019 price review by better understanding some of the surprising valuations generated in Wave 1, Impact Utilities carried out a ‘follow-up’ study in 2018.

This research, known as ‘Wave 2’, was carried out to further explore results for specific attributes and refine the scope of attributes included. Similar to the Wave 1 study, this second wave of research among household and non-household customers involved large-scale quantitative surveys (among 263 household and business customers) assessing willingness to pay through SP choice experiments.

In Wave 2, the levels of service improvements displayed to respondents were amended to reflect a more realistic level and new attributes relating to retail/community included. In addition, around one-third of respondents completed the SP exercise in the context of a lower bill.

In both the Wave 1 and Wave 2 studies more than 90% of customers said they were satisfied with current service levels. The only the notable exception of dissatisfaction is that of water hardness among both HH and NHH customers, reflecting the feedback in our customer service tracker.

The WTP valuations from Wave 1 and Wave 2 were then subject to a robust triangulation approach by our partners Accent and PJM Economics. The table below provides the full details of normalised WTP figures (per year) among Cambridge customers, which have been subject to our robust triangulation approach. We can see that despite the high levels of satisfaction with current service levels, customers were able to judge which service improvements offered them value for money.

Table 8 Comparison of WTP triangulated values, South Staffs region (£/unit/year)

Attributes	Unit	Combined unit value: HH	Combined unit value: NHH	Combined unit value: main
Water not safe to drink	Property affected	£1,029	£1,516	£2,545
Flooding from a burst pipe	Property affected	£491	£2,107	£2,598
Taste and smell of water	Property affected	£247	£1,182	£1,429
Discoloured water	Property affected	£339	£699	£1,038
Unexpected temporary loss of water supply	Property affected	£183	£444	£626
Low water pressure	Property affected	£60	£85	£145
Water hardness	Property affected	£115	£4	£118
Lead pipes	Property affected	£16	£36	£52
Temporary use ban	1% change in risk	£183,864	£899,514	£1,083,378
Drought restrictions	1% change in risk	£357,268	£1,154,335	£1,511,603
Leakage	Ml/d	£91,862	£125,115	£216,977
Water metering	Household	£7	Not covered	£7
Giving customers control of their water usage	Household	£2		£2
Protecting wildlife habitats	Hectare	£11,870	£30,364	£42,233
Managing impacts on rivers and streams	Hectare	£2,131	£11,472	£13,604
Traffic disruption	Roadworks incident	£336	£1,923	£2,259

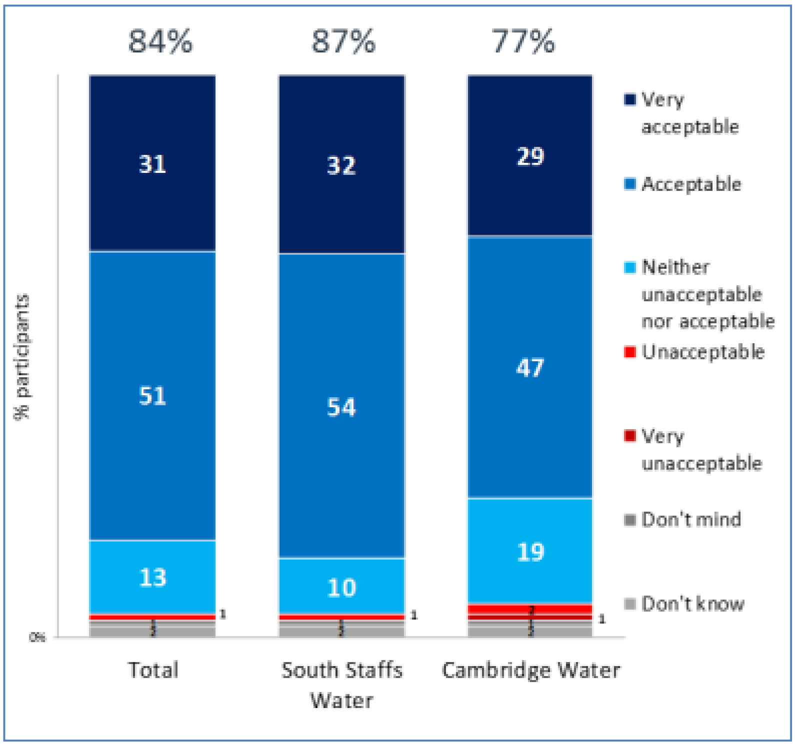
Note: Combined Unit value: MAIN refers to the WTP triangulated values from wave 1 and wave 2. Drought restrictions, smart metering and traffic disruption were not included in the Wave 2 study.

It is important to note that we have not used the values in isolation in our main PR19 investment programme, as they are the result of the cost of the improvement versus the value placed on it by customers, which determines if the investment is cost beneficial. We have used these values alongside a range of other inputs in our investment optimiser tool to determine the most appropriate PR19 investment programme.

5.6 Acceptability of our plans

The results of our extensive PR19 business plan acceptability testing, following CCWater's expectations for acceptability research, among both household and business customers were positive. Figure 6 shows that 77% of the 375 household customers in our Cambridge region found our plan acceptable. The figure was 82% among the 78 business customers.

Figure 6 Informed household acceptability figures for our PR19 business plan, including the impact of inflation and Outcome Delivery Incentives



Source: PR19 Acceptability testing, July 2017.
Base: 375 household customers.

We also asked our HH and NHH customers, if they agreed that our proposed 2025 performance commitment targets in our PR19 business plans were sufficiently stretching. Customers were informed about our current targets and performance and also given comparative industry performance figures, where available.

The table below shows a reasonably high level of acceptability among HH customers with a more mixed view among NHH customers, in part driven by them not being able to comment, if they thought our targets were stretching enough.

Table 9 Acceptability figures for Performance Commitment targets

Performance commitment and 2025 target	% of customers agreeing that the level of stretch is acceptable	
	Household	Non-household
Reducing leakage by 15%	69%	31% (note that 38% said don't know)
Reducing how much water each person uses by 1 l/p/d	79%	83%
Increasing the area of land we protect to 690 hectares of wildlife, trees, plants and water sources	76%	36% (note that 36% said don't know)

5.7 Key overall conclusions

The key findings from our engagement work carried out to date are described in more detail in table 10. Our response to these findings is also sign-posted.

Table 10 Key findings from our customer engagement work

Area of focus	What customers and other stakeholders told us	Our plans to meet our customers' expectations needs and expectations
Level of metering	Increased metering, viewed as a necessary and important approach for us to carry out. • 88% of customers support metering as the fairest way to charge for water usage. • Support is lower, 73%, among unmeasured customers – however they stress the need for us to support them to make usage savings. • Consensus at workshop events that customers struggling with financial and/or health disabilities should be protected from bill shock. Awareness of our metering service proposition remains low among customers.	We propose to enhance our communications with customers around the benefits of metering and will target an increase in the number of customers who opt for a meter. See section 11 for our metering proposals.

Area of focus	What customers and other stakeholders told us	Our plans to meet our customers' expectations needs and expectations
Compulsory metering	No overwhelming evidence that customers want us to adopt a compulsory metering approach. • Only 38% of unmeasured customers support this (80% among unmeasured). • Real concerns voiced over affordability for customers struggling to pay their bills.	We do not propose to include metering policies which do not allow customers a choice regarding whether they pay for their water use by metered charge or not, except for customers who wish to use sprinklers or have high non-essential use such as a swimming pool. See section 11 for our metering proposals.
Smart metering	Overall positive level of support for smart meter devices in homes to help customers monitor and control their water usage. • 51% are 'for' smart meters. • 20% ranked it as their least preferred supply/demand-side option showing polarised view – some doubt its effectiveness as an approach.	We are exploring how to give our customers a smart meter in their homes to help them monitor and control how much water they use. See section 11 for our metering proposals.
Leakage	Reducing our leakage levels emerges as a clear and consistent priority among most customers. Strong and consistent view that we need to do more to reduce leakage from current levels. • 72% agreed this at the workshop. • 54% of household customers support us going above and beyond our current efforts, including investing in innovations to deliver the reduction. • Moral argument outweighs the economic cost of reducing leakage for 91% of household customers. • Not reducing leakage has the potential to create barriers to customers reducing their consumption and discourage the uptake of meters. Evidence that our current speed of response times to starting work to fix leaks are not meeting 43% of household customers' expectations.	We are proposing to reduce leakage by 15% by the end of 2024/25. We will explore the benefits of operating a live network to identify if further leakage reductions can be gained. See section 11 for our leakage proposals.

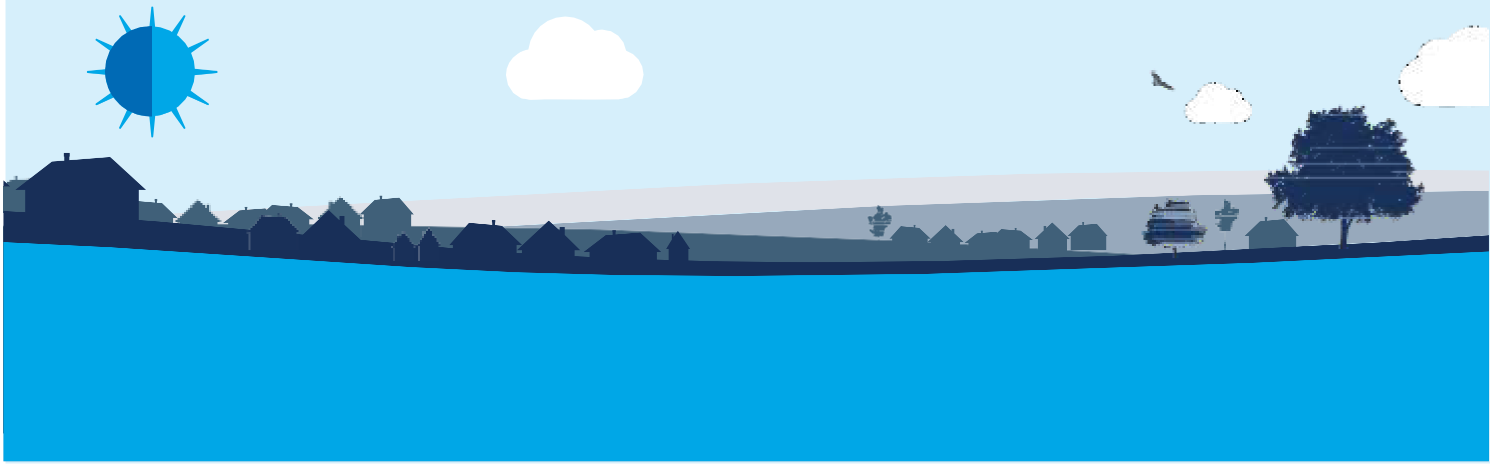
Area of focus	What customers and other stakeholders told us	Our plans to meet our customers' expectations needs and expectations
Levels of service	No evidence that customers want us to improve the level of service for temporary use bans – or TUBs (1 in 20 years) and non-essential use bans – or NEUBs (1 in 50 years). Current levels viewed as easy to cope with. • 37% of household customers supported more frequent bans vs 13% who wanted an improvement in service levels. • Figure who support more frequent bans rises to 47% among informed customers at the workshop. Caveat that many customers could not recall the last ban and the impact it had on them. • Business customers open to considering bespoke arrangements to reduce consumption on request. In terms of severe restrictions, all the qualitative evidence from customers and other industry studies is that having to draw water from stand pipes in the street (or any other severe restrictions of the supply) is not a scenario that customers are willing to accept. When tested, customers' willingness to pay valuations for avoiding severe drought restrictions were relatively low compared to leakage.	We do not propose to make any changes to our levels of service for TUBs or NEUBs. It is important that our plans provide the required level of resilience to ensure that severe supply restrictions never occur, now and in the future.
Water efficiency	Lack of knowledge around the 'big picture' reasons as to why they need to reduce their consumption are described as a barrier. 55% of customers agree they could do more to reduce their own usage – rising to 83% among informed customers at the workshop group. Low awareness of our current activities and only 51% agree that we are currently effective at helping them to save water. 48% are 'for' us offering services to help them reduce water consumption as an option.	We propose to reduce average PCC to 137l/p/d by the end of 2024/25. See section 11 for our water efficiency proposals, and section 11.1.3 for the way the target was derived

Area of focus	What customers and other stakeholders told us	Our plans to meet our customers' expectations needs and expectations
Environment and sustainability	High on customers' priority list but many customers appear disconnected from the natural environment. Environmental concerns only emerge when presented with the detail around an option – abstracting more groundwater received the lowest ratings because of environmental concerns when tested (25% said it was their least preferred demand or supply-side option of the seven presented, although at the workshop the negative focus was on drilling new boreholes, with re-activating older boreholes viewed as a positive). However, our engagement has picked up a step change in the level of importance customers are placing on protecting the environment since the start of 2018. A third of customers disagree that we are "environmentally focused" as a company. Strong level of interest in grey water harvesting systems, particularly when informed about our challenges and the quantity of clean water being flushed down the toilet.	We propose an ambitious demand management programme which will help reduce the amount of water we take out of the environment. See section 11 for more information about this. We will work closely with the Environment Agency to understand the impact of our abstractions on key water courses and water bodies and will identify mitigation measures or changes in our abstractions to address this. See section 7 for more information about the WINEP.

Further detail of customer views relating to key themes for our WRMP are included in **appendix E**.

Section 6:

Baseline demand for water



6. Baseline demand for water

Overview of baseline water demand forecast

The baseline demand forecast uses latest forecasts of population and properties in conjunction with the continuation of existing policies around metering, water efficiency and leakage management to derive a forecast of what demand would be if no changes to policy or strategy were implemented. It does not at this stage account for customer views on what they want us to do in these areas going forward and does not include any preferred demand management options. The baseline demand forecast is the starting point for assessing whether we have sufficient water to meet demand over the next 25 years.

The final demand forecast resulting from demand management interventions is described in section 11.

We have produced our final WRMP tables using updated data with the base year being 2017/18.

Baseline household demand

Household population is forecast to increase by around 79,000 and 44,000 new household properties are forecast to be built from the 2017/18 base year to the end of the planning period. This is an increase of 34% in household properties. Households are getting smaller with average occupancy falling from 2.4 to 2.3. A household micro-component model has been used to forecast average PCC. Average PCC is forecast to fall from 137l/p/d to 129l/p/d. (Figures based on 25 year forecast for NYAA, and as such different from tables)

Overall household dry year demand is forecast to rise by 8Ml/d by 2044/45 from the base year.

Baseline non-household demand

We have used a trend-based model to forecast non-household demand. The significant drop in demand seen since the economic downturn starting in 2008 has now stabilised. Demand is forecast to grow very slowly over the planning period.

Water efficiency in the baseline demand forecasts

Water efficiency savings are included within the baseline household consumption forecasts and are not broken out explicitly. The forecast assumes we will continue our current programme of water efficiency activities targeting behaviours, education and the uptake of water efficiency devices. Household consumption is therefore lower than would occur without this activity.

Our proposals for further water efficiency are described in section 11.

Baseline metering strategy

The baseline demand forecasts reflect the continuation of the following existing metering policies.

- All new properties are metered.
- Compulsory metering of customers with swimming pools or ponds greater than 10,000 litres capacity and of domestic customers wishing to use unattended garden watering devices.
- Compulsory metering of all non-household properties.
- The option for unmeasured household customers to opt for a meter free of charge with the opportunity to revert to unmeasured charges within the first two years of installation.

Meter penetration (excluding voids) will rise from the current level of around 70% to 88% by 2044/45.

Our proposals for further metering are described in the final demand forecast section.

Overview of baseline water demand forecast continued

Baseline leakage

The baseline forecasts include leakage continuing at the current performance commitment of 13.5Ml/d across the 25-year planning period.

Our proposals for leakage reduction are described in section 11.

6.1 Summary of the baseline demand forecast

The WRMP tables present only the dry year annual average (DYAA) and peak week scenarios but we build both of these up from the normal year demand forecast. We base the following commentary on the development of the normal year annual average (NYAA) forecast and we highlight how we converted this to DYAA and peak week.

We built the baseline demand forecast on latest forecasts of population and properties in conjunction with the continuation of existing policies around metering and leakage management. The baseline does not account for customer views on what they want us to do in these areas going forwards and does not include any preferred demand management options. The baseline demand forecast is our starting point for assessing whether we have sufficient water to meet demand over the next 25 years.

The final demand forecast resulting from our proposed interventions on leakage reduction, metering and water efficiency is described in section 11.

We have followed the Environment Agency's 'Final water resources planning guideline' (May 2017) and the following methodologies when developing our forecasts.

- UKWIR (2016) 'WRMP19 Methods – Household Consumption Forecasting'.
- UKWIR (2016) 'Population, household property and occupancy forecasting'.
- UKWIR (2006) 'Peak water demand forecasting methodology'.

The baseline demand forecast includes:

- baseline DYAA – climate change impacts, population growth, changes in household size, changes in property numbers and existing demand management policies; and
- baseline critical period – as above plus household consumption driven by sunny dry weather.

By 2044/45 distribution input in the baseline dry year scenario is forecast be 9Ml/d higher than the base year. Household water demand is forecast to rise by around 8Ml/d. Non-household consumption and minor components account for the remainder.

Total household population is forecast to rise by approximately 79,000 people by 2045 and it is forecast there will be an additional 44,000 households (excluding voids). Under our proposed metering strategies an additional 61,000 meters would be installed. Domestic meter penetration (excluding voids) would rise from the current level of 70% in the base year to around 88% by the end.

The household demand forecasts include assumed savings as a result of water efficiency activity. Our demand forecasts estimate that average PCC under normal year conditions will fall across the planning period from 137l/p/d in the base year to 129l/p/d.(Figures based on 25 year forecast for NYAA, and as such different from tables)

Under the dry year annual average (DYAA) scenario, we forecast a base year average household PCC of 141l/p/d reducing to 133l/p/d by 2044/45 in the baseline forecasts.

We forecast that non-household demand will remain relatively stable with slow growth over the plan period.

We included total leakage in the baseline demand forecast at the current performance commitment of 13.5Ml/d.

We converted normal year demand to dry year demand by applying a dry year factor of 4.5% to household demand. We derived this factor from a review of climatic factors and per household consumption. We applied the adjustment to both the measured and unmeasured household demand in a normal year.

We included the central estimate of the impact of climate change on demand in the household demand forecast and included the uncertainty associated with the impact of climate change on demand within headroom.

6.2 Total population and property projections

Population data is collected every ten years through the National Census by the Office for National Statistics (ONS). ONS provides detailed census results at a number of spatial scales from local or unitary authority (LAUA) down to small scale ‘output area’ (OA) level where the mean population per OA is 300. ONS also provides annual updates of population and biannual 25-year forecasts of future population growth at the medium spatial scale – that is, lower super output area (LSOA) where the mean population per LSOA is 1,500.

The ONS datasets also provide information on the number and type of households and the age distribution (demography) of the population. Data on the type of households is used to distinguish the population who live in non-household (‘institutional and communal’) properties and includes those living in medical, care, defence, prison service and education establishments, and those living on farms.

We have worked with the consultancy firm CACI to ensure its approach to population and property forecasting meets the standards specified in the current guidance. Trend-based and plan-based projections were produced following UKWIR guidelines and taking into account further availability of data from the company and relevant local government bodies.

We carried out the project in four main stages.

1) Area reconciliation

   We defined the geographical area covered by Cambridge Water in terms of individual unit postcodes. We confirmed that the Cambridge supply zone is comfortably within the boundary of Cambridgeshire and as such no postcodes that were found to straddle the boundary between Cambridge Water and neighbouring local authorities or water companies. Therefore, we treated all postcode data as wholly inside the area. Postcodes are smaller than Output Areas, and definition in terms of postcodes provides a detailed assessment of which Output Areas, and parts of Output Areas, lie within the boundary. The process used to split Output Areas across boundaries was used by CACI in the South Staffs region only.

2) Trend-based forecasts

   We produced forecasts based on ONS trend-based projections of population and Department for Communities and Local Government trend-based projections of households. These fulfil the requirements for trend-based population, household and billed household forecasts as specified in UKWIR's guidance.

3) Plan-based forecasts

   We produced forecasts based upon Local Authority plans and forecasts. These fulfil the requirements for plan-based population, household and billed household forecasts as specified in UKWIR's guidance (UKWIR 19 Methodology 'Population, Household Property and Occupancy forecasting 15/WR/02/8). Plan-based forecasts project higher levels of growth than trend-based-forecasts.

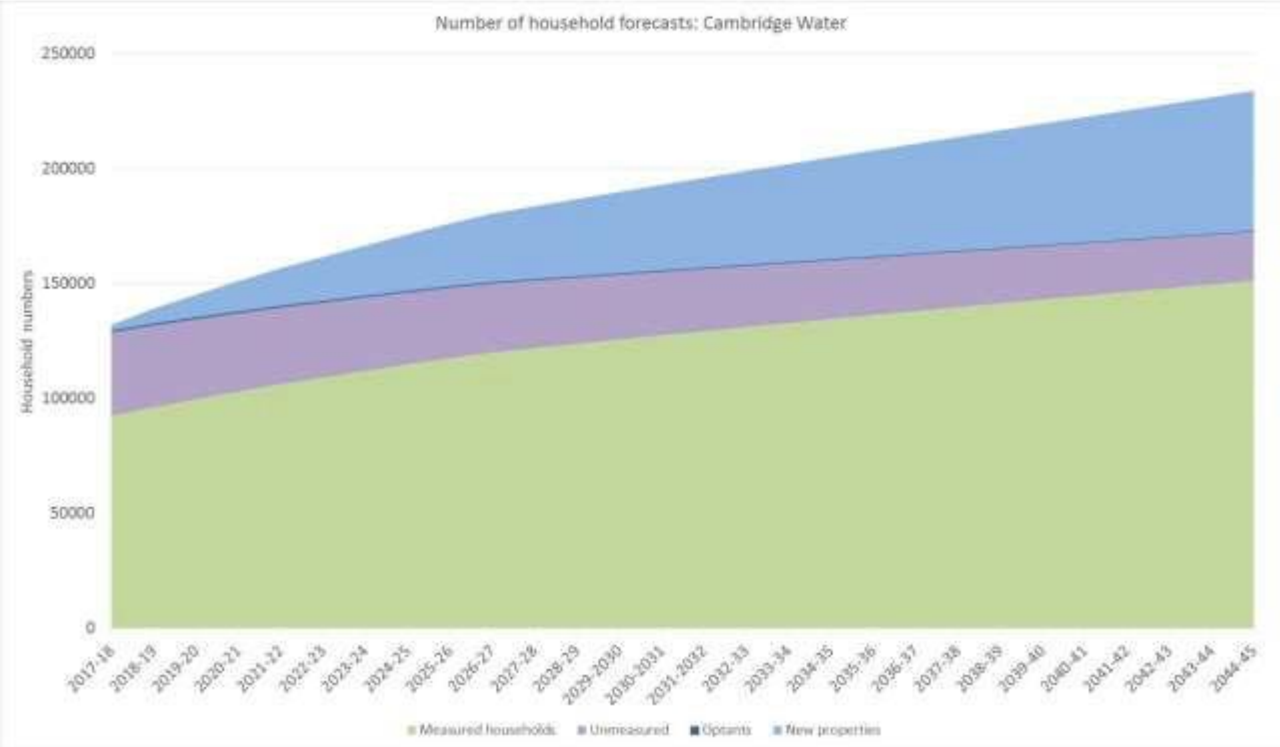
4) Reconciliation of plan-based forecasts with most recent billed household counts

   We adjusted the plan-based forecasts to agree with counts of billed households for mid-year of the base year 2017/18.

The detailed methodology for population forecasts is included in **appendix F**. This covers our Cambridge Water region and our South Staffs region as CACI carried out the work to cover both regions. We used base year household population and property figures taken from our customer database and consistent with those reported in the 2018 Annual Review to reconcile the base year data.

We forecast that household population will increase by around 79,000 people by 2045 and that approximately 44,000 new household properties (excluding voids) will be built. This is an increase of 34% in household properties.

Figure 7 Household numbers forecasts



6.2.1 Non-household population and properties

We assume growth in new non-household properties to be flat but steady over the planning period based on the average growth experienced in recent years plus an assumption round the emerging growth plans for the county. This includes where unmeasured non-household supplies are refurbished and supplies are split. Unmeasured non-household properties will continue to reduce because of commercial meter optant switchers and as a result of site developments. The overall reduction is forecast to reduce from 780 to just over 500 across the planning period.

Data on the type of households is used to distinguish the population who live in non-household ('institutional and communal') properties and includes those living in medical, care, defence, prison service and education establishments, and those living on farms. We call this 'communal population'. Communal population is deducted from total population to give household population.

6.3 Metered household property projections

The continuation of our existing metering policies will result in a significant increase in metered households by the end of the planning period.

Total measured households (excluding voids) will increase from 93,000 in 2017/18 to 151,000 by the end of the plan, an increase of 95,000. Unmeasured households (excluding voids) fall from 36,000 in 2017/18 to 21,000 with total household properties (excluding voids) being 172,000 by the year 2044/45. The number of unmeasured households falls as optional metering increases. Those households that remain unmetered will be the residual that have not been selectively metered, are on a shared supply and therefore difficult to meter or have not opted by choice.

Continuation of current metering policies will result in meter penetration increasing from around 70% of billed properties in 2017/18 to 88% by 2044/45 (excluding voids).

6.3.1 Free meter optants

We have reviewed the actual number of meter optants experienced over the past 12 years and the latest forecasts for the remaining years of the AMP6 period (2015 to2020) to guide the likely number of optants going forwards. While there has been variation in the number of optants installed year-on-year the averages for the five-year periods 2005/06 to 2009/10 and 2010/11 to 2014/15 showed a fall in optant take up. The past three years have been the lowest in the data set.

Table 11 Meter optant numbers

Period	Actual/latest forecast number of meter optants
2005/06	1,143 (Actual)
2006/07	1,456 (Actual)
2007/08	1,367 (Actual)
2008/09	1,411 (Actual)
2009/10	1,288 (Actual)
2010/11	1,197 (Actual)
2011/12	1,047 (Actual)
2012/13	1,246 (Actual)
2013/14	944 (Actual)
2014/15	1,056 (Actual)
2015/16	772 (Actual)
2016/17	770 (Actual)
2017/18	706 (Actual)
Average 2005/6 to 2009/10	1,333
Average 2010/11 to 2014/15	1,098
Average over whole data set	1,108

We have based our forecasts on the most recent data with it slowly reducing over the planning period to an average of approximately 400 a year for the final five years of the period. A decline in the uptake is expected to reflect the smaller unmeasured base from which customers will opt.

The total number of meters forecast to be installed under the free meter option policy over the 25-year period (2020/21 to 2044/45) of the plan is almost 14,000.

We will continue with our policy to meter sprinkler users. Experience to date shows that once customers become aware of this policy they commit to stop using a sprinkler or voluntarily opt for a meter. So we have included these within the optant figures.

6.3.2 Change of occupier metering

Change of occupier metering was not chosen as one of the demand-side options in the 2014 WRMP for our Cambridge region. We did introduce it in our South Staffs region, but it has since proven a difficult policy to administer and is not one supported by customers. We have not enforced it since 2013/14.

We have considered reintroducing the change of occupier policy as one of the demand management options in our list of feasible options.

6.4 Void properties and demolitions

Void properties are those that are unoccupied and therefore do not have an associated consumption. Supply pipe leakage allowances are applied to void properties. The forecast for void properties is based on an assumption that the total number of household and non-household void properties remains constant over the planning period. For households, the number of measured household voids increases and unmeasured household voids decreases reflecting the change in numbers of measured and unmeasured households.

Demolitions are assumed to be from unmeasured household and unmeasured non-household properties. As demolitions do not appear separately in the WRMP tables void properties are net of demolitions.

6.5 Household occupancy rates

The base year household occupancies are derived from the 2016 Household Water Use and Occupancy Survey carried out by Mott MacDonald on our behalf. The results from the occupancy survey are used to distribute the population between each of the customer groups so that the sum of them all is equal the total household population estimate prepared by CACI.

While there is an underlying trend for population to grow over the planning period overall household occupancies are forecast to reduce. Overall occupancy falls from 2.44 people/property in 2017/18 to 2.28 people/property in 2044/45.

The household occupancies of different customer groups have independent profiles that reflect their characteristics.

Table 12 Household occupancy rates

Customer group	2017/18 occupancy	2044/45 occupancy
All households	2.44	2.28
Unmeasured households	2.77	2.91
Measured households	2.31	2.19
Meter optant households	2.33	2.28
New supply households	2.44	2.16

The occupancy rate for unmeasured households is forecast to rise reflecting larger family units (growing families) who are unlikely to opt for metering and continues to rise towards the end of the plan period.

The average occupancy rate for all measured households is a mixture of lower occupancy optants and lower occupancy, small, newly-built houses and reflects the overall trend for lower occupancy by 2044/45.

New meter optant households have a lower occupancy than other customer groups. This is because optants are generally smaller households who use low volumes of water and therefore make a financial saving by opting for a meter and controlling their water bills through metering.

The average occupancy of a meter optant property is forecast to fall over the planning period.

The average occupancy of a new supply property is forecast to reduce over the planning period as the demand for more new starter homes increases.

6.6 Baseline household demand

The current water resources planning guideline identifies the need for water companies to use methods for supply and demand analysis that are appropriate to the level of planning concern in their water resources zones (WRZs). The problem characterisation for our single WRZ identified a ‘moderate’ rating. We produced the baseline household consumption forecast using micro-component modelling and forecasting, which is suitable for a zone with a moderate level of water resource planning concern. Consultancy firm Artesia developed a new micro-component forecast model to inform this WRMP.

The model quantifies the water used for specific activities (for example, showering, bathing, toilet flushing, dishwashing and garden watering) by combining values for:

- ownership (O);
- volume per use (V); and
- frequency of use (F).

The micro-component model is combined with property, population and occupancy forecasts in a unique way in that the micro-components vary with occupancy. Certain components have a valid relationship with occupancy, and others do not. We used this method to calculate base year OVF per household consumption (PHC) values, which we then calibrated to the WRZ normal year PHC values.

We established forecasts of the property, population and occupancy by household segment through a model to allow for various assumptions and mathematical calculations as the meter penetration increases. Each household segment has a different base year OVF table/calculation; these are based on both measured differences between measured and unmeasured households, as well as assumptions made about devices within new properties and optant properties.

We then forecast micro-components using a combination of longitudinal micro-component data and future market transformation programme derived micro-component values. We applied these trends to the normal year micro-component values. We also added an additional occupancy specific trend, to ensure that we capture the varying occupancy within each of the household segments.

We used data from national studies to update previous micro-component estimates – from surveys, the Market Transformation (MTP) scenarios and other, older sources – and to consider upper and lower consumption forecasts.

We analysed and investigated relevant data, existing survey results, and consumption data from metered customer billing records, along with data collected in the 2016 UKWIR behaviour integration study, to generate base year micro-component estimates.

We segmented household customers based on meter status (measured/unmeasured), with sub-divisions for meter type (existing metered, free meter optants, new property). We used data to determine how to account for differences in consumption between segments and also the effect of meter switching. We made normal year and dry year adjustments to the base year consumption and the consumption forecast.

We have calculated climate change impacts on consumption in accordance with UKWIR 13/CL/04/12 'Impact of Climate Change on water demand'. Our model includes functionality to output forecasts with and without climate change factors. We added the additional demand from climate change to the external use micro-component only. We included the small additional volume attributed to climate change in our baseline forecasts.

We used a scenario approach to modelling uncertainty, to reflect the various uncertainties in consumption forecasts.

We have followed best practice guidelines for household demand forecasting in deriving the baseline household demand forecast.

We provided the following data to Artesia so they could develop the model.

- population forecasts;
- property forecasts;
- household survey data regarding ownership of water using appliances, frequency of use and household occupancy data taken from surveys carried out in 2014 and 2016; and
- reported annual return data for reconciliation with the base year.

We highlight the key outputs from the unmeasured and measured micro-component analysis in the following tables.

We provide full details of the micro-component modelling in **appendix G**.

The results of the micro-component forecast in terms of PHC and PCC in the following tables are based on normal year annual average (NYAA). Average household PCC (mean of all household types) reduces from 137l/p/d in the base year to 129l/p/d by 2044/45.

Table 13 PCC forecasts (base year NYAA)

Household group	Base year NYAA		
	Occupancy	PHC	PCC
Unmeasured household	2.77	466l/p/d	168l/p/d
Existing metered household	2.31	283l/p/d	123l/p/d
New build metered household	2.44	268l/p/d	110l/p/d
Optant metered household	2.33	267l/p/d	115l/p/d
Total measured household	2.31	282l/p/d	122l/p/d
Total household	2.44	334l/p/d	137l/p/d

Table 14 PCC forecasts (2044/45 NYAA)

Household group	2044/45 NYAA		
	Occupancy	PHC	PCC
Unmeasured household	2.91	466l/p/d	160l/p/d
Existing metered household	2.19	273l/p/d	124l/p/d
New build metered household	2.16	262l/p/d	121l/p/d
Optant metered household	2.28	274l/p/d	120l/p/d
Total measured household	2.19	270l/p/d	123l/p/d
Total household	2.28	294l/p/d	129l/p/d

We included water efficiency savings within the household consumption forecasts and did not break them out explicitly. The forecast assumes we will continue our current programme of water efficiency activities targeting behaviours, education and the uptake of water efficiency devices. We assume these activities suppress household consumption, maintaining it at a level that is lower than would occur without this activity. Historic reducing trends in household consumption are maintained in the baseline forecast. We also carried out sensitivity testing using alternative future scenarios and described this in the Artesia report in **appendix G**. We describe our proposals for additional water efficiency activity in section 11.

Data included in the sector's new Discover Water website (www.discoverwater.co.uk) ranked the average PCC for all water companies in England and Wales. This highlighted that there is quite a wide variation in PCC which might relate to:

- demographics;
- level of meter penetration;
- climate; and
- method calculation.

This data demonstrated that the PCC for Cambridge Water was below average for the sector in 2015/16 and 2016/17.

Government expectations are for PCC to be reducing over time and our baseline demand forecasts demonstrate that we consider this will be the case. We are already sector leaders on this comparative performance measure and expect to continue to make further improvements.

The overall dry year household demand (water delivered) shows an increase of 8Ml/d by the end of the planning period. Dry year unmeasured household demand falls by 7Ml/d. This reflects our metering policies, future changes to water using appliances, their associated water use and changing household densities in the micro-component forecasts. In comparison, dry year measured household demand rises over the planning period by

15Ml/d reflecting the increasing number of metered households because of switching and new supplies.

6.7 Baseline non-household demand

We commissioned Artesia to carry out modelling to derive non-household consumption forecasts to the year 2045. Forecasting non-household demand with confidence beyond a five-year period is difficult because of a range of significant uncertainties. A large proportion of total non-household consumption is driven by a small number of individual non-households, and a number of larger consumers have closed, to be replaced by housing. Generally non household consumption increases is related to an increase in property numbers.

We analysed non-household consumption using a 'trend-based' approach at a high level, and subsequently, at individual sector level and consumption bands. We also considered large users separately.

We tested consumption figures against a set of economic factors including, but not limited to:

- unemployment;
- Gross Domestic Product (GDP); and
- population.

Some of these factors have shown a close relationship with a number of industries and/or consumption bands.

Results indicate a general increase in consumption over the next 25-year period. Further analysis by consumption band has shown that differences between groups tend to be masked when producing a high level forecast. Performance is improved when bands are evaluated independently.

We produced a set of forecasts based on high-level trend and band analysis. With a variety of scenarios, it is clear that some may have different probabilities of occurrence, and that all forecasts are not equally probable. We used the most probable scenarios to calculate a mean forecast for use in the plan.

We include full details of the approach to non-household modelling in **appendix I**.

We did not apply an allowance for a dry year to non-household demand as we assumed dry year conditions do not significantly affect commercial water use. But we included an allowance in the forecasts for supply pipe leakage.

Market reforms including retail marketing commenced in 2017. This allows non-household customers to select their front-end customer service provider (the retailer). There is no opportunity to change water supplier and therefore there is no change in demand.

However, one of the regulator Ofwat's assumptions is that retail competition will drive water efficiency as retailers strive to offer differentiating services. At this stage in the development of the new market, there is little information available on which to base any assumed water efficiency savings. We have used the range of scenarios produced for the non-household consumption forecast to provide the uncertainty estimate we include in headroom. We consider that this range of uncertainty is sufficient to cover the potential savings arising from retailer water efficiency activity.

6.8 Baseline leakage forecast

For the baseline demand forecast we have included total leakage across the period at the 2019/20 performance commitment of 13.5Ml/d. We have taken a different approach to leakage target setting for this WRMP and our proposals for leakage reduction are described within the section on our final demand forecast. Our leakage forecasts included in the WRMP tables are based on the approach to determining leakage which we have used for a number of years.

Recently, water companies have been working together, co-ordinated by Water UK, to improve the consistency of reporting of definitions of key measures of performance including leakage, so that performance can be compared between companies more easily. This work is supported by Ofwat, the Environment Agency, Natural Resources Wales and the Consumer Council for Water.

Companies need to make changes to their current reporting to align with the new, more consistent, reporting definitions. For some of these changes it will take some time to have robust data. Each company will be making different changes to their current reporting to come into line with the more consistent definition and so the impact will be different for each company.

We have begun a programme of transition to reporting leakage using the new consistent methodology, but do not have all the necessary data at the level of robustness required to have full confidence in the outputs at this stage.

We will continue to create 'shadow' data based upon the new methodology for the reminder of AMP6. We will assure the industry-wide approach during this period ahead of formal adoption at the start of AMP7. The change in reporting methodology for leakage is purely a change in reporting; it does not affect the actual amount of water lost through leakage. As such, it will rebalance the components of the base year water balance and the demand forecasts going forwards, but will have no impact on our future plans for balancing the supply and demand for water.

We describe our proposals for leakage reduction within the final demand section of this WRMP.

6.9 Minor components of water use

Minor components of water use include:

- distribution system operational use (for example, mains flushing and water quality);
- water taken legally but unbilled (for example, fire stations and standpipe use plus MUR adjustment); and
- water taken illegally (for example, water theft and illegal connections).

We base our estimate of water use for these categories on company-specific data for the base year and assume it will remain constant over the planning period and for all demand scenarios.

6.10 Dry year demand

We convert normal year demand to dry year demand by applying a dry year factor to household demand. This factor was derived as part of the Artesia modelling of household demand and is described in **appendix G**.

We applied the resulting dry year factor (4.5%) to the normal year household consumption forecast uplifting it to the dry year scenario. We applied the adjustment to both the measured and unmeasured household demand in a normal year.

The impact of the dry year adjustment on the final planning normal year demand is shown in the table below. The figures in the table exclude supply pipe leakage.

Table 15 Impact of the dry year adjustment on normal year demand

Household group	2020/21	2044/45
Unmeasured household NYAA consumption	15.93Ml/d	9.94Ml/d
Unmeasured household DYAA consumption	16.46Ml/d	10.26Ml/d
Measured household NYAA consumption	29.00Ml/d	40.83Ml/d
Measured household DYAA consumption	29.95Ml/d	42.17Ml/d
Total DYAA adjustment	1.48Ml/d	1.66Ml/d

We consider that all other elements of demand are unaffected by the characteristics of a typical dry year.

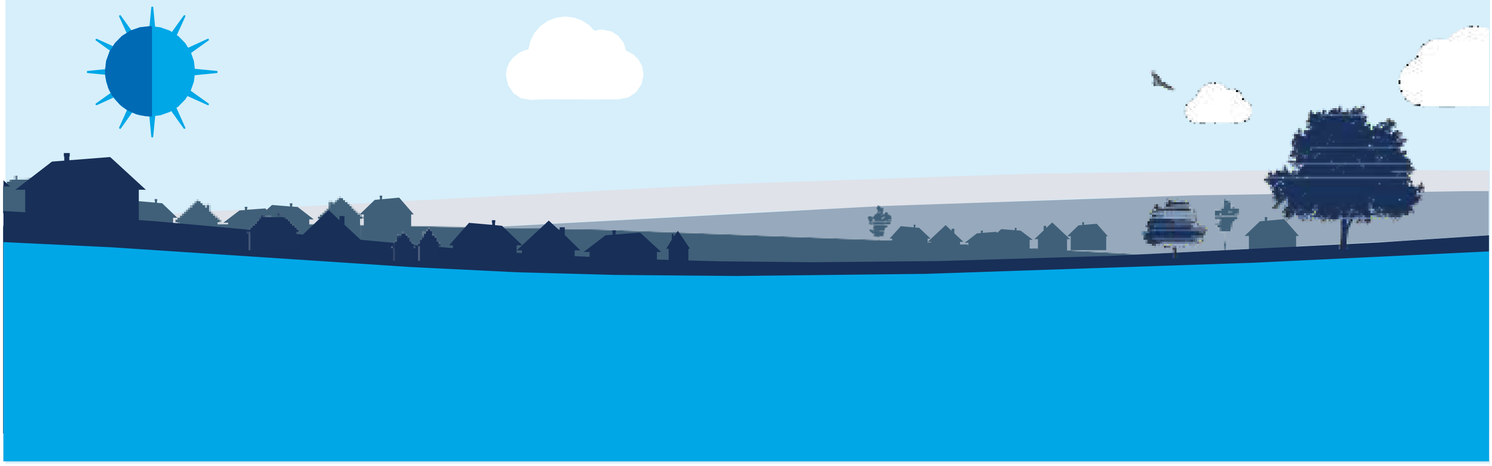
6.11 Critical period (peak week) demand

Our critical period is demand in a peak week scenario. Peak week historically occurs in June or early July driven by household demand in conjunction with warm, sunny, dry periods. Summer weather does not tend to drive changes in leakage or non-household demand. We effectively respond to more frequent shorter periods of high demand (peak hour and peak day) through network management and strategic storage supplies.

The Artesia per household micro-component model produces a peak week forecast. The derivation of the factor for peak week is described in **appendix G**. The peak week factor is 22.4%, which is applied to the components of use which are affected by summer weather. This ratio is applied across the period to convert normal year household demand to peak week household demand. This is an alternative forecasting methodology recognised by UKWIR 2006.

Section 7:

Baseline supply forecast



7. Baseline supply forecast

Summary of baseline supply forecast

Reductions to deployable output

There has been a significant reduction in the assessed DYAA DO of our sources since the last WRMP in 2014.

A key driver in this change is the need to address actual environmental impacts or the risk of causing deterioration to the environment. Under the WFD changes in abstraction volume, even when within authorised licence limits, are not permitted if there is deemed to be a risk of deterioration to the environment.

In some cases, the level of certainty around these risks is unclear and therefore a period of investigation is required to determine whether DO should be reduced or not. In our case, the Environment Agency has advised they view the likelihood of the risk to be high and therefore the reductions should be considered as a reduction to our baseline DO assessment. This is the approach usually applied for confirmed or likely sustainability changes where the impacts have been subject to investigations, or they are in progress. Not to include this element as a likely reduction to DO would present an unacceptable risk to the environment and to our water supplies. We need to plan now for the potential impact and continue to work with the Environment Agency to better understand the risks and implement solutions.

Baseline DO has decreased from 113.36Ml/d in the 2014 plan to 99.12Ml/d for DYAA conditions, and from 136.28Ml/d to 118.31Ml/d for peak week conditions.

The reductions in average DO arise from the following.

- 5Ml/d of sustainability changes from AMP6 NEP.
- 3Ml/d of expected licence reduction on time-limited licences because of deterioration risks.
- 3Ml/d of operational constraints.
- 3Ml/d of reductions because of source works being out of supply for water quality reasons.

Where there are operational restrictions and treatment requirements where DO could be increased without environmental impact we have included these as options within our feasible list of options for balancing supply and demand.

Drought resilience

We have evaluated our resilience to drought based on our current resources in the base year. We have considered drought scenarios with a severity up to a 1 in 500-year event. There is marginal difference between historic design droughts and more severe modelled events, and there remains a surplus for the base year when drought measures are applied.

We have also tested our drought resilience over the whole planning period with our forecast changes in demand and supply. Our analysis shows our supplies are resilient for a range of droughts across the 25 year planning period – including those more severe, or less frequent than our design droughts. Accordingly, we are not putting forward any new drought management options in addition to those currently in our existing drought plan.

Summary of baseline supply forecast continued

We will review this assessment when we have certainty on the impact of no deterioration, and this may require us to develop additional drought measures, such as drought permits to abstract licensed volumes no longer available following no deterioration precautionary limits. These would include any local mitigation required to ensure we can abstract in a sustainable way that would not cause permanent deterioration.

Climate change impacts on supply

The assessment of climate change impact has been reviewed since the previous WRMP, to align with the current Environment Agency guidance and latest supplementary information. Our assessment of climate change impacts remains at a vulnerability of low. The impact of climate change on supplies following the review remains approximately 1Ml/d by 2045.

Treatment works operational use (TWOU)

We have made improvements to the data collected for this component since our last plan. A total TWOU allowance of 0.16Ml/d has been included in the supply forecast, which is a marginal increase from 0.11Ml/d in the previous plan.

Planning allowance for outage

The DYAA allowance in our plan for outage has decreased from 8.48Ml/d in WRMP14 to 4.8 Ml/d in our final WRMP.

We have adopted the 70th percentile for this and we describe our updated outage modelling in **appendix L**.

Our supply forecast is built up of a number of elements to determine the supplies available for each planning scenario for each year in the planning period. To determine total available supplies available to meet forecast demand, the water available for use (WAFU) is calculated by deducting a planning allowance for outage from DO and taking account of bulk imports and exports, climate change impacts on supply, and losses at treatment works. Each of these components is explained in the following sections.

7.1 Overview of the Cambridge supply area

7.1.1 The supply area

We are responsible for the public water supply to more than 330,000 people every day in one of the fastest growing areas of south-east England. Our area of supply stretches from Ramsey in the north and to Royston and Haverhill in the south and from Gamlingay in the west to the east of Cambridge city. The area of supply is made up of seven water supply zones and constitutes a single water resources zone, and is shown in the figure below.

Figure 8 Cambridge area of supply

7.1.2 Planning area – the water resource zone

For WRMP14, we agreed with the Environment Agency that the Cambridge WRZ represents a single resource zone, following assessment using the water resources zone integrity guidance.

The definition of a single water resources zone (WRZ) is a supply area where the risk of supply failure to customers is determined as equal across the zone, subject to a de minimus rule – that is, the majority of customers experience the same level of service.

We have reviewed the WRMP14 assessment of water resources zone integrity, using the guidance[5] provided by the Environment Agency, which confirms that although minor changes have been made to some elements of the zone, we continue to operate as a single WRZ. The full assessment is in **appendix J**, which, in accordance with Defra instructions and the Security and Emergency Measures Directive Advice Notes and Guidance, we have not made available to the public. This report is only available to the Environment Agency.

[5] 'Water resource zone integrity – Supporting document for the Water Resource Management Plan Guidelines', Environment Agency, July 2016.

7.1.3 Sources of supply

Our water resources are supplied wholly by groundwater, mainly abstracted from the chalk aquifer in the southern and eastern part of the supply area, with a small percentage of greensand aquifer sources. All these sources are linked by an integrated supply and transfer system. Less than 1% of supplies are currently derived from bulk imports from neighbouring companies.

7.1.4 Levels of service

We plan for a published level of service based on the frequency of droughts previously experienced, and the likelihood of water use restrictions becoming necessary.

Our level of service is based on droughts observed in the historic record, specifically those where we required additional measures to manage supplies and demands, and the likelihood of restrictions being necessary. We plan to meet unrestricted customer demands in a repeat of the conditions experienced during the 1991/92 drought, which we equate to a frequency of restrictions of once every 20 years.

The calculated DO for this level of service models the available yields in drought conditions to ensure this level of service can be met with the available resource.

We are also required to demonstrate that we can achieve the included reference levels of service from the water resources planning guideline. The levels of service to be assessed against DO are shown in the following table.

Table 16 Levels of service assessed against deployable output

Restriction	Company stated levels of service	Reference level of service
Temporary use bans (formerly hosepipe ban)	1 in 20 years	1 in 10 years
Non-essential use (Ordinary Drought Order)	1 in 50 years	1 in 40 years
Rota cuts or standpipes	1 in 100 years or less frequently	Not applicable

Table 17 Annual average percentage risk of restrictions

Restriction	Annual % risk 2020/25	Annual % risk 2025/30	Annual % risk 2030/35	Annual % risk 2035/40	Annual % risk 2044/45
Temporary use bans (formerly hosepipe bans)	5%	5%	5%	5%	5%
Non-essential use bans (Ordinary Drought Order)	2%	2%	2%	2%	2%
Rota cuts or standpipes	< 1%	< 1%	< 1%	< 1%	< 1%

The annual average risks shown in the table above are based on the following assumptions:

- We are not proposing any changes to our current levels of service in our PR19 business plan.
- We do not change our levels of service between now and 2045.
- We continue to meet, or exceed, these levels of service with a view to moving towards 1 in 200 drought resilience.
- Should any of these risks change during the 25-year planning horizon – for example, as a result of a changing climate – we will bring in timely demand- or supply-side options that mean that we can still maintain our levels of service for customers
- We are committed to asking our customers and wider stakeholders on their views of whether we should formally change our stated levels of service from 1 in 100 to 1 in 200 before we publish our 2024 plans.

To derive the annual risks shown above we converted our levels of service from a 1 in X return period to a percentage risk. We did this for TUBs, ordinary and emergency drought orders. For example, where we have a < 1 in 100 level of service for emergency drought orders, this converts to an annual probability of < 1% (1/100). We calculated levels of service and the annual probability by using our historic design drought. Our design drought is based on historically observed data, but we have also modelled more extreme/severe events as described in section 7.4 below.

We note that the timescales for the next round of drought plans and WRMPs mean that the most likely way forwards is:

i. We publish final WRMP19 documents late in 2019.
ii. We start feasibility work on re-commissioning SIPW, CRPW2 and KIPW2 early in AMP7 with an intention to commission them by 2024/25, or sooner if achievable.
iii. Once these sources are commissioned we expect it will trigger a ‘material change’ review of the drought plan we published in 2018 (but began pre-consultation on in 2016).

iv. Our next round of WRMPs and drought plans will clearly set out our drought resilience levels and stated levels of service in relation to both the 1 in 100 and 1 in 200 standards in a scenario which includes SIPW, CRPW2 and KIPW2 as part of the baseline instead of being purely drought options.

7.2 Deployable output

Available source output is limited by abstraction licences granted by the Environment Agency and constraints other than the licence which restrict outputs for a given planning scenario. Further understanding the constraints on delivering this water into supply provides a total DO for our resources zone under observed conditions.

We have reviewed our existing licences to determine if they are, or what proportion of volume, is sustainable with respect to WFD deterioration, and made adjustments as necessary as reductions to overall DO.

7.2.1 Deployable output assessment method

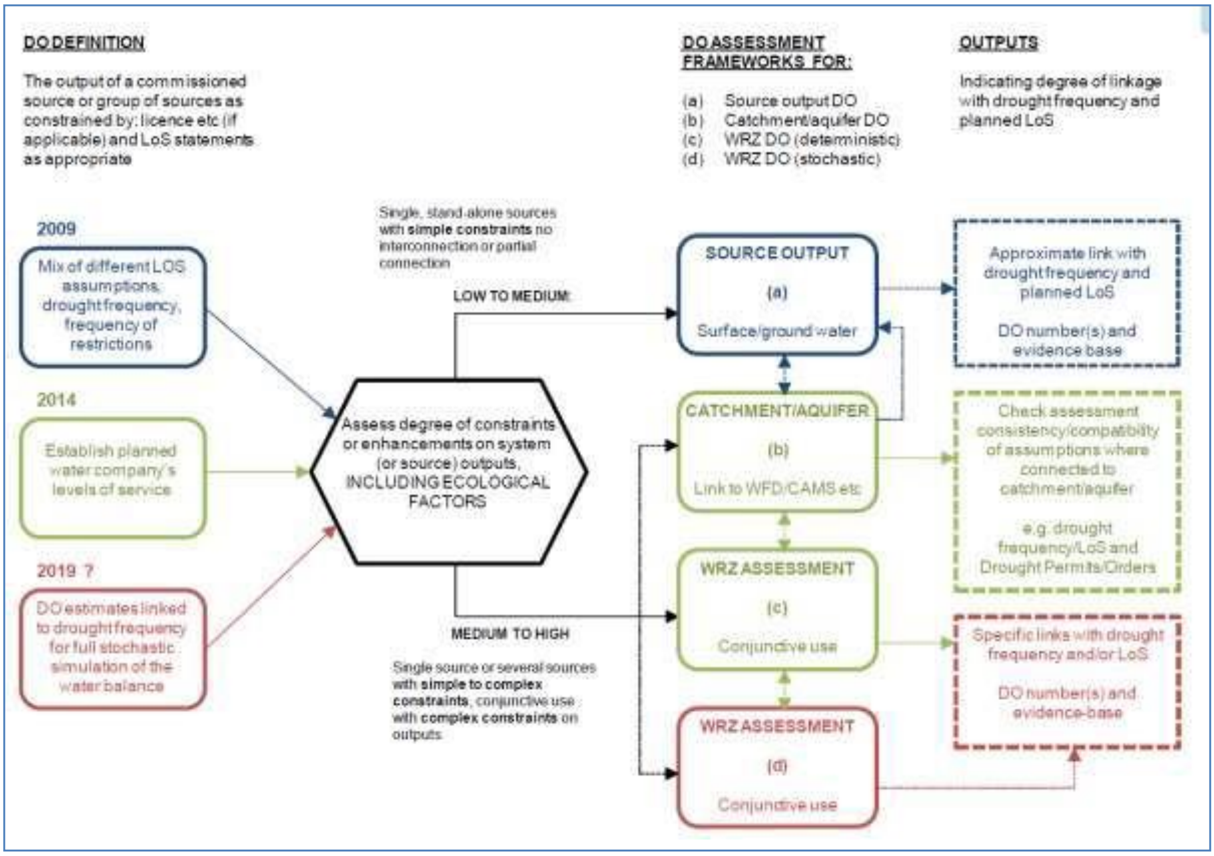
The DO total used in the plan is an aggregate to the WRZ level of the DOs derived from our source reliable output (SRO) study, which has been carried out in accordance with best practice techniques in the UKWIR handbook of source yield methodologies[6]. First carried out in 1997 and periodically updated to reflect changes to sources, the SROs for all sources were updated during 2012, and have been comprehensively reviewed again during 2017 with reference to the Environment Agency's 'Water resources planning tools', WR27[7].

The SRO studies determine the quantity of water available from each of our sources to satisfy average and peak demands, under drought conditions. The DO from our sources has been assessed on a source output basis with reference to the appropriate UKWIR guidelines, and is proportionate to the nature of our supply system and the risk to both supplies and the environment.

[6] 14/WR/27/7, 'Handbook of Source Yield Methodologies' (UKWIR, 2014).

[7] 'Water Resources Planning Tools 2012: Summary Report', 12/WR/27/6, UKWIR 2012.

Figure 9 UKWIR framework for groundwater source assessment



A source output approach assesses the maximum maintained output expected under drought conditions using water level and source output assessment to determine hydrological yield. The data used for this includes water levels and outputs recorded during the 1991/92, 1995/96 and 2005/06 dry periods. Our abstraction sources are standalone sources with limited connectivity and where there are multiple boreholes are considered as a single source for assessment purposes. In some cases, the output will be constrained by factors other than the hydrological yield, such as:

- licence conditions, or other regulatory constraints – for example, the abstraction incentive mechanism (AIM). The AIM is an Ofwat mechanism to incentivise companies to reduce abstractions at environmentally sensitive sites, where no other mitigation is yet in place[8];
- physical limitations, such as aquifer properties;
- operational constraints, such as transfer ability, pumping plant, etc; and
- water quality, or treatment constraints.

[8] 'Guidelines on the abstraction incentive mechanism', Ofwat, February 2016, www.ofwat.giov.uk/publications.

We have carried out a comprehensive review of reliable source capability and constraints which has resulted in a reduction in DO.

7.2.2 Baseline deployable output assessment results

The WRMP19 DO is presented in the tables below, for DYAA conditions and for peak demand conditions, and compared with the DO for WRMP14.

The change in net DO for average demand conditions (dry year) since the previous plan is in total 14Ml/d. The key components of this are:

- 5.6Ml/d of confirmed sustainability changes from AMP6 NEP, now incorporated into licence conditions (from 2020);
- 3.1Ml/d of expected licence reduction on time-limited licences, as agreed with the Environment Agency to protect against deterioration under the WFD;
- 23.0Ml/d of reductions to DO because of source works being out of supply for water quality reasons (KIPW2 and CRPW2); and
- 2.6Ml/d of further minor yield reassessments.

DOs for each of the individual sources within our WRZ are also listed in the Environmental Agency data table, WRP1a BL licences.

Where there are treatment requirements (KIPW2 and CRPW2) where DO could be increased without environmental impact we have included these options within our feasible list of options for balancing supply and demand.

Table 18 Deployable output – dry year annual average conditions

Source name	Deployable output average daily demand		
	WRMP14 Ml/d	WRMP19 Ml/d	Constraint
APPW	1.00	1.00	Annual licences
BAPW	9.09	7.17	Annual licence/compensation flow licence conditions
BRPW	11.34	8.25	Annual licence (from 2018)
CRPW2	1.99	0.00	Out of service – requires treatment plant
DUPW	3.60	3.60	BH performance
DAPW	4.56	4.56	Annual licence
DGPW	3.41	2.88	DAPWL/drawdown
EUPW	8.00	8.00	Annual licence
FD12PW	3.27	3.27	Annual licence
FD36PW	12.30	12.30	DAPWL
GCPW	1.06	1.06	DAPWL peak yield (as licence)

Source name	Deployable output average daily demand		
	WRMP14 Ml/d	WRMP19 Ml/d	Constraint
GWPW	5.67	5.67	Annual licence
HEPW	1.13	1.13	Annual licence
HGPW	5.77	5.77	Annual licence
HOPW2	2.30	1.80	WFD 'no deterioration' cap
KIPW2	1.00	0.00	Licence HOF conditions
LOPW	3.41	3.40	Annual licence
MEPW	7.94	7.20	Annual licence
MGPW2	1.50	1.20	Pump/network configuration
RIPW	2.20	1.00	Licence HOF conditions
SAPW	1.49	1.49	Annual licence
SIPW	0.00	0.00	Out of service – requires treatment plant
WEPW	11.39	10.60	Network pressure
WCPW	2.92	2.92	DAPWL
Total	**113**	**99**	

Table 19 Deployable output – critical period (peak week)

Source name	Deployable output critical period peak week		
	WRMP14 Ml/d	WRMP19 Ml/d	Constraint
APPW	4.44	4.00	Pump rating
BAPW	9.09	7.17	Annual licence compensation supply condition
BRPW	15.00	15.00	Daily licence
CRPW2	1.99	0.00	Out of service – requires treatment plant
DUPW	3.63	3.63	BH performance
DAPW	5.68	4.56	Daily licence
FD12PW	3.27	3.27	Daily licence
FD36PW	12.70	12.70	Peak yield
FOPW	5.40	5.40	Daily licence
FUPW	1.80	1.25	Pump capacity
GCPW	1.06	1.06	DAPWL peak yield

Source name	Deployable output critical period peak week		
	WRMP14 Ml/d	WRMP19 Ml/d	Constraint
GWPW	8.65	9.0	Pump capacity
HEPW	2.13	1.20	Pump cut out
HGPW	6.82	6.92	Daily licence
HOPW2	2.88	1.80	WFD 'no deterioration' cap
KIPW2	1.18	0.00	Out of service – requires treatment plant
LIPW	2.73	0.00	Licence HOF conditions
LOPW	4.27	3.40	Daily licence
MEPW	9.15	7.20	DAPWL
MGPW2	1.50	1.20	Pump configuration/network
RIPW	2.75	1.00	Licence HOF conditions
SAPW	2.16	2.16	Licence
SIPW	0.00	0.00	Out of service – requires treatment plant
WEPW	11.30	10.60	Network pressure
WCPW	2.92	2.92	DAPWL
Total	**137**	**118**	

7.3 Time-limited licences

Included in the assessment of DO above are a number of licences that have been time limited by the Environment Agency, for future review. These have been considered for any risk that the time limits may pose to the availability of supplies. The details of this are presented below.

Table 20 Time-limited licences

Licence	Expiry	Details	Risk
BRPW	March 2018	Reduction in temporary element of licence comprising 7.34Ml/d annual average and 10Ml/d at daily peak	The time-limited elements have been renewed until 31 March 2024, following agreement with the Environment Agency, at the reduced DYAA volumes stated in our DO assessment, and aggregated with EUPW

Licence	Expiry	Details	Risk
EUPW	March 2018	Reduction in temporary element of licence comprising 2Ml/d annual average and 2.5Ml/d at daily peak	The time-limited elements have been renewed until 31 March 2024, following agreement with the Environment Agency, at the reduced DYAA volumes stated in our DO assessment, and aggregated with BRPW
FOPW	March 2027	Increase in licence of 5.49Ml/d at annual average	We would need to submit a written environmental assessment of the impact of abstracting at the higher volumes and require written approval to abstraction taking place from the Environment Agency. Current rates of abstraction can continue, and have been agreed with the Environment Agency as sustainable following completed NEP investigations.

7.4 Links with the drought plan

The DO presented in this plan is for source yields under dry conditions, assessed in accordance with UKWIR practice for groundwater sources and is constrained by various factors, including licence, treatment constraints, etc. Our design drought is based on actual data of the worst groundwater conditions observed in the historical groundwater record. Supply- and demand-side drought measures are not included in the DO, which is modelled as reliable under design drought conditions for which pump test data is available. This in most cases includes at least the 1991/92 drought sequence, the only occasion when we had to impose a temporary use ban (TUB), and all sources have been evaluated for worst case historical yield conditions. More than half of our available resource is constrained by licence and not hydrological yield, and is therefore unaffected in drought conditions. See section 7.2 for a full explanation of how we calculated DO.

7.4.1 Measures included within DO analysis for WRMP

The DO assessment does not include supply-side drought and demand-side drought measures, which is modelled as reliable under design drought conditions. Drought measures included in the drought plan will have the effect of increasing supplies and reducing demands as they are employed and can offset any reductions to yields beyond the design conditions.

Drought measures included in the drought plan are detailed in the following table.

Table 21 Drought measures included within the WRMP and drought plan

Drought measure	Supply-/ demand-side	Comments	Yield Ml/d	Savings Ml/d
Extra promotion of water efficiency	Demand	Extra promotion of water efficiency, increased publicity		0
Appeals for restraint	Demand	Further enhanced publicity campaign		3
Increased leakage detection and repair	Demand	Yield dependant on conditions and leakage levels		1
Temporary use (hosepipe) ban	Demand	Yield estimated from UKWIR studies and previous historical experience		5
Re-commission FD12PW	Supply	Yield dependent upon conditions and operational readiness	3.27	–
Re-commission CRPW2	Supply	Yield dependent upon conditions and operational readiness	1.99 (1.4)*	–
Re-commission KIPW2	Supply	Yield dependent upon conditions and operational readiness	1.0 (0.9)*	–
Re-commission SIPW	Supply	Yield based on licence	1.6**	–
Non-essential use ban	Demand	Yield estimated from UKWIR studies	–	2
Rota cuts	Demand	Civil emergency measure only	n/a	n/a

*These are the yields if the licences were capped to ensure 'no deterioration' under the WFD, and may be applicable for a future revision of the drought plan, following appropriate investigation. Drought permits may be required if this is the case, to obtain the higher yield. However, the difference in yield is immaterial to the overall balance of supplies required for the design drought.

** The reliability of this yield for the SIPW source in drought conditions has been raised by the Environment Agency in the consultation for our drought plan. We intend to carry out modelling and if necessary pump testing to determine what the yield would be for the next drought plan.

The balance of available resources, with savings and additional yields is more than sufficient to counter the expected yields at sources under more severe drought conditions, supporting our chosen levels of service.

We have no drought permits in our current drought plan and only an Ordinary Drought Order for a non-essential use ban (NEUB), which would be implemented in a three dry winter drought sequence. This is not included in the WRMP DO assessments, and therefore the baseline supply/demand balance.

7.4.2 Additional measures within drought plan

There are no additional measures within the drought plan.

7.4.3 Determination of more severe droughts

The impact of more severe droughts in the historic record on DO has been evaluated for the historic rainfall record from 1920 to the present, which includes short-, medium- and long-term historic drought sequences, including a three dry winter drought, which is the most critical for our water supply system. This was done using hindcasting regression to reconstruct groundwater levels based on observed rainfall, and this work is detailed in **appendix K**. The impact on drought vulnerable sources for droughts of various durations has been assessed, and presented below. Worse droughts do vary somewhat between sources, but this variation is minor compared to intrinsic uncertainties in yield relating to borehole and aquifer properties, and as a percentage of overall DO.

Table 22 Impact of drought on groundwater levels at vulnerable sources

ABH source	OBH	Minimum observed OBH GWL (mOAD)	Minimum observed ABH RWL (mOAD)	Min modelled ABH GWL – one-year period	Min modelled ABH GWL – two-year period	Min modelled ABH GWL – three-year period	DAPWL (mAOD)
APPW	TL54/102	20.61	19.92	19.81	19.39	19.07	–1.7
BAPW	TL45/017	12.28	11.05	10.55	10.24	10.51	–4.5
BRPW	TL88/013	12.58	11.35	10.02	10.01	10.42	–5.75
CRPW2	TL35/001	18/08	17.6	14.01	14.0	13.66	–3.91
DUPW	TL65/043	9.85	8.66	4.80	6.93	6.53	–26.2
DGPW	TL44/240	20.18	18.98	18.16	18.02	17.32	6.68
DUPW	TL44/048	19.10	19.22	17.48	18.23	17.42	14.5
EUPW	TL88/013	12.61	12.72	12.73	13.00	12.93	11.2
FD12PW	TL55/005	8.84	5.49	5.27	5.02	6.22	–8.8
FD36PW	TL55/005	8.84	6.70	5.81	5.18	6.28	–9
FOPW	TL44/293	18.29	18.51	14.50	14.50	13.52	12.5
FUPW	TL45/017	12.28	8.11	7.55	6.78	7.27	4.4
GCPW	TL44/234	25.9	25.11	21.79	23.32	22.69	–4.19
GWPW	TL55/144	10.02	5.39	5.11	5.24	4.99	–9.4
HEPW	TL44/238	22.52	23.21	21.23	21.21	18.40	10.3
HGPW	TL54/002	20.89	20.46	20.15	20.37	20.22	6

ABH source	OBH	Minimum observed OBH GWL (mOAD)	Minimum observed ABH RWL (mOAD)	Min modelled ABH GWL – one-year period	Min modelled ABH GWL – two-year period	Min modelled ABH GWL – three-year period	DAPWL (mAOD)
KIPW2	TL35/004	12.13	12.86	10.54	11.98	10.60	–9.9
LIPW	TL54/028	21.11	28.11	27.17	27.67	27.36	–15.5
LOPW	TL44/234	25.32	27.87	24.37	25.77	22.30	17.9
MEPW	TL44/427	20.85	19.70	18.81	19.42	19.19	–0.82
MGPW2	TL34/007	39.23	37.24	36.89	36.68	36.48	27
RIPW	TL54/001	35.93	32.93	30.89	31.92	30.92	–38
SAPW2	TL54/006	19.65	14.79	14.03	14.37	14.36	0
WEPW	TL55/009	8.99	8.00	6.11	5.22	6.47	–14.6
WCPW	TL65/042	11.38	11.38	0.38	0.11	–9.82	–14.38

7.4.3.1 Severe drought evaluation

We have also considered more extreme droughts beyond the design drought and historic weather record droughts, for 1 in 200, and 1 in 500 events. The definition of these droughts requires a stochastic approach using a weather generator to produce a set of synthetic weather time series and defining the impact of these events on groundwater levels at regional observation boreholes. A lumped parameter model (LPM) is used to calculate change in water levels, which can then be applied to source yields to derive a revised DO under extreme drought.

This approach is consistent with that used elsewhere in the region and uses 200 sets of Met Office 91-year, stochastically generated, time series of rainfall and temperature to randomly generate artificial weather time series which could have happened. We ran these series through a simulator to establish modelled aquifer storage levels, and likely impact on the supply system. The simulator is a regional-scale water resource model, which includes several lumped parameter groundwater models (LPMs), each of which calculates time series of storage from spatially average recharge, determined from precipitation and temperature.

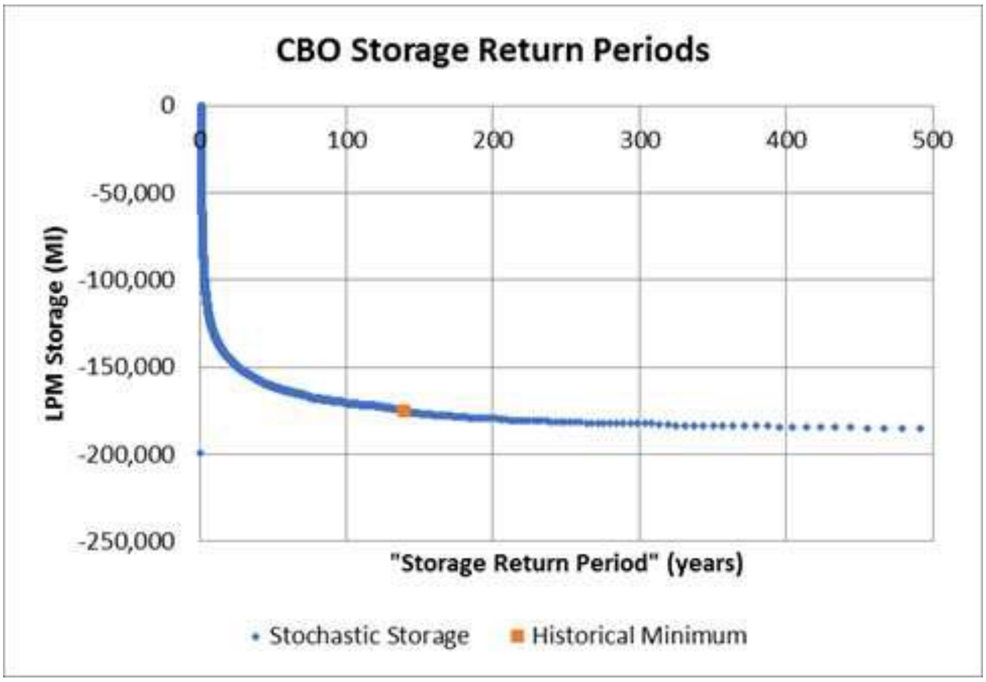
A summary of the key data analysis steps in the study is as follows:

1. Determine minimum annual LPM storage for every year in each stochastic time-series. Rank series-years by minimum storage and create frequency distribution plots of minimum annual storage for every series. Identify ‘1 in 200-year’ (‘severe drought’) and ‘1 in 500-year’ (‘extreme drought’) minimum storage value for each LPM.
2. Plot monthly historical LPM groundwater storage vs observed groundwater level at each key observation borehole in the Cambridge WRZ. Determine linear regression line and standard deviation.
3. Use storage versus level regression in combination with the severe drought LPM storage value for each LPM to determine a potential severe drought response to groundwater level for each key observation borehole.
4. Translate this severe drought groundwater level impact across to the relevant source reliable output summary diagrams(s), using the accepted “curve shifting” methodology.
5. Determine a potential severe drought yield for each source, using the adjusted bounding curve intersection with deepest advisable pumping water level, along with expert knowledge regarding source response to drought (groundwater quality and quantity).
6. Compare this severe drought yield to deployable output (DO) at each source and determine the potential DO impacts of severe drought.

We provide the full detail of our approach in **appendix U**.

The 1 in 500-year events as determined using the LPMs have no significantly greater impact than 1 in 200-year events, as shown in the following chart.

Figure 10 Storage return periods



The stochastic lumped parameter modelling showed that the worst droughts determined from historical rainfall records (early 20th Century) are of a severity equivalent to return periods in excess of 200 years in terms of groundwater yield. To better reflect our chosen levels of service, we have chosen instead to use the worst groundwater conditions observed in the historical groundwater record as the Design Drought.

We have applied the change in DO for drought sequences to WRMP table 10, and the values are detailed in the following table.

Table 23 Change in deployable output in drought scenarios

Event	DO Ml/d		Change in DO Ml/d	
	DYAA	DYCP	DYAA	DYCP
Design drought	99.1	118.3	0	0
Serious drought	99.1	118.3	0	0
200-year	89.2	112.7	9.9	5.6
500-year	89.2	112.7	9.9	5.6

Note when we mention Table 10 in this context, we are referring to a worksheet within the WRMP excel spreadsheets that we publish alongside our WRMP narrative on our website. Table 10 is specifically designed to provide information about the impact of different droughts and how effective our drought management options will be in terms of providing more water or reducing demand.

The modelled impact of more extreme droughts, using a lumped parameter (LPM) model which accounts for regional effects and surface water–groundwater interactions – rainfall/run-off modelling – is fairly similar to the impact of historic rainfall modelled hindcast sequences. Both methods have uncertainties in the approach, with the LPM more reliable at a regional scale, and including many more simulated years of data, than the rainfall hindcast models. The rainfall hindcasting method does take more account of localised effects on borehole levels that may be masked by the regional approach, but can be limited by available calibration data. However, both approaches are fairly precautionary and the impacts when aggregated to the WRZ level are a satisfactory indication of drought impacts for a range of magnitudes.

7.4.4 Assessment of resilience in base year

We have evaluated our resilience to drought based on resources and forecast demands for a dry year, for the 2017/18 base year. We have considered five historic drought scenarios over the period 1920 to 2011, and a further scenario that has been created using a stochastic modelled synthetic dataset, to consider extreme droughts with a greater severity, for up to a 1 in 500-year event.

There is marginal difference between historic design droughts and more severe modelled events, and the supply/demand balance remains in surplus for the base year when drought measures are applied.

7.4.5 Assessment of resilience over planning period

We have also tested our drought resilience by considering how our measures might perform over the whole planning period under our final plan.

This indicates that:

- baseline demand increases by 9Ml/d from 82Ml/d in the base year to 91Ml/d in 2044/45;
- demand management in our final plan reduces the expected DYAA demand to 83Ml/d by 2044/45 with savings of around 8Ml/d; the majority of this is from a leakage reduction programme (5.5Ml/d) with the remainder from reductions to customer consumption; and
- supply-side options in AMP7/AMP8 increase DYAA supplies by around 3Ml/d over the 25 years.

Coupled with reductions to DO as a result of sustainability changes, these measures ensure that we maintain surplus above target headroom throughout the planning period.

7.4.6 Contingencies for extreme droughts

Our analysis shows our supplies are resilient for a range of droughts across the 25-year planning period – including those more severe, or less frequent than our design droughts.

Accordingly, we are not putting forward any new drought management options in addition to those currently in our existing drought plan.

Further reductions to DO as a result of WFD 'no deterioration' measures have not been explicitly included in the drought analysis in WRMP Table 10, which also excludes any planning allowances. The available drought measures and preferred final plan programme would allow us to manage an extreme drought scenario without resorting to additional drought measures; however, we will review available drought measures when we have certainty on the impact of 'no deterioration', and this may require us to develop additional drought measures, such as drought permits to abstract licensed volumes no longer available following 'no deterioration' precautionary limits. These would include any local mitigation required to ensure we can abstract in a sustainable way that would not cause permanent deterioration.

7.5 Outage allowance

Within our WRMP we must include an assessment of outage, which is to accommodate potential short-term or temporary loss of the amount of water available for supply.

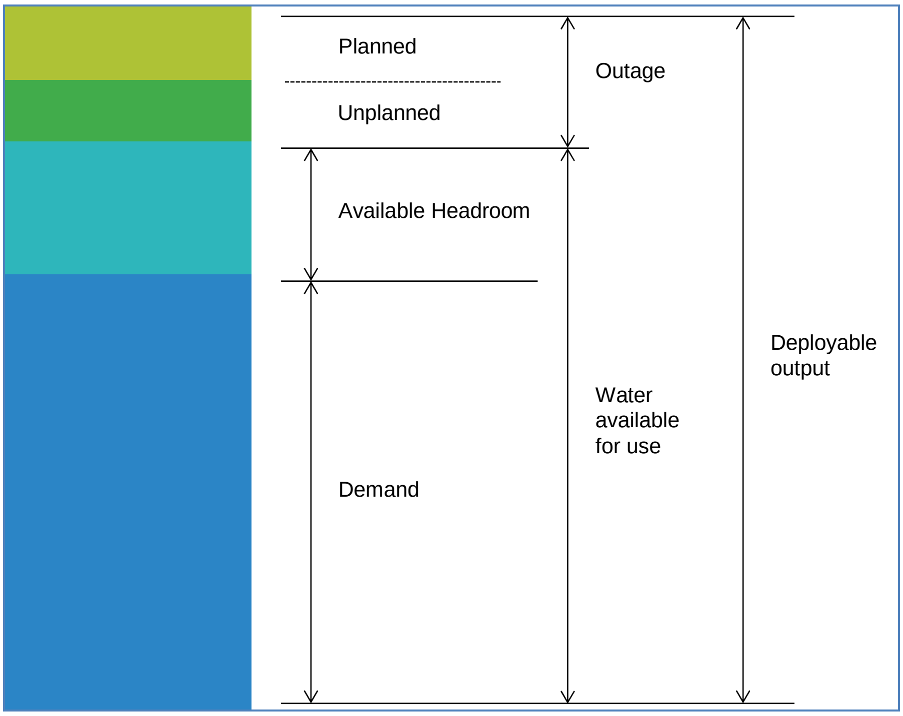
Outage is defined as a temporary loss of DO because of:

- planned maintenance and capital work (planned outage); or
- unforeseen events such as power failure, source pollution or system breakdown (unplanned outage).

We calculated the outage allowance in line with the standard methodology developed and published by UKWIR[9], in accordance with the expectations of the Environment Agency guidance, 'WRMP19 methods: Outage allowance', July 2016.

[9] 'Outage Allowances for Water Resource Planning', UKWIR/Environment Agency, March 1995.

Figure 11 Context of outage in the supply/demand balance



The 1995 methodology advocates the use of a probabilistic approach, based on Monte Carlo analysis. The analysis involves defining probability distributions for magnitude and duration for all identified outage events and combining these to give an overall probability distribution for the outage allowance.

Historic events have been analysed and included from 2004 to 2016. The list of events was first reviewed to identify if events were legitimate outages. Non-legitimate events have been excluded from the data. The data were then grouped by source and by category, and categorised as planned or unplanned events. The events were also reviewed to ensure that where two or more events were recorded as occurring at the same time and the same site, these were only counted as one event.

Events at sources no longer in supply were excluded to avoid overestimating overall magnitude (if DO has decreased) and prevent any bias in the outage calculation. The frequency value for the events is calculated by the total number of events divided by the time covered by the dataset (in this case, 15 years). This is then used as the outage frequency value for the Poisson distribution used in the model.

7.5.1 Outage results

The results of the outage assessment are presented in the table below, for both average and peak conditions. The results have been calculated from simulations using 10,000 iterations which is deemed sufficient to ensure repeatability of the results in the analyses.

The results of both analyses are presented as Ml/d for various percentiles of risk.

Table 24 Outage assessment results

Percentile	DYAA outage Ml/d	DYCP outage Ml/d
10%	1.2	0.0
25%	1.8	0.3
50%	3.1	1.0
60%	3.9	1.4
70%	**4.8**	**2.1**
80%	6.0	3.2
90%	7.7	8.7
95%	9.2	15.3

For WRMP14, the 80th percentile values for outage at both DYAA and DYCP were considered to be most appropriate for capturing a suitable level of risk to our water supply availability to protect our level of service. For this WRMP, we have selected the 70th percentile as we consider outage performance will further improve following a period of significant investment and improvement at works over the AMP6 period, which is not fully reflected in the data in the assessment. We have excluded events that we do not expect to happen in the future, because of investment that we are making within AMP6.

The corresponding values for DYAA and DYCP outage are 4.8Ml/d and 2.1Ml/d respectively; these have been entered into the WRMP tables.

A report detailing the outage methodology and results is included in **appendix L**.

7.5.2 Options to reduce outage

Our approach is to minimise the potential for and impact from unplanned and planned outages at sources through an effective capital maintenance strategy, and mitigation measures, such as standby power generation. A significant level of investment will be completed during AMP6 involving refurbishment at the majority of source works. This will enhance reliability moving forward and improve unplanned outage performance. Planned outages required for major refurbishment works will also reduce.

Since publishing our draft WRMP for consultation we have reviewed the work we will complete during AMP6 and more fully incorporated the impact of this on our forecast, future overall outage performance.

We will manage our forward capital programme to ensure planned works do not present an unacceptable risk to overall supply availability and all capital works aim to ensure robust operating processes going forwards to minimise unplanned outage. Accordingly, we have not included a specific option to target a reduction in outage in the feasible list of options within this plan. However, we will review our outage annually against our forecast through the WRMP annual review process and will implement measures to reduce it, if this becomes necessary.

7.6 Climate change

In accordance with the Environment Agency's water resources planning guidance we are required to include reductions to available supplies because of climate change. We have carried out an assessment of sources to determine which would be vulnerable to climate change, and assessed the level of vulnerability in accordance with the updated methodology, 'Estimating the impacts of climate change on water supply', Environment Agency (2017). We have then made an allowance in the supply forecast for the impact of climate change.

Of the 28 sources assessed for vulnerability to climate change, eight have been identified as constrained by factors other than licences. These sources were taken forward for further climate change assessment. These eight sources are also those that demonstrate the most vulnerability during low groundwater level conditions, and have hydrogeological constraints on yields. The potentially vulnerable sources are:

- DUPW;
- DGPW;
- FD36PW;
- GCPW;
- GWPW;
- MEPW;
- WEPW; and
- WCPW.

7.6.1 Vulnerability assessment and choice of method

To predict the effect of climate change on groundwater levels, we developed a model to simulate yearly groundwater level minima, depending on the amount of recharge to the groundwater and the change in groundwater levels. The type of model considered for the climate change analysis was selected using the decision tree provided as figure 3.1 of the Environment Agency Water Resources Planning Guideline[10] document. The decision tree provides an indication of the level of complexity that should be considered for modelling climate change and source vulnerability. In general, we consider our sources to be Low to Medium vulnerability, based on the results of the most recent Source Reliable Output (SRO) studies (2012).

[10] Environment Agency; GEHO0612BWPE-E-E, June 2012.

The vulnerability of the resource zone is determined by a magnitude versus sensitivity plot, created using a vulnerability scoring matrix as provided in the Environment Agency guidelines, which is presented below.

Table 25 Climate change vulnerability assessment

Uncertainty range (% change wet to dry)	Mid scenario (%reduction in deployable output)		
	<5%	>5%	>10%
<5%	Cambridge Water	Medium	High
6 to 10%	Medium	Medium	High
11 to 15%	High	High	High
>15%	High	High	High

Our resource zone is classified as low vulnerability, for both average and peak conditions at potentially vulnerable sources. A summary of the information used to make the overall assessment carried out by Atkins, is presented in **appendix M**.

We have also assessed the vulnerability of individual sources applying the same scoring matrix, which has identified three sources that in isolation would fall into the medium or high vulnerability classification.

7.6.2 Details of the assessment

The Environment Agency methodology includes a tiered approach to estimate the impact of climate change based on the basic vulnerability classification of each resource zone. As our resource zone has been assessed as low vulnerability to climate change impacts, a tier 1 analysis is recommended, using the future flows hydrology monthly change factors as outlined in the guidance[11]. However, our previous assessments of climate change impact have been more detailed, and therefore our analysis complies with tier 3 (UKCP09/water company own approach) analysis as defined in the guidance.

The climate change analysis included using UKCP09 probabilistic climate change projections and a regression analysis to model rainfall/recharge and groundwater level minima. Following Environment Agency advice, the regression model also considers rainfall and soil moisture deficit (SMD), which has a direct correlation with temperature. A multiple linear regression (MLR) approach was applied to model a number of parameters that affect groundwater levels, rather than a simple linear regression. By using this approach, it is possible to consider recharge as well as the effect that this has on groundwater levels – that is, the rate of groundwater level change.

To define recharge to the groundwater, the rainfall and SMD data were considered in the model by means of six two-monthly variables comprising the rainfall in the two-month

[11] 'WRMP19 supplementary information on estimating the impacts of climate change on water supply', Environment Agency, 2017.

period plus the change in soil moisture deficit during the period. The periods were defined within a water year from October to September. Although the majority of recharge occurs over the winter months (that is, October to April), it was necessary to include the full year of recharge data as the some of the climate change scenarios indicate that future conditions will include drier winters and wetter summers, so the extent of the recharge period may change.

In addition to the climate correlation with groundwater level minima, the groundwater trends can also be defined by the change in groundwater following each recharge period. The model incorporates this through six variables representing the change in groundwater level over each two-month period within the water year. We used monthly monitoring data for Environment Agency observation boreholes close to our sources to represent the general groundwater level trends that occur at the source, without the influence of abstraction.

The MLR model applied these variables to correlate with observed groundwater levels for the Environment Agency observation boreholes selected as best representing groundwater levels at the source. It also defines 12 coefficients and an intercept for the linear regression equation that can be used to simulate groundwater levels.

This method provides predicted change to DO or yield at source level, for three emissions scenarios for the 2030s, 2060s and 2080s, and this approach is detailed in **appendix M**.

7.6.3 Results of assessment

The results of our climate change assessment on the most vulnerable of sources indicate that, out of the eight most vulnerable sources, only three sources are shown to have the greatest impact (>5%) on outputs because of climate change.

To consider the range of uncertainty associated with climate change projections, we developed 15 scenarios from the 10th, 33rd, 50th, 67th and 90th percentiles of the low, medium and high emission scenarios. These scenarios were selected based on the principles of climate change risk assessment best practice, in terms of communicating the probable range of uncertainty. Each of the scenarios has been applied to model the groundwater levels, without bias, and the lowest drought groundwater level (independent of scenario) has been used to determine the 'worst case' climate change deployable output.

This assessment does not consider projections from the 'very unlikely' (less than 10% probability) as we did not consider this appropriate for WRMPs, where there is flexibility over time to monitor and evaluate climate change risks and change direction of approach if required.

The results at WRZ level are presented in the following table.

Table 26 Climate change impact on deployable output results (Ml/d)

Emissions scenarios	Impact to average demand Ml/d – 50%ile			Impact to peak demand Ml/d – 50%ile		
	2030	2060	2080	2030	2060	2080
Low	0.38	0.59	0.73	0.74	1.15	1.43
Medium	0.65	1.01	1.24	0.89	1.38	1.71
High	0.40	0.63	0.77	0.74	1.15	1.43

The results present the impact to DO, for time slices of each emissions scenario, as an example of the ranges included in the planning tables. Any positive impacts indicated from climate change to source yields has been removed – that is, the results above are the highest impact for future climate change scenarios. We have used values for the tables from the medium scenario at the 50th percentile. For the eight sources that could be impacted by climate change, the overall change in DO is relatively small at less than 1Ml/d.

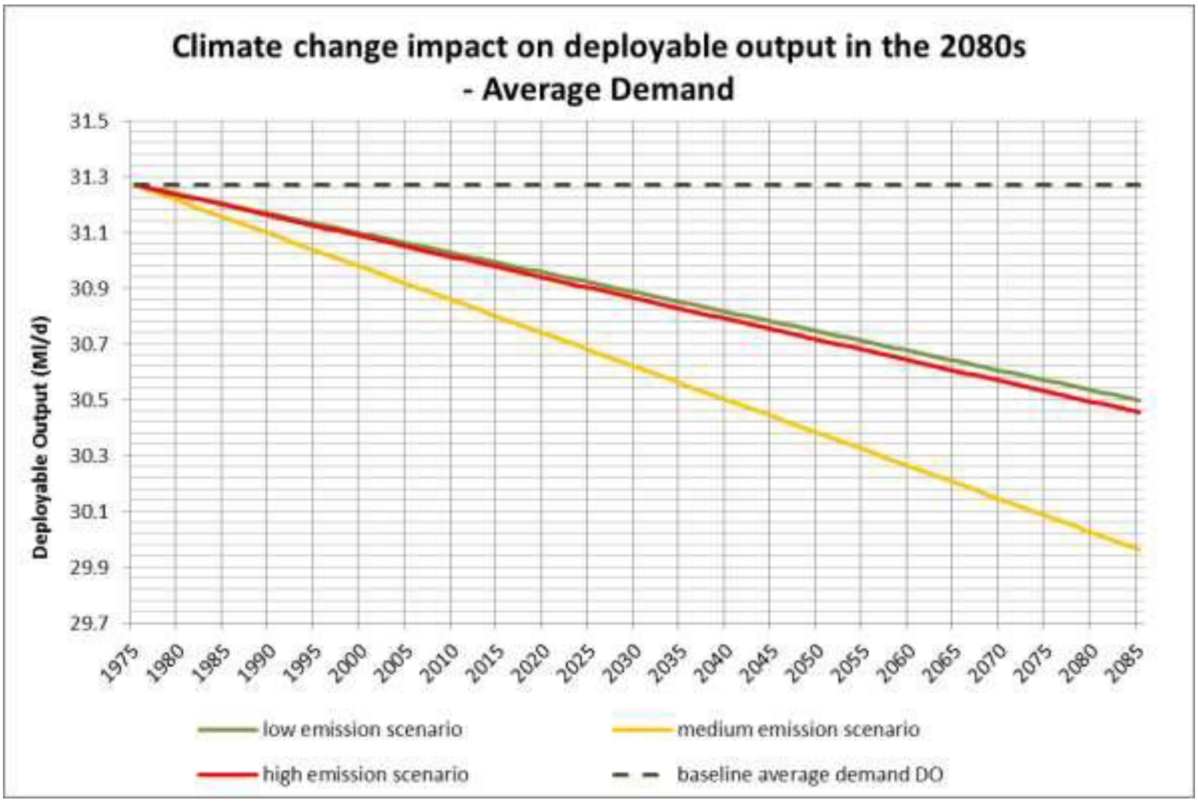
7.6.4 Implications for the supply forecast

We calculated the impacts on DO for the 2030s, 2060s and 2080s. There is a need to scale the changes back to a date when climate change impact on yields is given as zero. This is because our DO has been calculated from a long period of climate data, some of which (pre-1990) is generally regarded as unaffected by climate change, but the remainder of which is affected by climate change. The Environment Agency[12] suggests selecting a datum of 1975 as this zero point for a baseline period of 1961 to 1990.

The figure below shows the scaled impact that has been derived for the year-on-year climate change impact in the WRMP.

[12] Environment Agency, 'Water resources planning guideline: Interim update', April 2017.

Figure 12 Climate change impact on deployable output in the 2080s – average demand



7.6.5 Compliance with WRMP Directions 3(d) and 3(e)

As required by Direction 3(d) we have described the "the emissions of greenhouse gases which are likely to arise as a result of each measure which it has identified in accordance with section 37A(3)(b)." The following table shows in numerical format our estimates of greenhouse gases that are likely to result from our current and future operations. These estimates show the difference between our baseline and our final plan, this difference incorporates the impact of the options selected in our preferred plan.

Table 27 Estimated greenhouse gas emissions associated with our baseline and final planning scenarios

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
CAM baseline tCO_2e per year	10,288	10,675	10,958	11,089	11,207	11,316
CAM final plan tCO_2e per year	10,194	10,328	10,595	10,659	10,658	10,506

Table 28 Estimated greenhouse gas emissions associated with our final planning selected options

	Year 1 2020/21	Year 5 2024/25	Year 10 2029/30	Year 15 2034/35	Year 20 2039/40	Year 25 2040/45
SIPW	0	203	189	189	188	188
CRPW2	0	176	163	163	163	163
KIPW2	0	113	105	105	105	105
Leakage Bundle 020	20	129	199	292	402	511
Live network 2.0	30	122	162	179	179	179
AMR enhanced free metering - Committed	3	16	32	39	39	39
Water efficiency commitment 2.0	55	271	277	277	277	277

Also, to signpost where further information on this can be found outside of our WRMP, we as the South Staffordshire group, report our estimates of greenhouse gas emissions annually to the Environment Agency as part of the CRC (Carbon Reduction Commitment) scheme.

As required by Direction 3(e) we have described the "implications of climate change, including in relation to the impact on supply and demand of each measure which it has identified…." To address this specifically for the impact on supply and demand of our selected options, we have shown the factors we have applied to the DO/yields in the table below.

Table 29 Climate change factors applied to our selected options

	2024/25	2025/26	2030/31	2035/36	2040/41	2044/45
Factor applied to DYAA supply side option DO	1.000	0.928	0.928	0.927	0.926	0.926
Factor applied to DYCP supply side option DO	1.000	0.993	0.992	0.992	0.991	0.990
Factor applied to all demand side option DO	1.000	1.000	1.000	1.000	1.000	1.000

We apply these factors every year from when they start to contribute to our supply demand balance. For ease of presentation, we have only shown five-yearly segments here. We note that these factors reduce the supply benefit of our options and are consistent with those we used in the appropriate PR19 tables and with the reductions we apply to our baseline DO for these years. The factors shown above include reductions as a result of sustainability changes as well as climate change. We split out the impact of these two components in our WRMP tables that we publish alongside our WRMP.

The reason why we do not reduce the benefit of our demand side schemes is that when we commit to a certain yield in terms of mega litres per day or litres per person per day we commit to that value. We do not think it would be acceptable, for example, to commit to reduce leakage by a certain quantity but then allow that saving to decline over time. We have accounted for the impact that climate change will have on our demand forecast, as described in section 6.6.

7.7 Water transfers

We will always endeavour to utilise transfers or bulk trading of water resources where it is the most cost-effective and efficient means of ensuring robust water resources for supply to our customers, and where appropriate, those customers of neighbouring water companies.

7.7.1 Raw and non-potable transfers

We have no raw or non-potable transfers into our supply system, nor do we provide any raw or non-potable exports. Three of our source works abstract raw water for transfer to other treatment locations a few kilometres away through dedicated trunk mains. None of these transfers return any raw water to the environment, and therefore pose no risk for the transfer of invasive non-native species (INNS).

7.7.2 Potable transfers

We currently have a number of cross-border metered supplies with Anglian Water and with Affinity Water both into and out of our area of supply. These serve small numbers of properties only, and are either operated under formal agreement, or under the terms of a standard commercial supply. The volumes concerned are small and do not significantly impact on the overall supply/demand balance. Nevertheless, these are included in our calculations.

The volume associated with these supplies is less than 1Ml/d, and has been included in the water resources planning tables.

7.8 Treatment works operational use

This component is required to calculate usage included in deployable outage that is not supplied into the distribution network as a result of it being used in treatment processes. This is typically discharged into surface water courses or into the main sewer.

The majority of our sources have very minor losses because of the volume of water passing through monitors and for water quality sampling as the treatment process is relatively simple and does not use much water. The exception is at ion exchange treatment plants used to remove nitrates, where the losses are measurable.

In our 2016 review of site losses, we used representative sample sources to derive typical values. Treatment works are classed as 'simple', 'complex', or 'no treatment'. Typical TWOU losses for a complex site range between 0.29%–0.47%, and on average 0.38% of the normal site total DO. Of the total volume, losses attributable to treatment process at sources without ion exchange treatment – 'simple' treatment works – account for 0.003Ml/d.

A total TWOU allowance of 0.16Ml/d has been included in the supply forecast, of which 0.11Ml/d is from complex sites and 0.05Ml/d from all other sources (simple and no treatment).

7.9 Reductions in deployable output

7.9.1 Sustainability changes

We are committed to ensuring that our abstractions are sustainable and to minimise any impact from our operations on the environment. Where our abstractions may have an impact on environmentally sensitive sites or water bodies, then we work together with the Environment Agency to determine if there is an impact, and to identify any measures required to implement a solution.

To protect designated sites under the Habitats Directive and the Wildlife and Countryside Act, and sites such as Sites of Special Scientific Interest (SSSIs), Biodiversity Action Plan sites (BAPs) or locally important sites such as local nature reserves (LNRs), and to deliver WFD or RBMP objectives, the Environment Agency may require sustainability reductions to water company licences.

7.9.1.1 Current drivers for change (AMP6 NEP)

We are currently funded to put in place solutions or investigate the need for solutions as part of the AMP6 National Environment Programme. These are all planned to be completed by the time this plan comes into effect in 2020 and are included in our baseline DO assessment. Details on the AMP6 schemes are as follows.

Table 30 Impact of AMP6 NEP in three catchments

Catchment	Basis for sustainability change	Sustainability change	Change to DO
River Granta and catchment	Investigations have shown that our abstraction impacts on flows in the Granta	3.5Ml/d – as 'Hands off flow' on licence(s)	Included in baseline DO
Cherry Hinton Brook	Options appraisal with impact investigations to determine abstraction impact and solution	None – signed out of NEP	None indicated for AMP6 but small reduction under discussion in AMP7*
Hobsons Brook (Nine Wells)	Investigations have shown that our abstractions impact on spring flows in Nine Wells at low flows, and consequently flow in Hobsons Brook. Augmentation of flows required	1.92Ml/d	Included in baseline DO

*This excludes risk of deterioration.

7.9.1.2 Future drivers for change in WRMP19

The drivers relevant to WRMP19 are presented in the following table. The three WFD drivers which must be considered for possible sustainability changes are highlighted in blue.

Table 31 PR19 WRMP drivers

Investment driver	Driver code	Description of measure	WINEP3 schemes
Habitats and Birds	HD	Measures that contribute to, maintain or meet conservation objectives of Natura 2000 or Ramsar sites.	0
Sites of Special Scientific Interest	SSSI	Measures that contribute to, maintain or meet conservation objectives of Sites of Special Scientific Interest (SSSI).	5 sites 4 licences 1 Implementation
NERC and Biodiversity Priorities	NERC	Measures that contribute to biodiversity priorities and obligations on water company owned land or in the catchments they influence and operate in.	2 company scale

Investment driver	Driver code	Description of measure	WINEP3 schemes
WFD hydrological regime	WFD WRFlow	Measures to protect (prevent deterioration) and improve the hydrological regime of WFD water bodies to meet environmental objectives.	14 waterbodies 19 licences ('no deterioration' investigation) 1 water body ('no deterioration' sustainability change) 1 water body (implementation)
WFD Artificial and Heavily Modified Water Bodies	WFD WRHM WB	Measures to achieve environmental objectives for Artificial and Heavily Modified Water Bodies for water storage and regulation (WR A/HWMB) where flow and/or morphology pressure on water body as a result of water company assets and/or operations.	3 waterbodies 18 sites
Groundwater and Contaminated Land Pressures	WFD GW GWR	Measures for groundwater and contaminated land pressures to meet water company obligations in the catchments they influence/operate in. Also includes DrWPA guidance for groundwater safeguard zones.	0
Eel Regulations	EE	Measures required under Eel Regulation to consider eel passage as part of solution. This need reflected within provisions contained within the Eels (England and Wales) Regulations (2009).	0
Drinking Water Protected Area	DrWPA	Measures that ensure the necessary protection for water bodies identified as DrWPAs, with aim of preventing deterioration in water quality, avoiding an increase in level of treatment required to produce drinking water, and over time seeking a reduction in level of treatment required.	3
Invasive Non-Native Species	INNS	Measures that deliver new regulation and GB strategy for INNS, focusing on pathways of introduction and spread. Majority of investigations/schemes contribute to prevention of WFD deterioration.	2 company scale
Local	L	Locally significant measures not eligible under WFD, or any other driver, but with clear evidence customer support and positive cost benefit ratio.	0

Measures to protect and improve the environment are set out in the WINEP, formerly known as the NEP, issued by the Environment Agency. In March 2018 the Environment Agency provided us with WINEP3 information, notifying us of PR19 schemes, and where applicable, sustainability changes to include in our WRMP.

The Environment Agency applies the PR19 managing uncertainty approach using a four-coloured system to determine the status of measures and whether these should be included in the WRMP as sustainability changes, presented below.

Figure 13 Environment Agency's assessment of sustainability changes measures

Colour	Status of measure	Description	Equivalent sustainability change category in WRMP14	WRMP19 action
Green	Certain	A confirmed change to a licence following completion of an investigation and an options appraisal, which is cost beneficial and affordable (where applicable).	Confirmed	Include as an adjustment to deployable output
Amber	Indicative	A likely change to a licence following completion of an investigation and an options appraisal, which is cost beneficial but awaiting decision on affordability.	Likely (subject to affordability test - WFD improve status only)	Include as an adjustment to deployable output and consider impacts through scenario analysis
Amber	Indicative	A likely change to a licence to meet a statutory driver either (a) before completion of an investigation; (b) following completion of investigation but before completion of an options appraisal.	Likely	Include as an adjustment to deployable output and consider impacts through scenario analysis
Red	Unconfirmed	A possible but unknown change to a licence where the evidence is not sufficient to determine a green, amber or red sustainability change. In some cases we will provide a best guess sustainability change figure	Unknown / unconfirmed	Include in scenario analysis
Purple	Direction of travel	We will not identify purple sustainability changes. We will identify direction of travel measures using an investigation code. No implementation action in AMP7.	N/A	Include in scenario analysis if sufficient information available

The WRMP supporting guidance states that only certain and indicative changes with a green or amber status, should be included in the WRMP and confirms that further information will be provided for reducing the more uncertain measures. The risk of future sustainability reductions is excluded from target headroom. We can choose to present scenarios for red or purple measures in our plans. We have only green and amber certainty for schemes included in the WINEP3, issued March 2018.

7.10 WFD implementation schemes

There is one scheme under the SSSI_IMP (Implementation) driver included in the WINEP, for the Alder Carr SSSI with a sustainability change status of amber certainty. This reduction has already been included in the baseline DO figure, as a licence change has already been agreed resulting from AMP6 NEP investigations into the River Granta. Therefore, no further sustainability reduction has been made to DO.

7.11 WFD 'no deterioration' schemes

The WINEP3 includes a number of licences where increased use above recent abstractions (over the period 2005/15) has been identified as at risk of causing deterioration to a total of 15 surface water bodies and three groundwater bodies. Prevention of deterioration is an action included in RBMPs. These licences have been included in WINEP3 for investigations under risk of deterioration in AMP7. WINEP3 indicates that these investigations are certain – that is, the investigation need is certain. It does not indicate that a reduction in DO is certain. It is therefore unclear how the potential outcome of the investigations should be dealt with. This is a particular issue for us because of the scale of the impact and the restrictions that this approach places on our ability to find additional new sources of water.

We have been engaged in national debates with the Environment Agency and other water companies about this approach for the past two years; more recently we have sought clarification from the Environment Agency on how we might carry out these investigations and what the potential outcome might be in terms of impact on DO.

In a letter to us dated 3rd November 2017, the Environment Agency advised the following.

"We recommend that with the scale and immediacy of the issue facing the Cambridge part of South Staffordshire Water, you include the capping of abstraction licences within the baseline scenario of your draft WRMP."

We consider that the approach taken by the Environment Agency for assessing the risk of deterioration is too precautionary and does not allow the potential to prove that there will be no risk of deterioration. However, not to include this element within the baseline would present an unacceptable risk to the environment and to our water supplies. We need to plan now for the potential impact and continue to work with the Environment Agency to better understand the risks and implement solutions.

We have therefore included within table 2, line 8.2 reductions in DO based on a cap set at the maximum annual abstraction between 2005 and 2015 at each source. This equates to a reduction to DO of 6.12Ml/d.

7.12 SSSI 'no deterioration' schemes

Four SSSI sites are included in WINEP3 that have been previously investigated and solutions already agreed. These sites are included in WINEP3 to identify the risk of deterioration if nearby abstraction were to increase. The effect of this is to cap the relevant licences. The impact is small, and has been built into the overall 'no deterioration' cap to licences as described in the previous section.

7.13 Other changes to deployable output

We have not included any further changes to DO.

7.14 Abstraction reform

The UK Government is undergoing a process to reform the water abstraction management system in England. The proposed direction, principles and process for reform were published in the water white paper, 'Water for Life', in December 2011. Its proposals for implementing change were published in a consultation response, 'Making the most of every drop', in July 2014 but the final timescale for implementation has yet to be published.

We have not included any changes to DO as a result of abstraction reform. The expectation is that at the time of reform, all our abstraction licences will already be sustainable, or that an agreed plan will be in place to make them sustainable.

7.15 Drinking water quality

Our WRMP also has to include the requirement to meet drinking water quality standards and compliance levels set by the DWI. An increase in nitrate concentrations as a result of agricultural land use has required investment in additional treatment and catchment measures in previous AMPs.

Our monitoring of groundwater nitrate concentration trends predicts future increases at a number of sources, although we do not expect the need for any additional treatment in AMP7 or AMP8 (2025/30) as the existing treatment and blending with low nitrate water maintains our compliance with DWI standards. We have made a small allowance in headroom for the impact of increased nitrate in groundwater at an increased trend above what is predicted which could have the potential to restrict existing blending capacities.

7.15.1 Catchment schemes

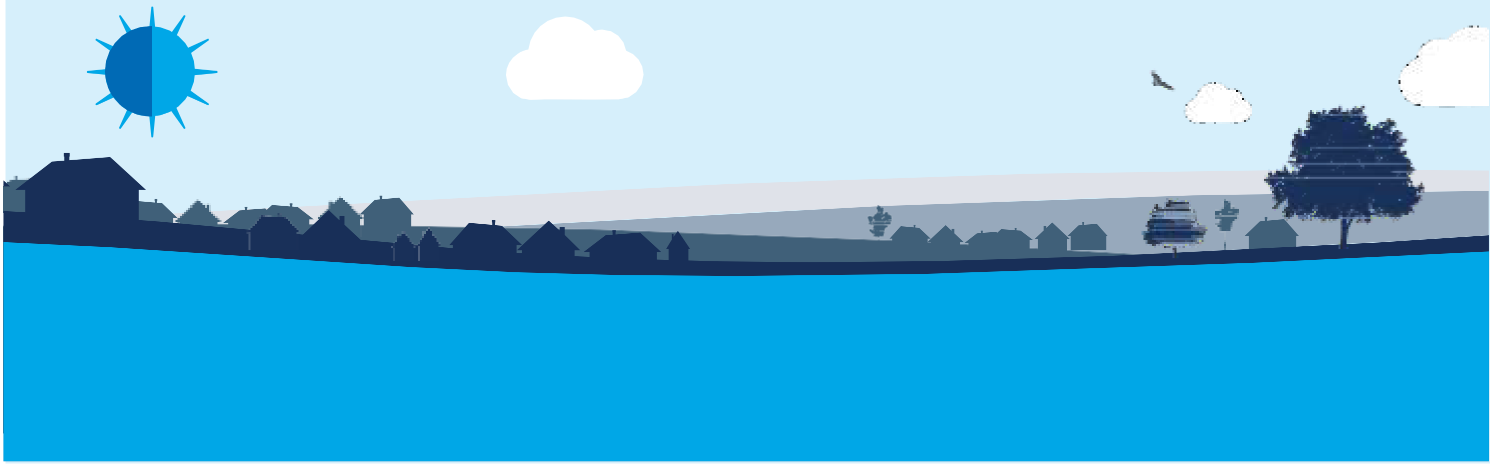
Our existing nitrate removal treatment plants will require refurbishment in the future, and so we have an existing catchment management programme to provide a twin-track approach to mitigation of nitrate in the future. At sources with rising nitrate trends where catchment management could be effective in delaying or removing a future need for treatment, we also employ catchment management as a sustainable long-term option as an effective solution to mitigate water quality risks.

The DWI, the Environment Agency and Natural England are supportive of our proposals for catchment management projects at groundwater sources, and there is an expectation that these schemes should be in place wherever they have potential to mitigate water quality risks, additional treatment and to provide multiple benefits.

There are three catchment management schemes included in our WINEP3, as result of AMP5 investigations. These are implementation schemes to avoid the further deterioration of Drinking Water Protected Area (DrWPA) parameters that may require the need for future treatment that could be avoided.

Section 8:

Headroom



8. Headroom

Overview of headroom assessment

Target headroom

Target headroom provides a minimum buffer for the uncertainty in the supply and demand forecasts, to ensure we are able to achieve our chosen level of service.

Target headroom has been reassessed using a more detailed stochastic methodology recommended in the guidelines developed and published by UKWIR[13], and is now approximately 2Ml/d lower than target headroom in our 2014 plan.

All components of target headroom uncertainty have been assessed and reviewed, with time series of uncertainty distributions defined from 2018 to 2045 for each component, reflective of DYAA and dry year critical period (DYCP) conditions.

A risk profile was selected in line with the WRMP guidelines and used to output target headroom values for supply/demand balance modelling of the WRZ. The risk profile starts at the 95th percentile which reflects a precautionary approach to our plan but reduces to the 80th percentile at the end of the planning period.

Target headroom is between 2.27Ml/d and 2.95Ml/d across the planning period, with a stepped risk profile over the 25 years that accepts an increase in risk beyond 2030.

We have assessed the uncertainty in our supply and demand forecasts using the target headroom approach. This is defined as the minimum buffer that a prudent water company should introduce into the annual supply/demand balance to ensure that its chosen level of service can be achieved. We have used the standard methodology developed and published by UKWIR and recommended in the water resources planning guidelines. We did not use this approach at the last WRMP and therefore this is an improved approach for us.

8.1 Review of headroom components

All components of target headroom uncertainty have been assessed and reviewed, with time series of uncertainty distributions defined from 2018 to 2045 for each component, reflective of DYAA and dry year critical period (DYCP) conditions. These components are listed in table 32 below.

13 'An Improved Methodology for Assessing Headroom', UKWIR, 2002.

Table 32 Supply- and demand-side headroom categories

Supply-side headroom categories	Demand-side headroom categories
S1 – Vulnerable surface water licences S2 – Vulnerable groundwater licences S3 – Time-limited licences S4 – Bulk transfers S5 – Gradual pollution causing a reduction in abstraction S6 – Accuracy of supply-side data S8 – Uncertainty of climate change on yield S9 – Uncertain output of new resource developments	D1 – Accuracy of sub-component data D2 – Demand forecast variation D3 – Uncertainty of climate change on demand D4 – Uncertainty of demand management solutions

8.1.1 Supply-side components

S1–S3 (vulnerable licences) – uncertainty over future reductions in abstraction licensing has been updated to include the latest DO and abstraction licence values (S1–S3 are only used for sensitivity analysis and are not included in target headroom).

No allowance for S4 has been included because these are insignificant in the baseline supply/demand balance.

S5, gradual pollution of groundwater sources, is applied to allow for uncertainty associated with future long-term trends in nitrate pollution. No allowance is specified for borehole deterioration, which is not considered to present a significant risk to DO for Cambridge Water, and there are no mine water pollution risks. Temporary losses of DO relating to nitrate are quantified and accounted for in the outage allowance.

S6 comprises uncertainty in the accuracy of supply-side data. For every groundwater source, the following constraining factors are identified.

- Abstraction licence.
- Infrastructure.
- Pumping water level (potential yield).
- Treatment capacity.
- Water quality.

For abstraction licences, the uncertainty relates to meter reading reliability. To avoid double-counting, only meters measuring abstraction separately to distribution input are included here. Infrastructure constraints carry uncertainty in pump outputs; yield constraints are subject to a number of uncertainties in the 'source reliable output' method. There are uncertainties in a number of treatment processes, and water quality can limit DO subject to uncertainty in existing conditions (not relevant to Cambridge Water). Trend uncertainty is covered under S5. No surface water sources exist in the Cambridge WRZ.

Uncertainty of climate change on groundwater source yield (S8), is quantified using the results of regional groundwater modelling with monthly climate change perturbation for the 2030s, 2060s and 2080s. Wet and dry scenarios are interpolated for 2045 and a time-series of uncertainty input to the headroom model using the standard Environment Agency methodology.

No new options are planned for completion in the near future, such that in S9, only final preferred options need be considered. These should not feature in baseline target headroom, but uncertainty in their output will be determined as necessary for any options selected in the final preferred balance.

Supply-side components have been updated to include the latest DO values reviewed for the WRMP.

8.1.2 Demand-side components

D1 accounts for uncertainty in the accuracy of sub-component data. As for S6, this reflects the reliability of meter readings, which could impact the accuracy of the demand forecast. To avoid double-counting, only meters measuring distribution input separately to abstraction are included here.

D2 comprises uncertainty in:

- population growth;
- change in size of households;
- measured and unmeasured consumption;
- non-household consumption;
- dry-year correction; and
- peak period adjustment.

These are input as time series of % uncertainty to the model.

D3, uncertainty of impact of climate change on demand, has been determined according to the UKWIR methodology, ‘Impact of Climate Change on Water Demand’ (2013), with time series of % uncertainty applied to household consumption.

D4, uncertainty of demand management solutions, has not been included in baseline target headroom. Should demand management solutions be required to maintain the supply/demand balance to 2045, an allowance will be made in final preferred target headroom for D4.

8.2 Data analysis and results

The distributions were uploaded into a tailor-made spreadsheet headroom model using @Risk Monte Carlo analysis. Ten thousand iterations of the model were run to determine a comprehensive percentile distribution of headroom time series for both DYAA and DYCP conditions.

A risk profile was selected in line with the WRMP guidelines and used to output target headroom values for supply/demand balance modelling of the WRZ. The risk profile starts at the 95th percentile which reflects a precautionary approach to our plan but reduces to the 80th percentile at the end of the planning period.

DYAA target headroom starts at 2.16Ml/d in 2017/18, increasing on the 95th percentile profile to 3.49Ml/d in 2030-31. The increase in risk acceptance beyond 2030 means that target headroom decreases to 2.95Ml/d by 2045.

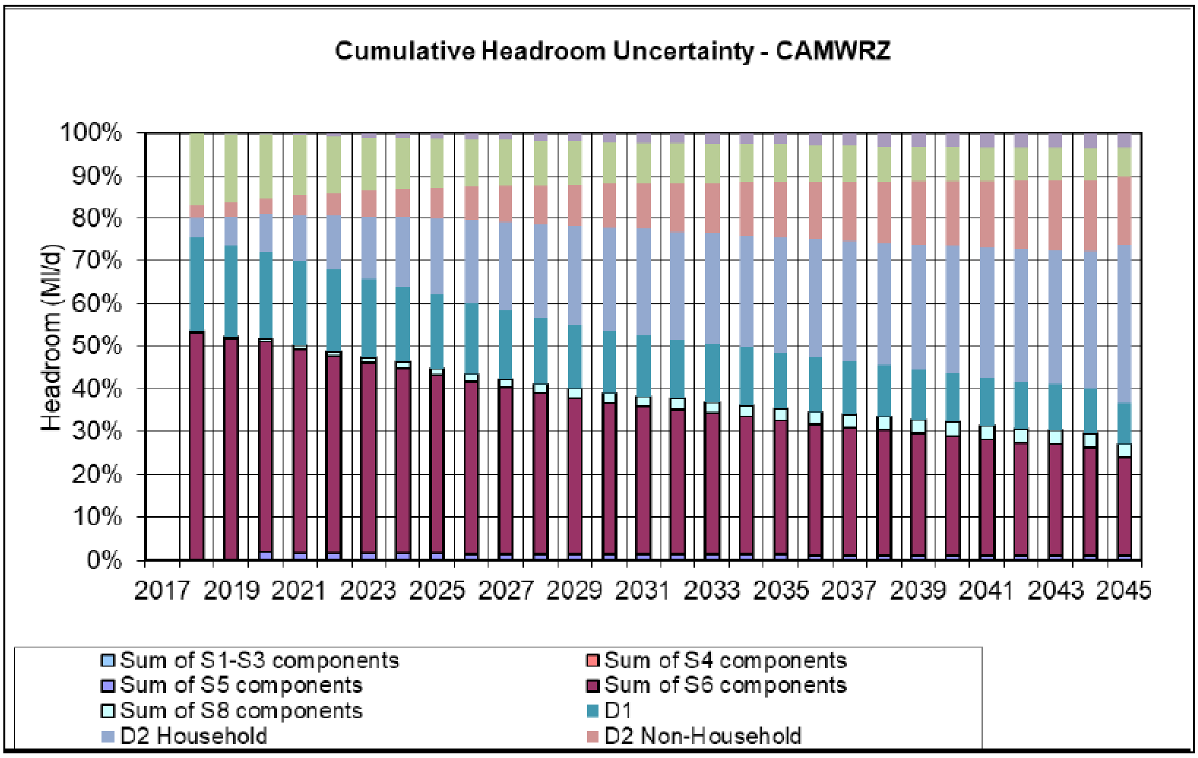
DYCP target headroom starts at 4.22Ml/d in 2017/18, increasing on the 95th percentile profile to 6.25Ml/d in 2030-31. The increase in risk acceptance beyond 2030 means that target headroom decreases to 4.48Ml/d by 2045.

Table 33 Target headroom DYAA and DYCP – 2017/18 to 2044/45

Year	DYAA (in Ml/d)	DYAA (%ile)	DYCP/peak (in Ml/d)	DYCP/peak (%ile)
2017/18	2.16	95%	4.22	95%
2020/21	2.27	95%	4.42	95%
2025/26	3.39	95%	6.31	95%
2030/31	3.49	94%	6.25	94%
2035/36	2.97	89%	5.10	89%
2040/41	2.76	84%	4.53	84%
2044/45	2.95	80%	4.48	80%

The breakdown of target headroom by sub-component in the following figure shows that uncertainty is dominated by the accuracy of demand-side data (D1–D4), with household forecasts uncertainty increasing over the plan.

Figure 14 Breakdown of DYAA target headroom by sub-component



A report detailing the headroom methodology and results is included in **appendix N**.

Section 9:

Baseline supply/demand balance

9. Baseline supply/demand balance

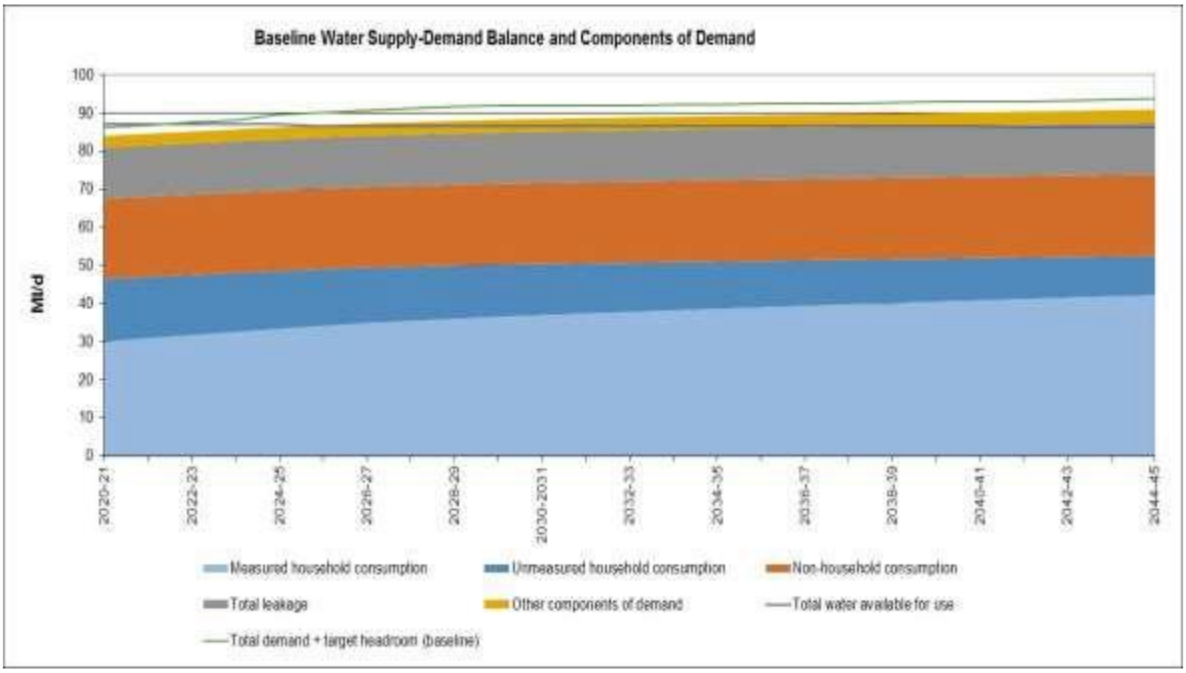
Overview of baseline supply/demand balance

Under the baseline scenario the supply/demand balance for the DYAA shows a deficit from 2022/23 beginning of the plan period but there is no deficit for the critical period.

9.1 Baseline dry year annual average supply/demand balance

The following chart shows the baseline supply/demand balance for the DYAA planning scenario. This is the predicted outcome if existing policies are continued without any further changes. It includes impacts from growth in population and properties, impacts on supply from climate change, reduced DO from groundwater source availability and reductions in DO to protect the environment. Target headroom is breached from the beginning of the plan period.

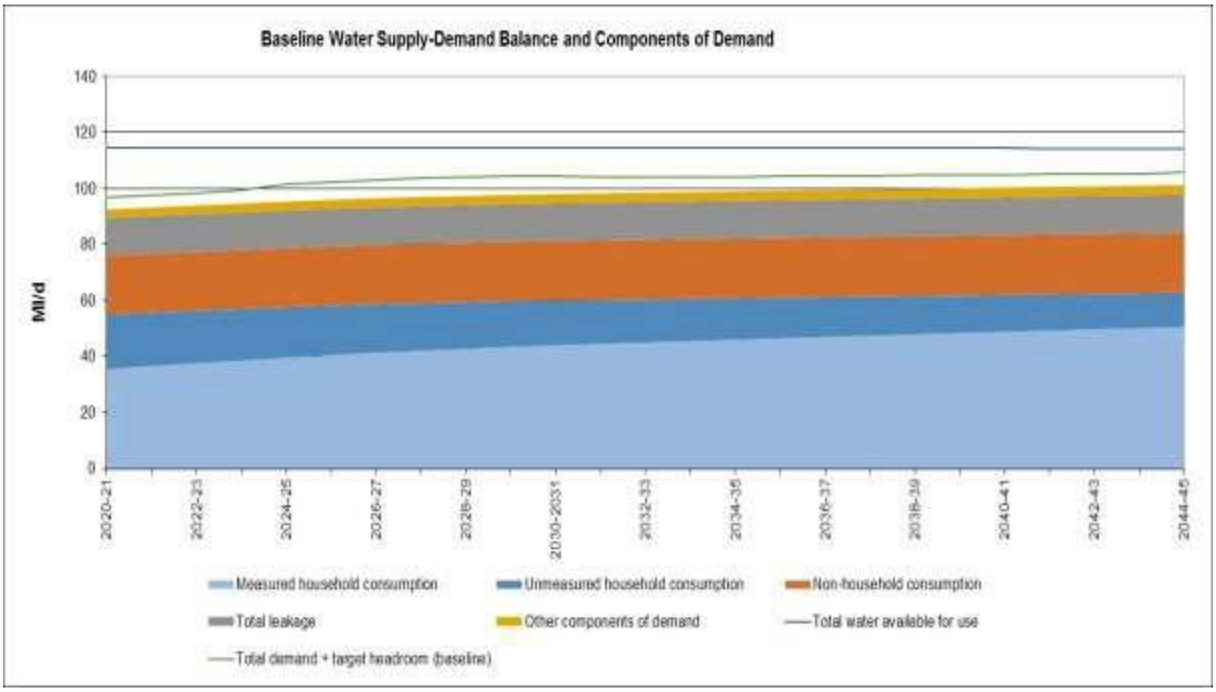
Figure 15 Baseline DYAA supply/demand balance and components of demand



9.2 Baseline critical period supply/demand balance

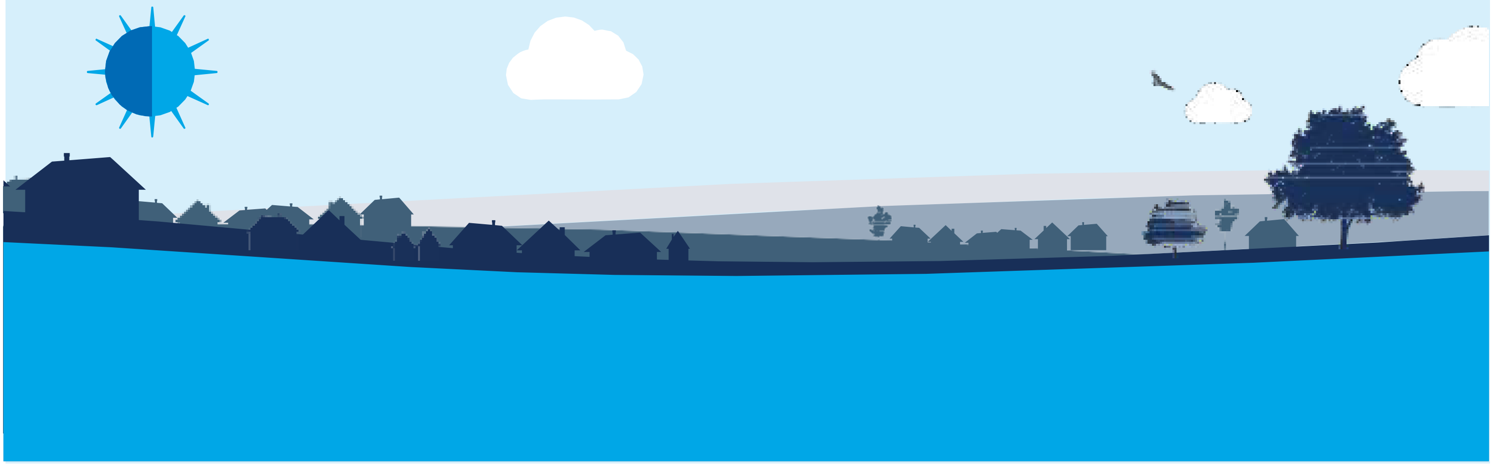
The following chart shows the baseline supply/demand balance for the critical period planning scenario. There is no breach of target headroom within the plan period.

Figure 16 Baseline critical period supply/demand balance and components of demand



Section 10:

Deciding on future options



10. Deciding on future options

Overview of options development and selection

We have followed the eight stage approach outlined in 'WRMP 2019 Methods – decision making process guidance' (UKWIR, 2016) for the identification of options and selection of our proposed programme of work.

We have carried out a process of defining the challenge we are facing and quantifying the complexity and scale of it. This has helped us define the approach to decision-making which is appropriate for us and our circumstances.

We have developed a multi-criteria decision-support tool to help model the future and make robust decisions about our proposed programme alongside a least cost approach.

We have developed an unconstrained list of options, including:

- demand-side options;
- supply-side options;
- production options;
- third party options; and
- resilience options.

These have been screened and evaluated to define our list of feasible options. An SEA has been carried out on all feasible options to help inform the proposed programme.

All options have been modelled in our MCA tool under a range of scenarios to test our plan.

We have developed our proposed programme taking account of:

- customer views;
- cost;
- resilience;
- environmental impact; and
- deliverability.

10.1 Overview

We have followed the eight-stage approach outlined in 'WRMP 2019 Methods – decision making process guidance' (UKWIR, 2016) for the identification of options and selection of our proposed programme of work.

1. Collate and review planning information.
2. Identify unconstrained options.
3. Problem characterisation and evaluate strategic needs/complexity.
4. Decide modelling method.
5. Identify and define data inputs.
6. Undertake decisions making modelling/options appraisal.
7. Stress testing and sensitivity analysis.
8. Final planning forecast and comparison to EBSD benchmark.

Traditionally, options would only be developed where a supply/demand balance deficit has been identified or is likely and an intervention is required to breach the gap. Problem characterisation for Cambridge Water identified that because of significant growth and the likely impact of reduced DO from our existing groundwater portfolio, there is an opportunity to review our existing operations across all sources to identify the most appropriate mix of supply and demand options going forwards. This approach allows us to take an integrated view of key questions for decision-making regarding water resource assets.

- How do we ensure we meet our future demand scenarios?
- Can we improve our levels of operational and extreme drought resilience?
- How do we ensure the decisions meet current and future needs?
- How do we ensure our plans reflect our customers' priorities and preferences?
- How do we ensure that our assets are fit for purpose?

To produce a least cost solution we appraise total expenditure or totex. This includes a full appraisal of capital expenditure (capex), life cycle costs and operating expenditure (opex) for all options (existing resources and potential new resources as well as demand management options). The inclusion of other un-monetised attributes (factors that are hard to value in pounds and pence) also allows us to optimise on other objectives and understand the value of differences. This multi-criteria approach and the DMF is described in detail in section 10.3.

Therefore, a full range of demand management options and supply options including all existing sources have been developed for modelling in the DMF and this allows the opportunity to re-evaluate the mix of resources for the future and ensure our assets are able to meet future demand scenarios.

10.2 Problem characterisation

The problem characterisation assessment is a tool for assessing our vulnerability to various strategic issues, risks and uncertainties. This assessment enables the development of appropriate, proportional responses with regards to decision making. We followed the approach set out in the latest guidance 'WRMP 2019 Methods – decision making process guidance'; this provided a robust and consistent approach that we applied to both our regions of operation (South Staffs Water and Cambridge Water).

There are two key areas to the problem characterisation assessment.

- How big is the problem? This assesses the scale of the strategic needs and the requirement for either new resources or demand management activities.
- How difficult is it to solve? This assesses the complexity of the challenge.

A detailed internal stakeholder workshop was held in both regions, facilitated independently by Arup and HR Wallingford. The appraisal of both problem and complexity concluded that compared with WRMP14 we face new risks to our overall supply/demand balance. The problem characterisation was developed collaboratively and is presented below. A full report detailing the problem characterisation is included in **appendix O**.

Figure 17 Problem characterisation assessment

		Strategic Needs Score ("How big is the problem")			
		0-1 (None)	2-3 (Small)	4-5 (Medium)	6 (Large)
Complexity Factors Score ("How difficult is it to solve")	Low (<7)	PR14			
	Medium (7-11)			PR19 - CAM	
	High (11+)				

Our WRZ is in the amber area of medium strategic needs (scale of the problem) and complexity scores. Based on the information presented in our WRMP14 our WRZ would previously have been in the green area of lower risk.

The key drivers behind the changes to the level of risk are as follows:

- A wider appreciation of drought resilience, which means that we may be vulnerable to droughts that are different to those experienced historically;
- Concerns because of regulatory pressures on abstraction licences, which are leading to sustainability reductions and restrictions on available groundwater resources;
- Long-term regional growth is being encouraged by Government but with large uncertainty over the amount and timing;
- There are limited supply-side options available to us within our area of supply – intercompany bulk imports or significant resource development would be required to replace supplies, and these carry additional uncertainty in timing, costs and availability.

The significance of the WRMP problem characterisation is that it drives a DMF based on a more complex extended modelling approach.

10.3 Modelling method and data inputs

In the past, we have followed the economics of balancing supply and demand (EBSD) approach, which is a well-established framework and traditionally focused on monetisation and developing least cost portfolios to meet supply and demand challenges. However, for the more challenging complex issues identified through the problem characterisation a more sophisticated approach to analysis is required.

Working with Arup and Hartley McMaster, our incumbent provider for asset management optimisation, we reviewed appropriate methods for combining both a WRMP challenge together with a more traditional asset management problem; therefore, providing a platform that enabled us to appraise our whole supply capability challenge. Together we worked through the UKWIR guidance to develop our existing optimisation software, which follows EBSD for portfolio selection, and extended it to allow investment option performance against other objectives to be assessed and incorporated into the portfolio selection process using multi-criteria analysis (MCA) techniques.

MCA is listed as a 'Current (Baseline) Approach' in the guidance document with this approach being followed by some water companies for previous plans. However, it is recommended that it is reasonable for a water company to take a progressive, yet pragmatic approach to WRMP 2019 based on the experience from WRMP 2014. We assessed in the problem characterisation that our area would have been classified as green at WRMP 2014 and therefore a move to MCA for this WRMP is a progressive move. We consider that through our application of MCA across a range of supply and demand scenarios, this approach goes beyond the 'Current (Baseline) Approach' and represents an Extended Approach.

The model can appraise both supply, including the requirements to maintain existing assets, and demand-side options and requires monetised information regarding construction, lifecycle and operating costs. Yield information for each of the planning scenarios is also captured, as well as any demand-side reductions/benefits.

The decision making within the model appraises two key criteria first – water quality and quantity; these are treated as 'gateways' in the model. These gateways are linked back to our customer priorities and hygiene factors and triangulate well with all other PR19 engagement to date, together with our ongoing day-to-day customer insight work.

A report detailing the modelling approach is included in **appendix P** and a summary of key aspects is included in the following sections.

10.3.1.1 Quantity

For each year of the planning period the DMF requires the demand problem to be set for each WRZ. This is the volume of water required for the zone, including allowances for:

- headroom;
- climate change; and
- population growth.

In line with water resource management planning guidelines, and to understand the normal operating scenario, the annual demand in the framework is set as a three-tier problem.

- Dry year annual average (DYAA).
- Dry year critical period (DYCP).

- Normal year annual average (NYAA).

In any year of the planning period the combination of options selected must be able to deliver the volume required for each of these scenarios as a minimum. The model is free to provide a volume greater than that required and subsequently partially utilise some sources. All volumes are mega litres per day (Ml/d).

To understand the impact of different population growth and climate change projections it is envisaged that a series of different future demand projections are generated that reflect different futures. This is further discussed in section 10.7.

10.3.1.2 Quality

The intention to include water quality in the framework is predicated on the assumption that we need to demonstrate that investments related to a particular source will deliver the required water quality both now and into the future against a range of possible future challenges, therefore meeting customer expectations.

There are choices to be made and trade-offs to consider in terms of the degree of sophistication, future proofing and flexibility for future adaption depending on the pace and scale of emerging challenges. There is likely to be more than one acceptable solution to the various quality issues and thus a degree of potential for different optimised portfolios.

We considered several measures.

- Regulatory (mean zonal compliance).
- Customer opinion (acceptability).
- DWI reported events/incidents.

If quality is to be taken into account a mechanism needs to be found to assess the relative beneficial impact on quality over time of each option considered.

We considered two options for assessing quality benefit.

1. Measurement of the number of failures that each option reduces compared to a 'do nothing' baseline (failure based).
2. The degree of quality improvement or protection that each option provides against a set of assumed challenges (risk based).

We discounted option 1 because of the difficulty and limited accuracy of generating sensible do nothing baselines and the highly subjective assessment of failure reduction for each project in isolation from other improvement activity over such an extended period of time. Option 2 has been developed as the basis of our approach to assessing the water quality impact of different investment options.

Water quality is impacted by both external and internal factors and investment decisions need to take account of known and likely changes to both. External factors such as raw water quality arriving at abstraction points, pollution, climate change impacts on water quality, peak summer temperatures and third party contamination can all be assessed in terms of risks, historic information and assumptions made on current and future challenges.

Assessments of water quality cover a wide range of parameters and it is not the intention of this framework to provide a detailed analysis of treatment performance; its purpose is to allow comparison between different investment options. Working with our internal water quality experts, in conjunction with Arup, a series of high-level water quality metrics have been identified against which the performance of investment options can be assessed. These are as follows.

- microbiology – E.coli, Coliforms, Clostridia, Cryptosporidia.
- pesticides – nitrates, metaldehyde.
- disinfection by-products – THM potential.
- aesthetic/discolouration potential – iron, manganese, aluminium.

For each source of water, a target water quality grade is entered for each water quality metric for each year of the planning period. This enables the model to reflect changing water quality and treatment targets over time.

Each investment option entered into the model must specify its performance capability with respect to each water quality metric. This is discussed later in the report.

10.3.1.3 Multi-criteria

All options are also scored against other un-monetised objectives, including:

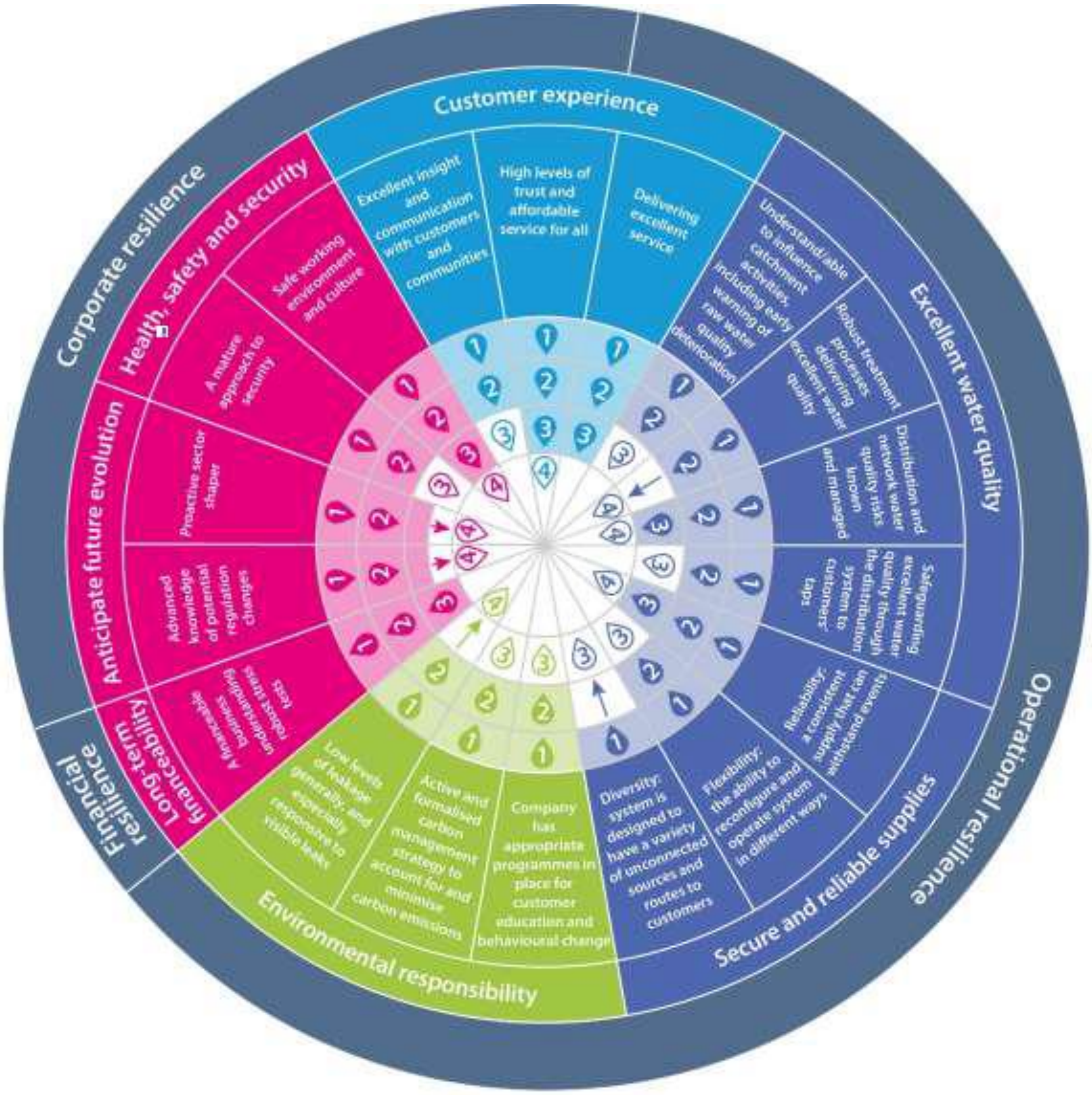
- operational resilience – each option was scored on how the delivered solution would improve reliability, flexibility and the diversity of our supply capability;
- deliverability – each option was scored to assess the operational certainty of the solution, if any third party consents were required;
- environmental sustainability – this was a basket measure and all options were scored on levels of carbon and impact on biodiversity, scale and severity (both during construction and implementation);
- social sustainability – this was a measure of disruption on local communities; and
- customer preference – this was gained from our customer engagement programme.

10.3.1.4 Resilience

We have been reviewing our approach to defining, quantifying and presenting resilience. To support this, we have developed a tool described as a ‘resilience lens’ with a number of key business objectives and a selection of desired states.

Elements from this business resilience tool can be associated with outputs from the DMF and in several different criteria when used in the assessment of investment options (figure 18). A single investment option on its own will have limited influence on the lens. However, if the cumulative impact of multiple options is considered, then an overall resilience performance for a portfolio can be calculated and compared against other portfolios. The choice of investment options is not able to influence performance against the entire resilience lens but will impact elements of the resilience lens as indicated in figure 18.

Figure 18 Resilience lens segments



Key

Where we think our projected maturity matrix scores will be by 2025

3 → 4

1 **Limited application**
Where we have not yet demonstrated resilient working, but are considering it for the future

2 **Low level of maturity**
Where we understand resilient working, but only apply it within isolated cases

3 **Medium level of maturity**
Where we demonstrate an understanding of resilient and can demonstrate its adoption within most of our activities

4 **High level of maturity**
Where we fully integrate resilient working into all our operational processes

10.3.1.5 Operational resilience

A major component of our resilience that the choice of the long-term plan investment options can impact on is operational resilience. A number of elements of operational resilience were considered for inclusion in the DMF. The selected categories are listed below.

- The extent to which an option impacts the **reliability of supply** to customers at the right volume and quality;
- The extent to which an option impacts the **flexibility of supply** options across the WRZ;
- The extent to which an option impacts the **diversity of supply** options available in the WRZ.

Each of the feasible options were scored from zero to five, with the lowest score assigned to options that have a low impact on resilience and the highest score to those that have the largest impact on resilience. The factors considered in the scoring are shown in figure 19.

Figure 19 Operational resilience

	Reliability	Flexibility	Diversity of supply
Principle	**The degree of reliability of critical assets - levels of unplanned outage**	**The degree of flexibility to reconfigure system to respond to events**	**The degree of diversity of supplies available; level of dependency on sources.**
Factors	Levels of drought susceptibility; range of yield Level of competition for the resource	Physical location of the resource within the network, ability to help support areas of single source	Extent to which the WRZ deployable output is dependent on this option
	Treatment vulnerability; level of complexity, difficulty of treatment, extent of dual streaming, extent of bankside storage. Experience of outage on existing sites	Ability to help the network recover, particularly with respect to North South and South North transfers	Extent to which the local network or area of supply is dependent on this option.
	Impact on discolouration events	Ability to provide extra capacity from normal (peak demand)	
Score	*Enter Option Score (0 to 5)*	*Enter Option Score (0 to 5)*	*Enter Option Score (0 to 5)*

All these attributes provide the framework for the MCA. Incorporating these aspects into the optimisation provides us with a robust DMF. Optimising across the full range of objectives together with stress testing key drivers, such as demand scenarios, yields and critical cost elements has enabled us to demonstrate that a robust, we have made a no regrets decision. We describe recent operational resilience in section 11.4.

10.3.1.6 Deliverability

Deliverability describes the complexity of an option in terms of execution. More complex solutions may provide a step change improvement but the benefits are less certain. A less complex solution may be a quick win and simple to implement but may not provide longevity of solution. For new technology there is also a risk that it will not work as well as expected, or that it costs more than anticipated. It provides a pragmatic means to measure the ease of an option in terms of development, implementation and operation to deliver a required outcome.

Within the DMF, we define deliverability as follows.

- **Third party approvals** – the degree of difficulty involved in obtaining permission to carry out the option and the likelihood that the option will be approved. This includes environmental and social impacts and effort associated with mitigating unacceptable impacts. The costs of this are included in the totex figure. A scheme which is located near or within an area of social or environmental significance will incur significantly more complex and intensive third party approvals and requirements. We also considered infrastructure such as the power and gas network from both a capacity and availability perspective.
- **Benefits proven** – the degree of confidence that the scheme will deliver anticipated benefits. This is demonstrated through the strength of the evidence base of solution benefits being demonstrated previously at scale in the water sector, and context relevant to the scheme proposed (that is, track record in material benefits). For example, a well-established treatment technology may have a strong evidence based demonstrating benefits, but if it has never been applied at similar scale to that proposed by us, this option is less well proven than one which has a strong evidence base at the relevant scale. For example, large-scale water efficiency may not have been proven.
- **Operations proven** – the degree of confidence that we will be able to operate, carry out or deliver the scheme without issue. This is based on both the technology maturity and how well acquainted we are with the site – for example, introduction of an existing mothballed site would be more deliverable than the introduction of a new resource.
- **Contractual supply chain risk** – level of risk associated with suppliers and supply chain needs for scheme. This revolves around the number of players in the supply chain with whom we do not already have existing or trusted relationships. Each new relationship represents an additional element of risk within the scheme as issues are more likely to arise within new relationships where expectations are not as well established and understood as in long-standing supply chain relationships.

The scoring matrix is shown in in figure 20.

Figure 20 Deliverability scoring

Deliverability

	Third Party Approvals	Benefits Proven	Operations Proven	Contractual Supply Chain Risk
5	Scheme does not trigger any third party approval.	Anticipated results proven at scale in the UK. High degree of confidence.	Technology and resource already used by South Staffs. Proven track record in with South Staffs.	Existing supply chain with good relationships well established. Simple contractual arrangements. Low risk.
4	Scheme triggers simple third party approval. South Staffs are well versed in the process. Scheme will almost certainly be approved.	Anticipated results proven in theory or outside the UK. High degree of confidence.	Technology or resource known to South Staffs but not currently used or use being significantly increased..	Existing supply chain with some new players and some existing players. Contractual complexity relatively simple.
3	Scheme triggers moderately complex third party approval. South Staffs know the process. Some uncertainty around likelihood of approval.	Strong evidence demonstrates that the scheme will deliver anticipated results. Good degree of confidence.	Technology or resource new to South Staffs but well known to other water companies. .	Both new and existing players in supply chain for scheme. Moderate contractual complexity, moderate degree of risk.
2	Scheme triggers complex third party approval process. South Staffs unfamiliar with process. Some uncertainty around likelihood of approval.	Evidence demonstrates that the scheme will deliver anticipated results. Moderate degree of confidence.	Technology not currently implemented in the UK or new resource to South Staffs with some data availabilty , not currently used by others.	Most players in the supply chain are new to South Staffs but all have very strong track records. Contractual complexity greater than usual for South Staffs
1	Scheme requires complex third party approval, not previously undertaken by South Staffs. Much uncertainty around likelihood of approval success. It is as likely that the application will be rejected as approved.	Evidence suggests that the scheme will deliver anticipated results. May require additional investment to get these benefits. Moderate degree of confidence.	Technologies not implemented anywhere else in the world or totally new resources with no data availability. .	Most players in the scheme supply chain are new to South Staffs. High degree of contractual complexity and risk.

	Magnitude Factor
1	Less than 10 Ml/d
2	10 Ml/d - 40 Ml/d
3	40Ml/d - 100 Ml/d
4	More than 100 Ml/d

Total Deliverability Score = Sum of scores x Magnitude

10.3.1.7 Environmental sustainability

Environmental sustainability is an important part of our existing decision making and operations, with a specific Outcome Delivery Incentive (ODI) allocated to ‘Operations which are environmentally sustainable’. Within this outcome there are several different ODIs, including:

- leakage (financial incentive to meet set performance levels);
- water efficiency (PCC);
- biodiversity (non-financial reputational measure); and
- operational carbon (non-financial reputational measure).

Within the DMF, environmental sustainability has been measured through:

- lifecycle carbon;
- biodiversity; and
- sustainable abstraction.

A summary of how these indicators in the framework, including inputs and background to their development, is described below.

Lifecycle carbon

Carbon emissions are ordinarily measured as ‘embodied’ or ‘operational’. Embodied carbon is the sum of emissions of greenhouse gases from the manufacture, transport and construction of materials, together with end of life emissions. Operational carbon is the emissions of greenhouse gases during the operational or in-use phase of a building or asset.

Figure 21 Carbon scoring

Carbon Emissions

Energy Consumption		kWh/year	
Output		ML/year	
KWh/ML	=Energy / Output	KWh/ML	
CO2e factor - energy	0.50036	kgCo2e/KWh	*(UKWIR workbook 15/16value)*
Operations Carbon for Option	'= KWh/ML x kgCO2e/KWh	kgCO2e/ML	
Comparison Score			
Carbon Score	=comparison score x output		

Score	*Comparison of option carbon with corporate measure*
5	*<0.1% of total corporate emissions*
4	*>0.1% - <0.3% of total corporate emissions*
3	*>0.3% - <0.5% of total corporate emissions*
2	*>0.5 - <1% of total corporate emissions*
1	*>1% of total corporate emissions*
SST Region emissions 2015/16 = 42,796,197 Kg CO2 on 120,964Ml	

The average energy consumption per year in full operation is calculated. This is then divided by the expected output from the option to quantify KWh per Ml. This is multiplied by the emissions factor calculated in the current UKWIR workbook.

The emissions result is then compared with the corporate total figure (currently 0.48TonnesCO_2e/Ml) and a score assigned. The final carbon score is calculated by multiplying the assigned comparative score by the volumetric output of the option.

We described the impact that our operations have upon greenhouse gas emissions in section 7.6.5 of this plan.

Biodiversity

Biodiversity represents the variety and population of animals and plants and the effectiveness of the natural systems that support them. Measuring changes in biodiversity in a business's decision making demonstrates stewardship and social responsibility in this area.

In 2010, the UK was a signatory to the Convention of Biological Targets, where a set of 20 global targets were defined dedicated to biodiversity goals (known as the 'Aichi Targets'). It has taken more than five years to define a biodiversity indicator to inform the decision-making process for a business.

As biodiversity is a devolved responsibility in the UK, it is difficult to pinpoint specific quantifiable measures that are comparable. There are also many different indicators to choose from rendering any tool cumbersome for the user. Since Aichi, the Joint Nature Conversation Committee (JNCC) has defined an indicator for biodiversity specifically for decision making as the "number of publicly accessible records [within the National Biodiversity Network Gateway] at 1km^2 resolution or better".

Therefore, on a global, national and regional scale, biodiversity can be used in decision making based on land area impacted (hectares) and a qualitative means to represent change over time for any indicator relevant to the decision. The indicator developed by the JNCC does not say if the solution reaches a specific target or if the solution is 'good or bad' for biodiversity. It does, however, define if a solution has a detrimental or improving effect on biodiversity, or no change. The JNCC also included time in this qualitative method – short term representing change over five years or less and long term as changes over more than ten years. The European Environment Agency and Defra both subscribe to this method in their Key Performance Indicator (KPI) expectations.

Our current ODI for this indicator quantifies the 'number of hectares under active environmental management'. While this is an easily understandable and comparable measure, it does not define the extent of the success of the management being carried out from a particular approach or method. The DMF takes both our current measure as a scaling factor and the JNCC indicative impact scale and provides a simple way for the tool's user to define biodiversity as appropriate to the solution in question.

As with the JNCC approach, it will not specify targets to be met or if a solution is good or bad, but it does enable the decision to be informed regarding likely positive and negative impacts to an area of space affected by the implementation of a solution.

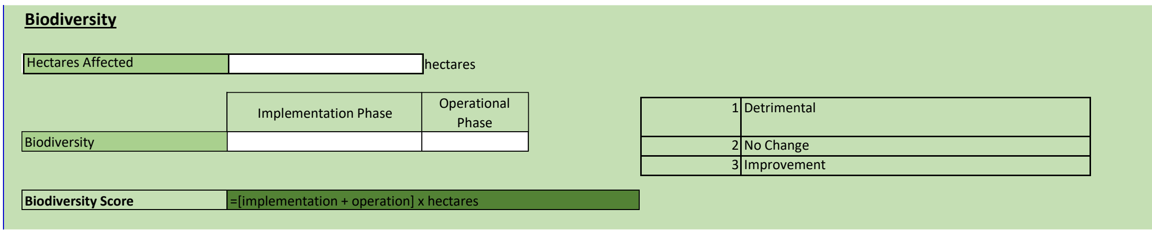
The biodiversity scoring method is shown in figure 22.

Hectares affected is based on understanding of the biodiversity in the area and how the solution may impact it.

To replicate the JNCC definition described above.

- 'implementation' period equates to five years or less from the start of build/implementation to point of hand over; and
- 'operation' represents the long-term effect on the biodiversity after the solution is implemented and is operating as business as usual.

Figure 22 Biodiversity scoring



This impact scores are defined as follows, compared to prior to implementation.

- **Detrimental** – for the biodiversity measures important to the area affected, a detrimental impact is anticipated;
- **No change** – there will be no impact or change to the existing biodiversity of the area considered;
- **Improvement** – a positive impact is anticipated from the solution in the area considered.

The scores are then scaled by area affected for option comparison.

Sustainable abstraction

Regulators and the industry at large agree that water abstraction must be sustainable and does not damage the environment. Sustainable abstraction can incorporate:

- leakage;
- water efficiency;
- metering; and
- consumer behaviour.

As these are covered in other indicators and work streams, this sub-indicator allows the user to score sustainable abstraction based on designation against the affected catchment area and the difference estimated from solution implementation.

Solution development will be done with the appreciation of the water cycle in geographical and volume terms to ensure that demand is met in the right location across the network. This is associated with the quantity measure but also that the quantity is in the right place. The current Restoring Sustainable Abstraction (RSA) programme is likely to lead to licence changes and designation changes that are not currently known, which can make this a difficult measure to pinpoint over a longer time horizon planning period.

If a region is designated as over-abstracted by the Environment Agency, then abstraction licences are likely to be reduced or removed. Some licences are also time limited.

The Environment Agency provides catchment abstraction management strategies (CAMS) for a specified catchment area. These are informed on a water availability status for the region. Our South Staffs region is considered a medium water stress area; our Cambridge region is a high water stress area (that is, it is over abstracted). The framework needs to be account for the regional differences and any potential future changes that may be enforced.

Abstraction licences impacts need to be considered using the following information.

1. Size of catchment area available and the volume affected within this area;
2. Environment Agency designation of abstraction from the catchment that is deemed sustainable; and
3. The abstraction licence available to us, even if it not fully utilised.

The DMF assesses what the change in abstraction would be against the licensed volume as a result of a solution's implementation.

The framework therefore uses volume abstracted (Ml/d) and a qualitative score based on the Environment Agency's current water resource availability status designation as a scaling factor (in order of increasing benefit).

- 1 – over abstracted.
- 2 – no water available (no new licences).

- 3 – water available, ‘no deterioration’ or impact on WFD.
- 4 – reduction in abstraction – for example, demand management.

The sustainable abstraction scoring method is shown in figure 23. The water sensitivity score is based on the Environment Agency’s definitions for the area in question.

Impact scoring is arranged to show any reduction in abstraction to have a more favourable (higher) score, and a lower score for where abstraction is taking place in areas that are highly water stressed.

Figure 23 Sustainable abstraction scoring

Sustainable Abstraction

Volume of abstraction impacted (Ml/d)	80
Water Sensitivity Score	3
Sustainable Abstraction Score	= Volume x Water sensitivity

1	Over Abstracted
2	No water available
3	Water Available, no deterioration or impact on WFD
4	Reduction in abstraction (e.g. demand management)

The sustainability abstraction score is then derived by a simple multiplication of score and output (Ml/d).

10.3.1.8 Combined score

The final indicator score is a sum of the three inputs described above. It is important to note that this indicator covers a number of different and complex elements in sustainability. The scoring is to be used for comparison purposes only. A low score does not necessarily imply a solution is detrimental to the environment, but that it has less positive benefit compared with other solutions considered.

10.3.1.9 Customer preferences

The embedding of customers’ preferences within the technical decision making process is a critical element of investment planning. In order to allow decisions to be guided by this we have used a simple indicator as shown in figure 20. This applies a score to each option based on how well it is aligned with customer preferences. This is informed by the customer engagement workshops.

10.4 Options development

Demand management options have been developed with the assistance of consultants Artesia. Details of the process of developing options and the pro formas for all feasible options are included in **appendix Q**.

Demand management options include:

- leakage reduction – including innovative options that enhance the efficacy of leak detection;
- water efficiency – options that stretch the boundaries of traditional water efficiency measures; and
- metering – more free meter options, change of occupier metering and compulsory metering with different types of meter.

As noted in section 3.1.1 we are not classified as water stressed using the Environment Agency water stress classification methodology (last updated in 2012) and therefore do not have powers to impose compulsory metering. We have carried out a partial re-evaluation ourselves to test the classification and consider our status would remain as not seriously water stressed.

Despite this we have explored the potential for compulsory metering as an option to understand whether it would prove to be the most cost-effective way to balance supply and demand going forward.

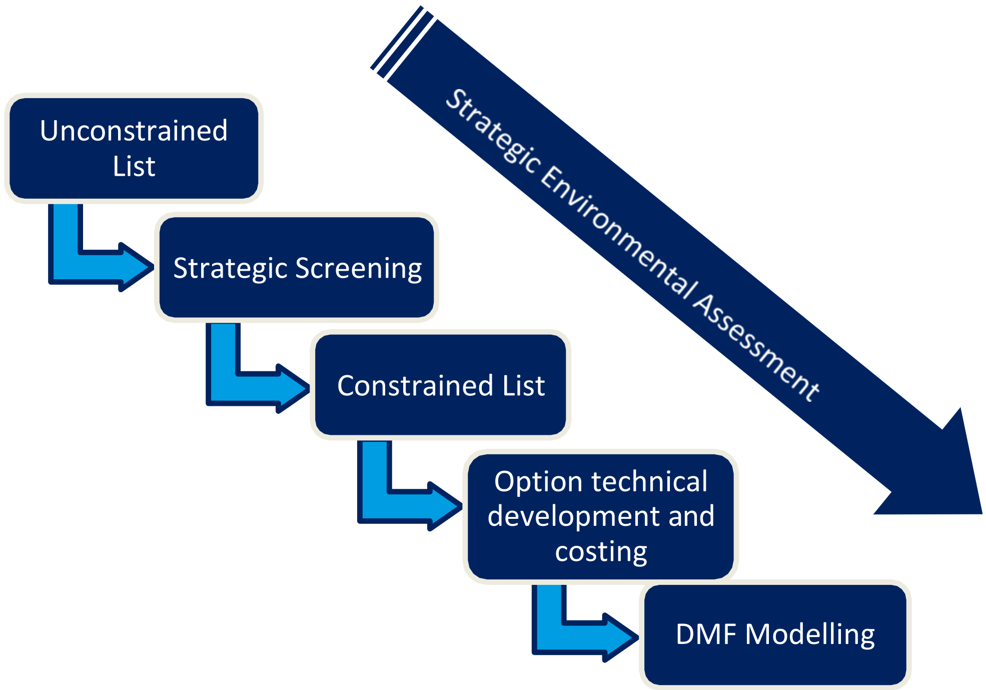
Supply options have been developed with the assistance of consultants Atkins, using a multi-stakeholder approach, both internally and externally. Details of the process of developing options and the pro formas for all feasible options are included in **appendix R**. In accordance with Defra instructions and the Security and Emergency Measures Directive Advice Notes and Guidance we have not made this detailed appendix available to the public. This report is only available to the Environment Agency.

Supply options include:

- investment in existing groundwater sources – making boreholes resilient new treatment processes based on deterioration of groundwater quality and other enhancements;
- new groundwater sources – remediation of mothballed sources, and trade or acquisition of sources from third parties;
- new surface water sources; and
- trades with third parties – neighbouring water companies and other licence holders.

Options development has followed a twin-track process from unconstrained through to constrained during which SEA has been carried out alongside options development.

Figure 24 Options development process



Stages of options development included.

- identification of unconstrained options through brainstorming events, including both internal expertise together with leading industry consultants;
- detailed engagement with the Environment Agency in developing both demand management options and resources options identification;
- initial screening using criteria such as technical and/or environmental feasibility – show stoppers;
- further review of screening following more detailed scheme description;
- Environment Agency views sought on resources options at various stages; and
- SEA scoping occurring concurrently.

The numbers of options considered throughout the process are shown in the following table.

Table 34 WRMP options considered

Option type	Number of unconstrained options	Number of streamlined options	Number of feasible options in DMF	Comments
Maintenance of existing groundwater	42	32	32	Options relate to capital maintenance of existing sources including replacement boreholes and new treatment requirements to maintain existing DO.
New groundwater	114	39	4	Options include additional boreholes at existing groundwater sources to provide greater peak output, reinstatement of sites currently unused because of treatment requirements and new locations providing additional resource.
New surface water			16	Options to develop new surface water sources and new associated treatment plants.
Third party water and trades			16	Identified from approaches to and discussions with other water companies and the Environment Agency.
Leakage reduction	190	40	5 bundles plus one separate option	Leakage options were bundled to provide packages of works to deliver different volumes of leakage reduction.
Metering and water efficiency			5 bundles plus two separate options	Metering options were bundled together with some water efficiency options to provide packages of works to deliver different volumes of saving. Some metering options were also kept as separate options.
Total	**346**	**111**	**86**	

Outline scheme design and costs were developed for each of the options included on the feasible list for modelling in the DMF. The criteria used to evaluate each option in the DMF modelling are described in the sections above. The following table summarises our evaluation of third party and trading options.

Table 35 Third party option log

Option	Gateway: Does the option give a quantity and quality of water benefit?	Does the option breach any statutory and/or regulatory constraints?	Is the option environmentally and socially sustainable/ does it meet customer and stakeholder expectations?	Is the option deliverable and/or does it increase resilience?	Have we selected this option?	Primary reason
Affinity transfer via LOPW connection	No, low certainty that this quantity will be available. Quality impacts unknown	Not to our knowledge	Environmental/ social impact uncertain – it meets expectations for more collaborative trading options	Likely to increase resilience, low certainty it is deliverable	No	Does not pass gateway – relies on a currently uncertain WRE option to provide Affinity a surplus
AWS transfer from Ruthamford South – location 1	Quantity uncertain and need to ensure SW to GW transfer acceptable in quality terms	As above	As above	As above	No	Does not pass gateway – relies on a currently uncertain WRE option
AWS transfer from Ruthamford South – location 2	As above	As above	As above	As above	No	As above

Option	Gateway: Does the option give a quantity and quality of water benefit?	Does the option breach any statutory and/or regulatory constraints?	Is the option environmentally and socially sustainable/ does it meet customer and stakeholder expectations?	Is the option deliverable and/or does it increase resilience?	Have we selected this option?	Primary reason
AWS Ruthamford North to CAM	As above	As above	As above	As above	No	As above
AWS transfer from Ely to Waterbeach – ten-year delayed start	As above	As above	As above	As above. Also note that the delay is to coincide with the growth it is designed to serve	No	As above
AWS transfer from Ely to Waterbeach – immediate start	As above and this option is too large for our needs, so will only work as a shared resource	As above	As above	Likely to increase resilience, low certainty it is deliverable	No	As above

Option	Gateway: Does the option give a quantity and quality of water benefit?	Does the option breach any statutory and/or regulatory constraints?	Is the option environmentally and socially sustainable/ does it meet customer and stakeholder expectations?	Is the option deliverable and/or does it increase resilience?	Have we selected this option?	Primary reason
AWS transfer from Haverhill to Shudy Camps	No, low certainty that this quantity will be available. Quality impacts unknown	As above	As above	As above	No	As above
AWS transfer from Haverhill to Rivey/Linton	As above	As above	As above	As above	No	As above
AWS transfer from Haverhill to Balsham	As above	As above	As above	As above	No	As above
Transfer/ Trade off with Ely Ouse Essex transfer – with new main from Kennett PS to Waterbeach	Quantity uncertain and need to ensure SW to GW transfer acceptable in quality terms	As above	As above	As above	No	As above

Option	Gateway: Does the option give a quantity and quality of water benefit?	Does the option breach any statutory and/or regulatory constraints?	Is the option environmentally and socially sustainable/ does it meet customer and stakeholder expectations?	Is the option deliverable and/or does it increase resilience?	Have we selected this option?	Primary reason
Ely Ouse Essex Transfer reversal from Abberton (including sub option)	As above	As above	As above	As above	No	The scale of this option is far greater than we require so will only work as a shared resource
Ely Ouse Essex Transfer with new res (shared with AWS) including sub option	As above	As above	As above	As above	No	The scale of this option is far greater than we require so will only work as a shared resource
Thetford (CAM)/Beck Row (AWS) sources swap	No, low certainty that this quantity will be available. Quality impacts unknown	As above	As above	As above	No	Does not pass gateway - relies on a currently uncertain WRE option

Option	Gateway: Does the option give a quantity and quality of water benefit?	Does the option breach any statutory and/or regulatory constraints?	Is the option environmentally and socially sustainable/ does it meet customer and stakeholder expectations?	Is the option deliverable and/or does it increase resilience?	Have we selected this option?	Primary reason
Thetford (CAM)/Barnham Cross (AWS) sources swap	As above	As above	As above	As above	No	As above
Licence trade at Barrington with new borehole, combined with CW54 – so added treatment and network connection at CRPW2/HEPW	Medium certainty that quantity will be available. Quality impacts unknown	As above	As above	As above	No	Does not pass gateway – needs more detail on water quality as borehole currently disused
Treated water reservoir (new service reservoir) in 'A428 corridor'	This provides storage but no additional quantity	As above	As above	It is not deliverable in isolation	No	Does not pass gateway – on water quantity grounds

Note that we used the abbreviation SW to denote surface water and GW to denote ground water in the table above. This distinction is crucial in the Cambridge WRZ as it is currently entirely supplied by groundwater.

In summary, none of the options listed in the table above are far enough advanced in terms of feasibility, environmental assessments, costing and, most crucially, confidence that they will deliver the quantity and quality of water required. As mentioned in section 4.3.6.1 we will continue to work on third party schemes through WRE and/ or via other routes. We continue to pursue options involving third parties at any stage within the five yearly WRMP cycles. Should any third party know of an opportunity of this sort we encourage them to contact us. We note that our bid assessment framework (BAF) that we have produced as part of our PR19 business plan submission will provide useful information on how we assess proposals from third parties.

The following sections describe the screening of unconstrained options to the feasible list.

10.5 Feasible options included in DMF

10.5.1 Maintenance of existing groundwater sources

Options relating to the existing groundwater sources contributing to baseline DO are included in the DMF. These options are based on requirements for maintaining the DO.

Capital maintenance requirements over the next 40 years have been identified to ensure that decisions regarding new options are considered alongside options to maintain existing sources and that we do not view continuation of output from existing sources as being at no cost

When considering capital maintenance schemes, we have factored the potential impacts on DO as a result of WFD ‘no deterioration’ into the expected yield. We have included all expected AMP6 sustainability changes and have capped those sites at risk of causing deterioration if abstraction increases above the recent actual abstraction over the period 2005 to 2015 at recent actual abstraction rates. Therefore, the options we have included are environmentally feasible.

All groundwater sources currently in use are included in baseline DO and are included in the model as capital maintenance options.

We excluded sources that are not in operation, but may be licensed, from the baseline DO. These have been reviewed in the options screening process to determine inclusion or otherwise in the constrained list. Specific examples include:

- LBPW – a licensed source which is not currently operational. This was screened out as it is low volume and the volume is included elsewhere on an aggregate licence developed into a more feasible option. There would also be a WFD limit on the available yield which screened this out on an environmental basis; and
- CRPW, SIPW, and KIPW2 – licensed sources which are not currently operational. These are options in our current drought plan and are therefore feasible. Options to reintroduce these sources are included in the ‘new

groundwater sources' options. The WFD limit on the available yield of these sources is less and therefore the options have a viable licensed yield available.

10.5.2 New sources

We screened the unconstrained list of options using the following criteria to derive the constrained list of options.

Table 36 Criteria used to screen supply options

Criteria	Considerations
Location of scheme benefits	
Scale	Option DO is proportional to the estimated supply-demand deficit.
Location	Option is within, or can serve, the area of estimated supply/demand deficit.
Future proofing	Ability to mitigate against future DO losses because of external events – climate change, licence reduction, etc.
Statutory/regulatory/legal constraints	
Planning and environmental	Likely to be acceptable in terms of planning and statutory environmental constraints.
WFD	Scheme does not cause deterioration of a WFD water body.
HRA (Habitats Regulations Assessment)	Scheme does not impact on Natura 2000 site.
Meet customer/stakeholder needs	
Customer	Scheme complies with customer experience targets and does not cause detriment to service standards. Avoidance of customer discrimination.
Internal stakeholder	Complements South Staffs Water's business plan, strategy and is in line with corporate objectives.
External stakeholder	Likely to be acceptable to third party group including local stakeholder groups.
Option robustness	
Flexibility	Option can be scaled and flexed operationally to meet supply/demand needs.
Favourable	Option is more favourable of all options identified for this water source.
Viability	Option is technically feasible.

Criteria	Considerations
Known technologies	Option is achievable without significant R&D/trials.
Licensing	Abstraction licence is likely to be secured.

The technical note in **appendix P** describes the screening process in more detail and we have also produced an annex to appendix P which contains our unconstrained list of options.

Appendix T contains a report detailing our approach to costing new sources of water.

10.5.2.1 New groundwater sources

Options to reinstate sites currently unused because of treatment requirements have been included in the DMF. We have also considered new locations providing additional resource.

Table 37 New groundwater sources options

New groundwater sources				
Option	**NYAA Yield Ml/d**	**DYAA Yield Ml/d**	**CP Yield Ml/d**	**Major investment requirements**
Re-commission SIPW	1.6	1.6	4.5	Existing licence, mothballed source. River gravels/shallow aquifer. Extensive rebuild required.
Re-commission CRPW2	1.4	1.4	2.5	Existing licence, mothballed source. Treatment review required (filters).
Re-commission KIPW2	1	1	1.2	Existing licence, mothballed source. Treatment review required (filters).
Combined Ouse Gravel Sources	2	2	5	Existing licences combined, mothballed sources. River gravels/shallow aquifer. Extensive rebuild required At location to be determined, requiring Environment Agency agreement to relocate abstraction point.

When considering all schemes we factored the potential impacts on DO as a result of WFD 'no deterioration' into the expected yield. All agreed AMP6 sustainability changes have been included in baseline DO and a reduction to this has been applied for WFD 'no deterioration' risk. In agreement with the Environment Agency, we capped deployable outputs at the recent actual abstraction for the period 2005 to 2015 to ensure there is 'no deterioration' risk while investigations are carried out in AMP7.

10.5.2.2 New surface water sources

There are limited available surface water resources within or close to our area of supply. The chalk rivers typical of the area are unsuitable for large PWS abstractions and already have existing environmental impacts. The only viable surface water source in the region is the River Ouse. We have explored options at two key locations – the Ely Ouse and Great Ouse in the main reaches of the river where flows could be available, at high flows. We have also developed options that take a transfer from the Ely Ouse Essex Transfer scheme, a strategic north to south transfer which uses the same source. We categorised these as trades/transfers.

Table 38 New surface water sources options

Option	New surface water sources			
	NYAA yield Ml/d	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
Upper Stour Reservoir	40	40	40	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
Abstraction from Ely Ouse with reservoir	24	24	24	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
Abstraction from Ely Ouse, with reservoir – ten-year delay to coincide with settlement development North of Waterbeach	25	25	25	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
Abstraction from Ely Ouse, with reservoir – no delay, pipeline connection to further South into grid	25	25	25	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable

Option	New surface water sources			
	NYAA yield Ml/d	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
Abstraction from Ely Ouse, with reservoir – including wider environmental benefits	20	20	20	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable. Landscaping access and habitat creation
Abstraction from Ely Ouse, with reservoir – supported by Anglian Water transfer	40	40	40	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
Abstraction from Ely Ouse, with reservoir – supported by Anglian Water transfer and wider environmental benefits	40	40	40	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable. Landscaping access and habitat creation
New raised reservoir on Great Ouse	40	40	40	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
New raised reservoir on Great Ouse – sub-option with smaller DO output	24	24	24	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
New raised reservoir on Great Ouse – with wider environmental benefits	30	30	30	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable. Landscaping access and habitat creation
New raised reservoir on Great Ouse – sub-option with smaller DO output and wider environmental benefits	18	18	40	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable. Landscaping access and habitat creation

Option	New surface water sources			
	NYAA yield Ml/d	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
String of high flow winter reservoirs – one site	10	10	10	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
Two high flow winter reservoirs – two sites	20	20	20	New intake and treatment works, associated infrastructure, new reservoirs and transfer pipelines, raw and potable
Three high flow winter reservoirs – three sites	30	30	30	New intake and treatment works, associated infrastructure, new reservoirs and transfer pipelines, raw and potable
Four high flow winter reservoirs – four sites	40	40	40	New intake and treatment works, associated infrastructure, new reservoirs and transfer pipelines, raw and potable
String of high flow winter reservoirs – four sites, sub-option with smaller overall DO	24	24	40	New intake and treatment works, associated infrastructure, new reservoirs and transfer pipelines, raw and potable

These surface water options on the Ouse are equivalent to, or have been included as part of the WRE project (see section 4.3.6.1). Other water companies in the region also have options which make use of water from the Ouse and there are already a number of licensed abstractions. An Ouse working group with members from Anglian, Cambridge, Essex and Suffolk and the Environment Agency has been formed to understand all the potential options associated with the Ouse. This group has liaised to determine what the available yields would be from the Ouse.

10.5.2.3 New trades/third party inputs

We have explored the opportunity for third parties to provide water to us. This includes:

- treated water transfers;
- raw water transfers; and
- licence trades.

The feasible options which were included in the DMF are as follows:

Table 39 New trades/third party inputs options

Option	New surface water sources			
	NYAA yield Ml/d	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
Affinity transfer via LOPW connection	8	8	8	Requires a WRE option to enable Affinity surplus from existing North ring main
AWS transfer from Ruthamford South – location 1	8	8	8	Similar WRE option. Potable treated water – Graffham SW origin to West of CAM area in A428 corridor
AWS transfer from Ruthamford South – location 2	8	8	8	As above, input South of A428 corridor
AWS Ruthamford North to CAM	5	5	5	Similar WRE option. (larger yield) Potable water – SW/GW into North of CAM area. Could be purchase of GW source as alternative.
AWS transfer from Ely to Waterbeach – ten-year delayed start	10	10	10	Potable transfer, supported by WRE options, East of CAM supply area. Delay to coincide with growth in location
AWS transfer from Ely to Waterbeach – immediate start	40	40	40	As above, no delay
AWS transfer from Haverhill to Shudy Camps	10	10	10	Potable transfer, supported by WRE options, SE of CAM supply area
AWS transfer from Haverhill to Rivey/Linton	20	20	20	Potable transfer, supported by WRE options, SE of CAM supply area
AWS transfer from Haverhill to Balsham	10	10	10	Potable transfer, supported by WRE options, SE of CAM supply area

Option	New surface water sources			
	NYAA yield Ml/d	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
Transfer/trade off with Ely Ouse Essex transfer – with new main from Kennett PS to Waterbeach	10	10	10	WRE option. Raw trade from EOETS, treated at either end. East of area, depending on treatment location
Ely Ouse Essex Transfer [EOETS] reversal from Abberton (includes a sub-option with smaller DO)	40 (24)	40 (24)	40 (24)	Reversal of EOETS from Abberton reservoir. Otherwise similar to above. Would be supported by WRE options
Ely Ouse Essex Transfer with new reservoir, shared with AWS (includes sub-option with smaller DO)	40 (24)	40 (24)	40 (24)	WRE option. Shared resource with AWS, CAM supplied via EOETS or new main (raw SW) with treatment to east of area.
Thetford (CAM)/Beck Row (AWS) sources swap	4.9	4.9	10.7	Acquisition of AWS GW sources with close proximity to existing main. Supported by WRE options for AWS
Thetford (CAM)/Barnham Cross (AWS) sources swap	4.9	4.9	10.7	
Licence trade at Barrington with new borehole, combined with CW54 – so added treatment and network connection at CRPW2/HEPW	0.24	0.24	1.2	Third party disused BH adoption
Treated water reservoir (new service reservoir) in 'A428 corridor'	2	2	8	Additional storage only – requires trade from AWS or other resource. AWS trade into west of area or new resource development

We have held discussions with Anglian Water and Affinity Water to consider the opportunities for bulk water trades. The WRE regional water resources strategy group also considers a variety of transfer options, and large resources options from all companies are included in the regional modelling. Some transfer options may be dependent on a larger resource being developed by one of the other companies to increase available resource to facilitate the trade and WRE considered these issues.

10.5.3 Demand management

We screened the unconstrained list of options using the following criteria to derive the constrained list of options.

Table 40 Demand management options screening

Criteria	Considerations
Yield uncertainty	What is the risk/uncertainty of the option delivering its estimated water saving?
Lead time	What is the time required to deliver the water savings?
Flexibility	Has the adaptability of an option be reflected?
Security of supply	How robust is the overall scheme?
Environmental impact	Will the option result in environmental impacts?
Sustainability	What is the impact of the option on wider sustainability?
Promotability	Will customers support the option?
Suitability	How well the option meets the assumed planning problem?
Technical difficulty	How difficult the option is to deliver?

After the screening exercise there remained around 35 options of which some represented only very small savings. We then created bundles of options which delivered different volumes of saving. We created bundles for leakage activities, some combined bundles for water efficiency and metering and some separate metering options

We based the savings for all options on annual averages. For metering there may be some additional peak benefits but there is limited evidence to support this and therefore we did not include this.

Metering options were based on automatic meter reading (AMR) meters, unless otherwise stated as advanced meter infrastructure (AMI) smart meters. We based the options on programmes of five years' duration unless otherwise stated.

Leakage reduction bundles 1.0 to 1.4 (phase 1) were tested in early runs of the DMF to test the baseline leakage reduction to be committed to. Leakage reduction bundles 1.5 to 1.8 (phase 2) and the live network option replaced the earlier leakage bundles in later runs to test how much more leakage could be reduced economically.

The make-up of the leakage and metering bundles is shown in the following tables. Full details of all the demand management options are included in **appendix Q**.

Figure 25 Phase 1 leakage reduction options

Bundles	Sub-option code	Sub-option name	Yield profile: Year first delivery	Year maximum yield	Maximum yield
Leakage Bundle 1.0	129	Pressure Management	1	1	1.64
Leakage Bundle 1.0	073a	ALC Ph.1	1	2	0.87
Leakage Bundle 1.1	059_60	Improve allowances	2	3	0.16
Leakage Bundle 1.1	073b	ALC Ph.2	3	5	0.78
Leakage Bundle 1.2	088	DMA sub-metering	1	2	0.81
Leakage Bundle 1.2	073c	ALC Ph.3	6	10	1.30
Leakage Bundle 1.3	057	TMSR monitoring	1	5	0.30
Leakage Bundle 1.3	073d	ALC Ph.4	11	15	1.10
Leakage Bundle 1.4	180a	LDAR Ph. 1	1	10	0.25
Leakage Bundle 1.4	180b	LDAR Ph. 2	1	10	0.22

Cam Leakage Bundle 1.0	1	2	2.5
Cam Leakage Bundle 1.1	1	5	3.4
Cam Leakage Bundle 1.2	1	10	5.6
Cam Leakage Bundle 1.3	1	15	7.0
Cam Leakage Bundle 1.4	1	15	7.4

sub-option code	sub-option name	Yield profile: year first delivery	Year maximum yield	max yield
500	Live Network	1	3	0.78

Figure 26 Phase 2 leakage reduction options

			Yield profile		
Bundles	Sub-option code	Sub-option name	Year first delivery	Year maximum yield	Maximum yield
CAM Leakage Bundle 1.8; CAM Leakage Bundle 1.7; CAM Leakage Bundle 1.6; CAM Leakage Bundle 1.5	059_60	Improve allowances	2	3	0.18
	073b	ALC Ph.2	3	5	0.78
	088	DMA sub-metering	1	2	0.81
	073c	ALC Ph.3	6	10	1.30
	057	TMSR monitoring	1	5	0.30
	073d	ALC Ph.4	11	15	1.10
	180a	LDAR Ph. 1	1	10	0.25

CAM Leakage Bundle 1.5	1	5	1.77
CAM Leakage Bundle 1.6	1	10	3.37
CAM Leakage Bundle 1.7	1	15	4.47
CAM Leakage Bundle 1.8	1	15	4.72

Figure 27 Water efficiency and metering options

Option Code	Option	modified	year first delivery	Year maximum yield	year stop delivery	yield profile	Max Yield (Ml/d)	2079/2080 Yield
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.2	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.2	
157a	Dual flush toilets social housing	N	1	5	14		0.1	
307	Variable infrastructure charge	N	1	10	14		0.3	
023a	Non HH water efficiency programme - company led site visit with installation	N	1	5	14		0.2	
207A	Compulsory Metering AMR	N	1	25	none		1.7	
	CAM - WEM 1.0		1	10	none		2.5	1.7
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.2	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.2	
157a	Dual flush toilets social housing	N	1	5	14		0.1	
307	Variable infrastructure charge	N	1	10	14		0.3	
023a	Non HH water efficiency programme - company led site visit with installation	N	1	5	14		0.2	
206A	206 FMO AMR	N	1	25	none		0.2	
	CAM - WEM 1.1		1	10	none		1.0	0.2
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.2	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.2	
157a	Dual flush toilets social housing	N	1	5	14		0.1	
307	Variable infrastructure charge	N	1	10	14		0.3	
023a	Non HH water efficiency programme - company led site visit with installation	N	1	5	14		0.2	
111A	111 Change of Occupier AMR	N	1	25	none		0.4	
	CAM - WEM 1.2		1	10	none		1.3	0.4
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.2	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.2	
157a	Dual flush toilets social housing	N	1	5	14		0.1	
023a	Non HH water efficiency programme - company led site visit with installation	N	1	10	14		0.2	
207S	Compulsory Metering AMI	N	1	25	none		2.3	
	CAM - WEM 1.3		1	10	none		2.8	2.3
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.2	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.2	
157a	Dual flush toilets social housing	N	1	5	14		0.1	
307	Variable infrastructure charge	N	1	10	14		0.3	
023a	Non HH water efficiency programme - company led site visit with installation	N	1	5	14		0.2	
	CAM - WEM 1.4		1	10	14		0.9	

207S	Compulsory Metering AMI	N	1	25	none		2.3	2.3
207A	Compulsory Metering AMR	N	1	25	none		1.7	1.7

CAM Final Committed WEM

	CAM - WEM 1.5	Y	1	5	none		0.6	0.6
206A - Committed	206 FMO AMR	N	1	25	none		0.3	0.3

10.5.4 Resilience options

We considered a number of options specifically for resilience purposes only. These include:

- enhancing our existing groundwater portfolio, by drilling additional boreholes, therefore reducing the impact of asset outage; and
- upsizing some delivery mains to ensure we can transport our maximum license value from our existing groundwater assets.

We appraised these options within the DMF in the same way as all the other supply- and demand-side options and scored them all for how they affect operational resilience. Where included in the preferred portfolio, we can demonstrate customer support.

10.6 Customer support for options

Our approach to customer engagement and the findings from that work are described in detail in section 5.

In general terms, customers are more in favour of all aspects of demand management, including:

- leakage reduction;
- metering; and
- education to help change behaviours.

Customers have not expressed a desire to improve levels of service and reduce the frequency of temporary use bans.

10.7 Modelling results

To successfully demonstrate that the preferred portfolio is effective and robust in meeting a range of future uncertainties, we appraised a series of scenarios within the model.

These scenarios mainly focused on stress testing the demands or available yields within the options; however, we also looked to understand the certainty in deliverability of an option and how the model would behave if some feasible options were excluded from the analysis (for example, the live network option). In addition to this, we have optimised across a range of the other objectives included within the MCA to understand how bringing in portfolios with a greater level of resilience, or more focused on customer preferences would change the base portfolio.

Through the scoring of some of the objectives within the MCA approach, such as resilience and deliverability we were able to generate the following scenarios.

- Scenario 1: Reduced DO as a result of a more extreme view of the impact of WINEP (additional 11Ml/d reduction on DYAA DO).
- Scenario 2: Reduced DO and demand because of drought.
- Scenario 3: A higher rate of growth than currently predicted.
- Scenario 4: Exclusion of options where there was some particular uncertainty:
  - Live network (because of uncertainty of volumes delivered).

We then overlaid the outputs of our specific WRMP customer engagement work to ensure that our customer preferences around the supply and demand options were reflected within our preferred portfolio, enabling us to demonstrate a level of customer interaction and co-creation.

We then considered the outputs of the DMF for each of these scenarios in the context of the distribution network to ensure that we maintained or improved on our customer priorities and hygiene factors such as continuous supplies and excellent water quality.

10.7.1.1 Base – least cost run

We derived our least cost programme from a combination of two modelling runs of the DMF.

- The first run had no reductions to DO for WINEP and was the baseline demand forecast. This identified the most cost-effective leakage reduction.
- The second run included the leakage reduction identified in stage 1 applied to the demand forecast and also included reductions in DO applied to our groundwater sources to reflect the most likely impact from WINEP.

Results

- Groundwater – 97Ml/d DO for DYAA (maintain all sites except RIPW and HEPW).
- Leakage – 2Ml/d reduction over AMP7.
- Compulsory metering – from year 24.
- Live network – earliest introduced in year 15 (1.4Ml/d).
- Trades – Affinity via LOPW (year 55).

10.7.1.2 Sensitivity testing

We then considered scenarios to test the least cost programme. The identified leakage reduction was applied to the demand forecast line for these runs so a 2Ml/d leakage reduction was an embedded option in all cases.

Scenario 1 – more extreme WINEP

We looked to apply a more severe application of the potential impact of WINEP. This looked at the additional impacts from time limited licences renewed in April 2018 with an aggregate being capped at individual recent actual volumes. To enable the model to return a feasible result we had to reduce the construction period of those feasible solutions that could be delivered in time for a 2020 start date.

Results

- Groundwater – 93Ml/d DO on DYAA (maintain all sites).
- Leakage – 2Ml/d reduction (included by reducing demand).
- Live network – year 16 (1.4Ml/d).
- Compulsory metering – year 26.
- New Groundwater – re-commission CRPW2 (1.4Ml/d).
- Trades – Affinity via LOPW (year 55).

Scenario 2 – Drought

We then considered scenarios to test the least cost programme. The identified leakage reduction was applied to the demand forecast line for these runs so a 2Ml/d leakage reduction was an embedded option in all cases.

In this scenario, we set the available groundwater yield at the DO modelled for the worst drought impacts at those sources where yields could be reduced in drought. The demand applied for dry year average, and the peak scenario is the constrained demand after any drought management measures have been employed.

Results

- Groundwater – 85Ml/d DO on DYAA (maintain all sites).
- Leakage – 2Ml/d reduction (included by reducing demand).
- Live network – year 4 (1.4Ml/d).
- Compulsory metering – year 18.
- Additional leakage – year 7 rising to 3.4Ml/d by year. 15.
- New groundwater – re-commission CRPW2 (1.4Ml/d).
- Trades – Affinity via LOPW (year 55).

In this portfolio, as a result of available licences already being reduced for ‘no deterioration’, more increases in demand management are required, reflecting the need for drought management options as per our drought plan.

Scenario 3 – Higher rate of growth than predicted

Because of the scale of growth we are experiencing in the Cambridge area, and the levels of growth forecast to continue, we have run a scenario with a higher demand forecast based on an increase in properties above that included in our baseline demand forecasts. The need to consider a higher growth scenario is further supported by development proposals such as the Milton Keynes−Oxford−Cambridge corridor. The impact of this on the future development of Cambridge is not clear at this stage but it is prudent to take the view that growth will be greater.

We generated feasible portfolios which were in line with the extreme WINEP scenario, utilising more of the available groundwater.

Scenario 4 – Excluding uncertain options

There is some uncertainty over the scale of leakage reduction which the live network option could deliver. Since this was selected in most portfolios within the 25-year planning period we tested to see what the alternative option would be if we excluded this from the modelling.

The feasible portfolios were similar to those selected for the extreme WINEP scenario, utilising more of the available groundwater.

10.7.1.3 Resilience

We also looked to understand the benefit of maximising the levels of resilience we could achieve by potentially doing something different within our asset portfolio.

We had included a number of feasible options that delivered the same DO, but offered more in terms of operational resilience. Coupled with this we also included network options to enhance our transfer capabilities, improving our operational flexibility.

We ran a series of scenarios targeting increased operational resilience. There was a clear trade-off between cost and resilience. We also tested the outputs of these scenarios with our network experts to ensure that the optimised portfolios were both feasible, in terms of network constraints and also delivered local operational resilience.

10.7.1.4 The preferred portfolio

The outputs presented in the table below show the journey from the base least cost scenario through to a hybrid portfolio that we consider demonstrates a robust flexible approach to ensuring the balance of supply and demand into the future. The preferred portfolio has been shaped by what our customers have told us is important. In essence this promotes demand-side opportunities and balances resilience benefits against cost for supply-side options.

Table 41 Preferred portfolio

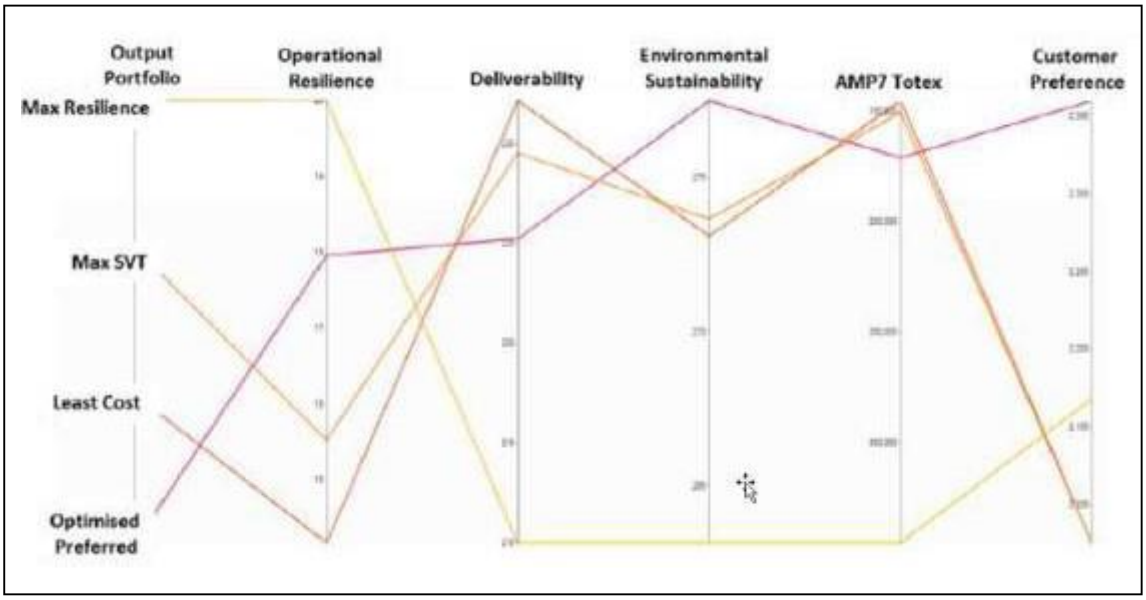
	Portfolio results						
	Baseline	WINEP applied (leakage reduction applied)	Drought (leakage reduction and WINEP applied)	Extreme application of WINEP (leakage reduction applied)*	Increased operational resilience (with WINEP and leakage reduction)	Reflecting customer preferences (with WINEP and leakage reduction)	Preferred
Existing groundwater	All existing groundwater – excluding RIPW and LIPW	All existing groundwater – excluding RIPW and LIPW	All existing groundwater (further reduce yield)	All existing groundwater	All existing groundwater	All existing groundwater	All existing groundwater
Leakage	2Ml/d reduction live network – yr14 1.4Ml/d	2Ml/d reduction live network – yr14 1.4Ml/d	2Ml/d reduction live network – yr4 1.4Ml/d	2Ml/d reduction live network – yr16 1.4Ml/d	2Ml/d reduction live network – yr1 1.4Ml/d	2Ml/d reduction live network – yr14 1.4Ml/d	2Ml/d reduction Explore live network
Demand management	Compulsory Metering yr24 – rising to 2.3Ml/d by yr51	Compulsory Metering yr24 – rising to 2.3Ml/d by yr51	Compulsory Metering yr18 – rising to 2.3Ml/d by yr45	Compulsory Metering yr26 – rising to 2.3Ml/d by yr53	Compulsory Metering yr26 – rising to 2.3Ml/d by yr53	Increase meter optants Increase water efficiency	Increase meter optants Increase water efficiency
New groundwater	Nothing selected	Nothing selected	Reintroduce CRPW2	Reintroduce CRPW2,	Reintroduce CRPW2, KIPW2 and SIPW	Nothing selected	Reintroduce CRPW2, KIPW2 and SIPW
New surface works	Nothing selected	Nothing selected	Nothing selected	Nothing selected	Nothing selected	Nothing selected	Nothing selected

Portfolio results							
	Baseline	WINEP applied (leakage reduction applied)	Drought (leakage reduction and WINEP applied)	Extreme application of WINEP (leakage reduction applied)*	Increased operational resilience (with WINEP and leakage reduction)	Reflecting customer preferences (with WINEP and leakage reduction)	Preferred
Trades	Affinity – LOPW yr 55	Affinity – LOPW yr 55	Affinity – LOPW yr 55	Affinity – LOPW yr 55	Affinity – LOPW constructs sooner, but not utilised	Affinity – LOPW yr 55	Affinity – LOPW yr 55

*Same portfolio was selected for increased growth.

The figure below shows how our preferred programme (or portfolio) delivered greater resilience, environmental sustainability and better met customer preferences than the least cost plan.

Figure 28 Plot showing our preferred and alternative portfolios



10.8 Managing and monitoring the delivery of our programme

Following receipt of a letter from Defra on 24 May 2019, we have included the following text to set out how we will manage delivery of our preferred programme and monitor this on an annual basis.

10.8.1 Sensitivity testing carried out

The options development in section 10 and the model runs and sensitivities that we have explored and are discussed in section 10.7 have been fundamental to developing our preferred plan. While we have not proposed an adaptive plan, the multiple criteria modelling inherently includes options that can be adaptive. Our approach also selects a portfolio of preferred options, all of which are ‘no regret’ options. By no regrets options we mean options that we are certain will be required at some stage within the timescales of our plan.

The sensitivities already explored indicate that our preferred portfolio provides resilience to variations in scenarios, such as an increased growth profile or consumption increasing at a higher rate than expected. For example, our high-growth scenario is broadly representative of what would occur if PCC remained higher than our forecast. For instance, if our household PCC estimates are 3l/p/d lower than turns out to be the case this would equate to approximately 1Ml/d higher demand than we forecast. Our surplus above target headroom in the dry year annual average scenario is greater than this and in the peak week it is significantly higher. As a result, we do not consider that such an eventuality would threaten security of supply.

10.8.2 How we would bring options forward

By disaggregating any of the supply-side or demand-side options, we would be able to apply an adaptive approach to delivery of our long-term plans if necessary. This is because the majority of options have a relatively short lead in time. For example, we could deliver any one of our supply-side options earlier in the AMP7 period, or accelerate some or all of the demand management options. Our modelling indicates that additional options, in particular on the supply side, would not be necessary until beyond the 25-year plan horizon. These supply options are considered within the WRE long-term regional plan, either as stand-alone options, or transfers supported by multi-stakeholder options. As such, these are still undergoing refinement but may be included for earlier delivery in updated WRMPs if the planning assumptions change significantly.

10.8.3 Decision points

The preferred plan shows a surplus over target headroom for the 25-year period with the options proposed. We review progress against expected outputs and forecasts each year through the established WRMP annual review process. For example, we submitted our 2018/19 annual review to the Environment Agency and Defra on 28 June 2019. If at any point within the plan the annual outturn data indicates that we are using the target headroom for a typical scenario then, where appropriate, this would trigger:

- an investigation into the reason and a process to identify remediation;
- increased frequency of monitoring and review; and
- a review of the likely effect on the supply/demand balance.

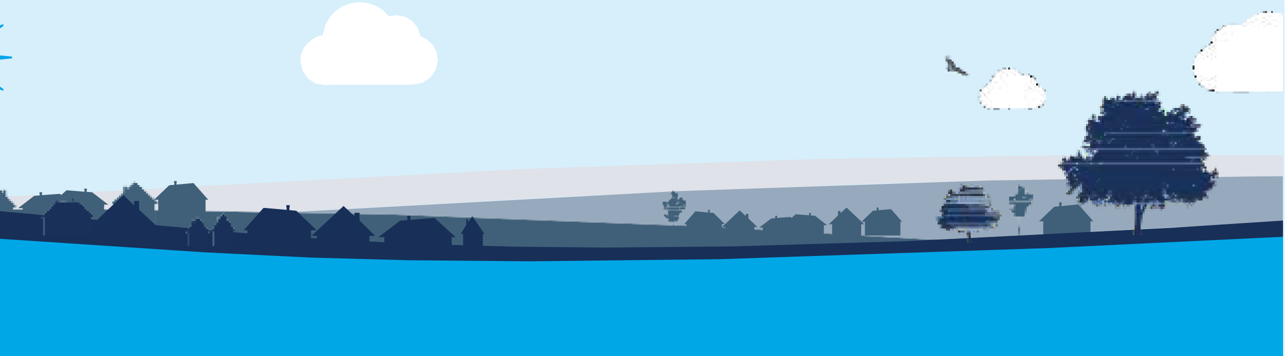
If this showed a deficit, then we would identify which, if any, other options are required. These options will include those described within this plan, any option that we have been told about through our WRE involvement or a new option that we have received via the Bid Assessment Framework (BAF) process. We will always use the most up-to-date data, costs and list of options we have available.

10.8.4 Engagement with the Environment Agency

Should the impact on the supply/demand balance or changes be of sufficient materiality, this would constitute a material change and require that we fully revise our WRMP. We consider this extremely unlikely, but will follow this route if required.

We also use the annual review data and any trends to identify any risk to achievement of longer-term objectives in the preferred plan that can then inform the next five-yearly WRMP revision.

Section 11:
Proposed programme



11. Proposed programme

Proposed programme

Our proposed programme has been informed by our multi-criteria modelling approach to determine the best mix of supply and demand policies and options, and has been heavily influenced by what our customers have told us they want us to do. For example, we increased our ambition in terms of per capita consumption (PCC) reduction as a response to the public consultation on our draft WRMP.

Demand management ambition

Customers have told us they want us to do more to reduce leakage, be more effective in how we help them to use less water and that they support metering as the fairest way to pay for the water they use.

Despite this current performance, we have taken customer preferences for further demand-side options on board and have included ambitious plans in our proposed programme.

Leakage

We will reduce total leakage by 2Ml/d from the 2019/20 performance commitment level of 13.5Ml/d by 2024/25.

We have committed to reduce leakage over the entire 25 years of the planning period. We plan to explore the costs and benefits of implementing a live network to aid more effective and efficient leakage reduction.

Metering

While a compulsory metering option was selected during optimisation, we know that although our customers support metering, they are not in favour of a compulsory approach. So, we will enhance our engagement with customers to educate them around the benefits of opting for a meter. We will target an additional 500 meter installations a year for the first ten years in addition to those included within the baseline demand forecast. We will target 90% meter penetration by 2044/45.

Water efficiency

We will target a reduction in dry year PCC to 132l/p/d by the end of AMP7. We will do this by delivering a varied programme of water efficiency measures. This is likely to include engagement with developers to explore incentives for them to include rainwater harvesting and grey water recycling within new sites. Where possible we will target water efficiency advice at those customers who may have concerns regarding affordability of water bills.

We will continue to explore innovative ways to work with customers to help them change their water using behaviour to make sustainable savings. We will consider options for 'smart meter' devices that would help our customers monitor and control how much water they use – something they said would be useful to them.

We are currently assessing the relative costs and benefits of our trial of the 'WaterSmart' customer engagement programme.

Final demand forecast

As a result of our ambitious demand management proposals, the final DYAA planning demand forecasts are 8Ml/d lower than the baseline forecasts by 2045. Household demand is 2.5Ml/d lower and the remaining 5.5Ml/d is from leakage reduction.

Proposed programme continued

Supply options

Our modelling confirms that continuing with our current base of resources is the most efficient and resilient solution.

The reintroduction of CRPW2 was required in both extreme WINEP and increased greater than predicted growth scenarios; therefore, we are including this in our final portfolio, because of the uncertainty in both.

We included investment for capital maintenance in our PR19 business plan that we submitted to Ofwat in September 2018.

Resilience

We have included a number of options which will bring important local resilience.

- Both HEPW and RIPW were not selected in the base run; however, from a local resilience point of view these sites are critical. Therefore, we have included these in our preferred portfolio.
- Also, the reintroduction of KIPW2 and SIPW provide additional local resilience, together with resilience to asset outage.
- Including options for resilience in our preferred plan provides adaptive options that can be delivered to accelerated timescales, if for example, our demand management options realise their benefits in a slower way than we expect.

11.1 Demand management proposals

11.1.1 Leakage reduction

As evidenced in section 5, our customers have been very clear on their preferences regarding levels of leakage.

- Reducing our leakage levels emerges as a clear and consistent priority among most customers.
- There is a strong and consistent view that we need to do more to reduce leakage from current levels.

When we take this into account and optimise our options on customer preferences the preferred programme includes a 2Ml/d (or 15%) reduction in total leakage to be achieved by the end of 2024/25. We will deliver this through the following initiatives.

- Deployment of additional field-based detection resource. This resource will become less efficient as the level of leakage falls to a point where the costs increase exponentially when compared to the benefit achieved. The forecast reductions can be achieved before the point at which costs become prohibitive.
- Effective management of repairs to ensure that work is completed quickly in order to ensure the leak volume is minimised. The number of repair teams available is currently and will continue to be continuously reviewed in order to optimise repair times.

- Our mains rehabilitation programme will continue to use leakage and burst indicators to prioritise activity. The full extent of the rehabilitation is subject to Ofwat's PR19 decision but, as a minimum, we anticipate that we will maintain the current levels of investment.
- Expansion of the current pressure management programme. Network pressures can be reduced within certain parts of the network without adversely impacting upon the service provided to customers.
- Continuation of the existing programme to split large DMAs to a level that provides a volume of total consumption that allows any consumption variance to be observed. This variance is then used to alert operational staff and deploy the appropriate resource.
- Further utilisation of automated detection equipment within specific areas of the network to enhance the speed of detection. This equipment will help to prioritise active leakage control (ALC) resource within certain parts of the network.
- Continuation of a revised assisted repair policy for customer supply pipes, which has significantly enhanced the efficiency associated with the supply pipe repair and replacement process.
- Consideration of the benefits of wider roll-out of a pilot scheme within our current mains rehabilitation programme in order to deliver cost-effective supply pipe leakage repairs, lead replacement, resolution of water quality issues (discolouration) and enhancing meter penetration. Effective and targeted customer engagement ahead of works commencing is a key element of this pilot.
- Our DMF modelling also identified the deployment of the live network as a preferred option from 2035. Work is ongoing to fully understand the costs and timescales associated with a full live network. We anticipate that this investment will deliver greater benefits than those currently identified. However, there is a significant gestation period associated with installation and full benefits being realised. We are currently evaluating the period over which the capital investment would need to be phased for both field and host hardware. The annual operating and maintenance costs also have to be considered which include the efficiency of ALC resource. We will explore the most cost-effective way to implement a live network to assist further leakage reduction with a view to potentially realising this earlier than 2035.

A more detailed description of a live network is contained within the Artesia report on demand management options in **appendix Q**.

The sustainable level of leakage (SELL) methodology for leakage target setting has been superseded and is no longer appropriate. However, for the benefit of transparency and continuity we have continued to produce the figure for comparison purposes. This provides context for the 2Ml/d reduction we are proposing. The SELL for PR14 is 15.5Ml/d with a Performance Commitment of 13.5Ml/d.

Analysis of the SELL has been carried out using both the current leakage calculation and using the new ‘consistency’ methodology as described in section 6. Both approaches indicate that the short-run SELL decreases through time because of the impact of the increasing cost of water, driven largely by the shadow price of carbon increase.

Table 42 SELL analysis – current and consistency methods

	Current method	Consistency method
SR-SELL (2015/16)	15.5Ml/d	n/a
Performance commitment	13.5Ml/d	n/a
2016/17 reported leakage	14.3Ml/d	15.6Ml/d
SR - SELL (2020/21)	14.1Ml/d	15.4Ml/d
SR – SELL (2024/25)	13.8Ml/d	15.0Ml/d
Leakage included in final demand scenario (2024/25)	11.5Ml/d	n/a

The proposed 2Ml/d reduction is significantly greater than the economic reduction indicated by the revised SELL calculation.

To achieve this change in leakage by the end of 2024/25, we have already started preparatory work with a view to seeing some benefits before 2020. We are currently quantifying this benefit.

In our WRMP tables and PR19 business plan submission we have shown the reduction in leakage to be linear between now and 2024/25. As a response to representations received to the public consultation on our draft WRMP, we have also included a linear reduction in leakage for the remaining 20 years of the planning period.

We are moving towards reporting leakage on a nationally consistent basis. We will complete this process by 2020. One significant barrier to this is the reporting of household and non-household night use values in a consistent way. We are currently upgrading our household night use monitor in our South Staffs region and are implementing a new household night use monitor in this region, along with new non-household night use monitors in both areas. This will allow us to report night use in a consistent way to the minimum night flow (MNF) value, on a daily basis.

We are making changes to our Waternet reporting software in the 2018/19 reporting year. This is part of the programme that we will complete by the end of AMP6. During AMP6, we are ‘shadow reporting’ to Ofwat leakage produced, as far as possible, in the new consistent method. In our most recent annual performance report, the shadow value was 0.4 Ml/d different to our ‘live’ value. This suggests that the impact of the reassessment will not be material to our preferred plan.

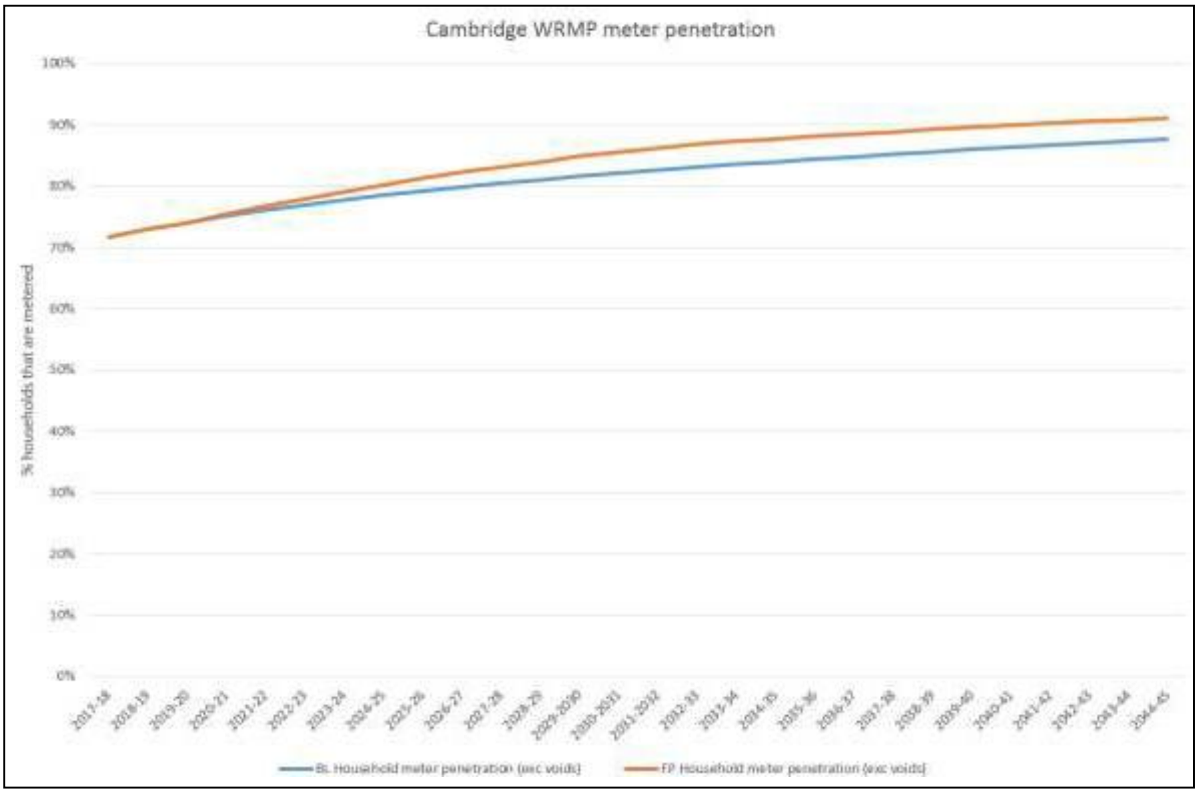
11.1.2 Metering

As evidenced in section 5 customers viewed increased metering as a necessary and important approach for us to carry out. They expressed concern over affordability for customers struggling to pay their bills and did not give overwhelming support for compulsory metering.

Meter penetration (excluding voids) in 2017/18 was around 70% and the baseline demand forecast shows this rising to 88% by 2044/45.

Customers support metering in principle. Through provision of better information to customers we will aim to educate customers about the benefits of opting for a meter and will target those on low incomes under our proposed water efficiency programme to help them manage their bills. We will target an additional 500 meter installations a year for the first ten years in addition to those included in the baseline forecast each year. As a result of this meter penetration will reach 90% by 2044/45. The following chart shows the overall growth in meter penetration under the baseline scenario and the final planning scenario.

Figure 29 WRMP meter penetration (excluding voids)



11.1.2.1 The cost of metering

In accordance with the Water Resources Direction we include the cost of our proposed household metering programme in the following table.

Table 43 Cost of our proposed household metering programme

	AMP7	AMP8	AMP9	AMP10	AMP11
New supplies					
Total number in period	11,070	7,700	6,240	6,170	6,170
Operating costs in period	£17k	£40k	£56k	£72k	£87k
Optant and selective meters					
Total number in period	6,560	5,600	3,670	2,330	2,040
Operating costs in period	£9k	£24k	£35k	£42k	£47k
Installation costs (total for period)	£1.36m	£1.24m	£0.81m	£0.51m	£0.45m

The installation of meters for new connections is funded through the connection charge and therefore there is no direct cost to us. However, ongoing operating costs do accumulate and these are shown in the table above.

Optional metering is part of our existing metering strategy and we have responded to customer preferences and propose to enhance our promotion of this to further increase the uptake.

11.1.3 Water efficiency

The baseline demand forecasts estimate that average PCC under normal year conditions reduces from 137l/p/d in 2017/18 to 129l/p/d by 2044/45. These forecasts include assumptions around the continuation of our existing water efficiency activities.

Our feasible options list includes a number of water efficiency initiatives. These do not get selected in options modelling because of the high cost compared with the small potential savings when compared to other feasible options.

However, we have heard what customers told us at our engagement events regarding water efficiency and we are committed to helping customers use water more efficiently. We know we need to be much more effective in our engagement and do more. As evidenced in section 5 customers have low awareness of our current water efficiency activities and only around half agree that we are currently effective at helping them to save water.

We propose to significantly change our approach to water efficiency activities and will ensure that we provide customers with the bigger picture reasoning for this, which was identified as a key barrier to engagement.

As well as working with customers to encourage more of them to choose to have a meter fitted, we will also work proactively to provide direct support to vulnerable customers by using home visits and simplified processes to ensure that we engage effectively with them. And we will consider options for 'smart meter' devices that would help our customers monitor and control how much water they use.

We consider engagement with developers to incentivise them to build more water efficient developments has an important role to play in managing future demands. One option is the introduction of a banded infrastructure charge for varying levels of efficient site design with the highest level based on rainwater harvesting and/or grey water recycling. We have established a Developers Forum and are engaging with this important group to identify the best way to achieve our aims.

We are currently exploring a number of initiatives. A trial of 'WaterSmart', a customer portal providing bespoke consumption reports to household customers, was deployed from November 2017 for 12 months and will provide data to evaluate its effectiveness in terms of water saving and customer service. This is a product that has been successfully used in the USA – particularly drought-hit California. We are currently assessing the benefits of this trial and considering similar alternatives.

We have also embarked on the management of a large rainwater harvesting system at the new North West Cambridge development led by the University of Cambridge. This will provide valuable information about how to engage with customers who live on such developments and through a long-term detailed monitoring plan we will be able to evaluate the effectiveness of the design and the water savings produced.

These projects demonstrate our commitment to demand management and our direction of travel but they do not appear as savings directly in our demand forecasts as it is too early to quantify benefits with certainty. However, we want our commitment to demand management to be represented by a tangible target and therefore we have included a reduction to 137l/p/d for Cambridge WRZ average PCC by the end of the AMP7 period. See also explanation below.

We have based this target on a range of activities comprising options from our feasible list, which aim to assist customers who might have affordability issues and target new developments. We will continue to develop our plans for the exact initiatives to be included in our water efficiency programme but it is likely to include:

- developer incentives – variable infrastructure charge for varying levels of water efficient design, including rainwater harvesting and grey water;
- working with housing associations and local authorities;
- providing a self-led water efficiency programme for non-household customers; and

- engaging with household customers when we are in their area doing works to explain more effectively about how to save water and how having a meter can help with this.

Since we published our draft WRMP we have reviewed our ambitions for PCC as follows.

- During the period 2015-20 (AMP6) we have continued to encourage our customers to use water wisely.
- Despite this, our household customers' consumption has increased over recent years.
- This increase is primarily due to the weather causing customers to use more water, for example, during the prolonged high demand period from May to early August 2018.
- We are now forecasting that our end of AMP6 outturn position in the Cambridge WRZ will be 145l/p/d.
- We have made our 2025 performance commitment target for average PCC more stretching by changing it from 138l/p/d to 137l/p/d
- So, based on this revised starting position, this equates to a reduction by 2025 of 6% or 8l/p/d from our forecast end AMP6 outturn. (these figures are based on an estimated baseline outturn when the plan was published and prior to our final ofwat determination and AMP6 actual outturn. The DYAA and DYPW figures are calculated differently and figures in the tables will be legitimately different from this)

To meet this more stretching target, in addition to the activity described above, we will:

- make more wide use of behavioural science (such as that demonstrated by our innovative 'WaterSmart' trial) to influence the behaviour of existing customers;
- apply the learning from our collaboration with the University of Cambridge on the North West Cambridge development in other parts of the region; and
- work with other developers in the area to fully consider water efficiency in other new housing developments.

11.2 Final planning demand forecast

As a result of our ambitious demand management proposals the final planning DYAA demand forecasts are 8Ml/d lower than the baseline forecasts by 2045. Household demand is 2.5Ml/d lower and leakage reduction accounts for the remaining 5.5Ml/d.

11.3 Supply proposals

Our modelling confirms that continuing with our current base of resources is the most efficient and resilient solution (excluding HEPW and RIPW, which from an operational point of view are a necessity). It also identifies that, in a number of scenarios, the reintroduction of a mothballed site, CRPW2, is required to maintain our supply/demand balance.

We included investment for capital maintenance in the PR19 business plan we submitted to Ofwat in September 2018.

11.4 Resilience proposals

Our modelling suggests that reintroducing KIPW2 and SIPW will support our operational resilience. These options were selected in our resilience runs. Also, when the feasible portfolios were challenged internally we established that these sources provide local resilience, with an additional source supplying a single feed zone together with helping resolve some local water quality challenges.

We have included HEPW and RIPW to provide local resilience.

As well as carrying out modelling to assess what our future resilience will be, we have assessed our resilience to historic events linked to risks like freeze-thaw and flooding. In response to the Defra National Flood Resilience Review (NFRR), (correspondence from Oliver Letwin of 27 May 2016), we have assessed the flood resilience of important infrastructure within the Environment Agency's extreme flood outline (EFO). We returned our completed assessment to Defra on 26 September 2016, with a single source identified as critical for risk of flooding. We have proposed a permanent flood protection scheme for this site as part of our 2015/20 investment programme. Our other sites that are located in flood plains can be taken out of supply during periods of flooding and the population can be supplied from other sources.

We have also assessed the impacts of past freeze/thaw events such as the exceptionally cold weather in March 2018, known as the 'Beast from the East'. It saw preceding sustained freezing temperatures followed by a rapid thaw. This resulted in an increase in leaks, both within our own network and also within the properties of our customers (both household and non-household). This significant increase in leakage resulted in greater demand on our network. A 17% increase in distribution input occurred over the weekend when temperatures rose to close to freezing and above. We estimate that the total impact was about 80% customer-side issues and 20% network ones. We maximised our storage, used additional standby staff and convened our Winter Action Plan (WAP) team. We managed the event with minimal impact on our customers. Our ability to increase supplies by up to 30% at short notice, by making use of peak licenced output at production sources demonstrates that we are resilient to events that require a rapid increase in distribution input. This also demonstrates how vital it is for resilience purposes that we retain these licence conditions that allow us to abstract more in peak conditions than in average conditions.

When Ofwat publicly wrote to all water companies about the 'Beast from the East' it said that overall Cambridge water "performed well and largely met its customers' expectations…"

Despite the fact that we were one of the best performers in the sector, we have learned lessons and we published our response to Ofwat's letter on 28 September 2018. So that we can maintain this resilience to such events, and in line with recommendations in Ofwat's 'Out in the cold' report and company letter, we are investing to maintain our ability to use peak licenced sources in AMP6 and thereafter.

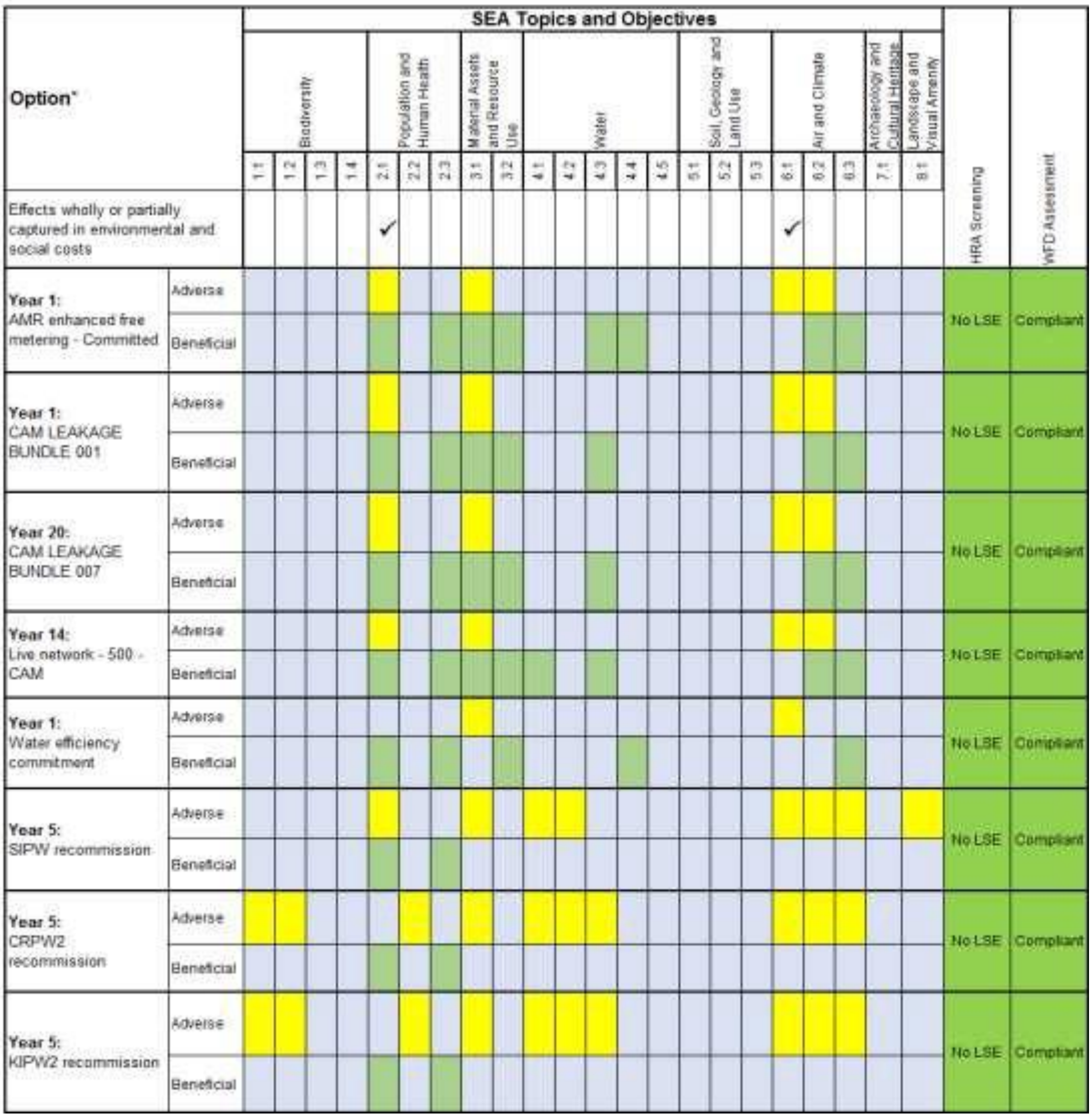
11.5 Strategic environmental assessment of proposed options

Our SEA work has considered the potential adverse and beneficial effects of all feasible options included in our WRMP. We have also reviewed WFD compliance and HRA likely significant effects. The SEA report and post-adoption statement

are included in **appendix A** and the associated annex.

Our proposed programme does not include any options assessed as having major adverse impacts. In summary the assessments of our proposed options are as follows:

Figure 30 Strategic environmental assessment summary



The table above confirms that the options and preferred programme as a whole will be compliant with WFD objectives. The Habitats Regulations Assessment (HRA) has confirmed that there will not be any likely significant effects (LSE) on any European sites. Our HRA report and our WFD compliance report are available on request. To request these reports, please email us at: WRMP.consultation@cambridge-water.co.uk

11.6 Summary of proposed programme

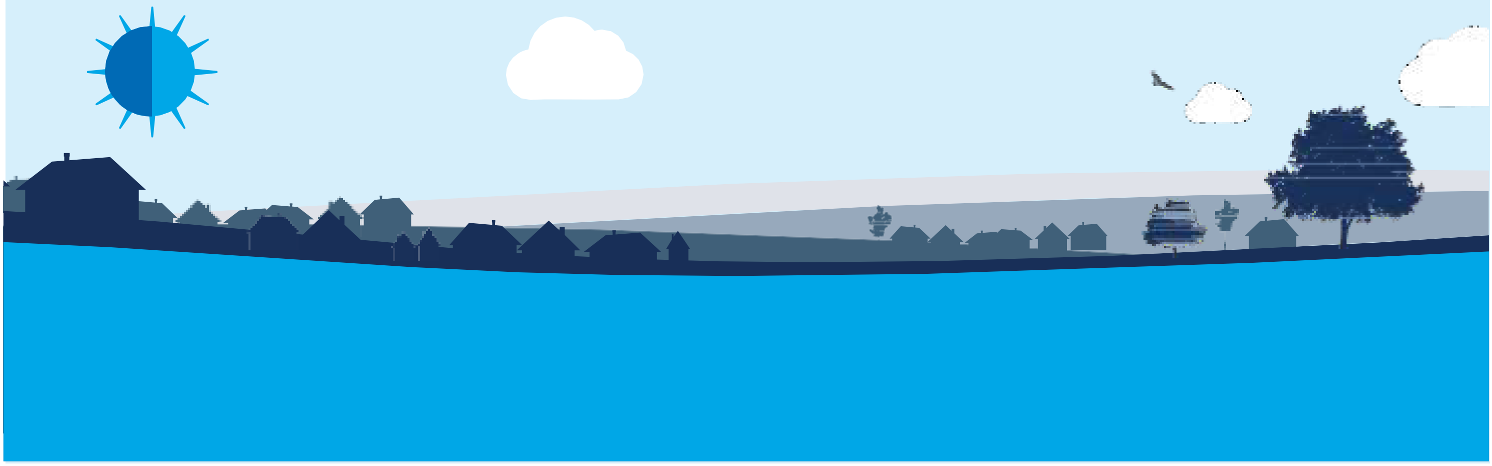
Table 44 Summary of our proposed programme

Option	Description
Baseline DO – existing groundwater	All baseline DO (including HEPW and LIPW).
Leakage	2Ml/d reduction by end of AMP7 with further leakage reduction throughout the planning period.
Enhanced free meter optants	Additional 500 free meter installations a year for the first ten years.
Water efficiency	Reduce average PCC to 137l/p/d by end of AMP7.
Resilience	CRPW2 mandated for local network resilience.
Resilience	SIPW mandated for local network resilience.
Resilience	KIPW2 mandated for local network resilience.

Our proposed programme is included in table 6 of the accompanying WRMP tables. Only those options which are not included within baseline DO are included – that is, leakage reduction, metering, water efficiency, CRPW2, KIPW2 and SIPW. All baseline DO sources are not included in table 6.

Section 12:

Final supply/demand balance

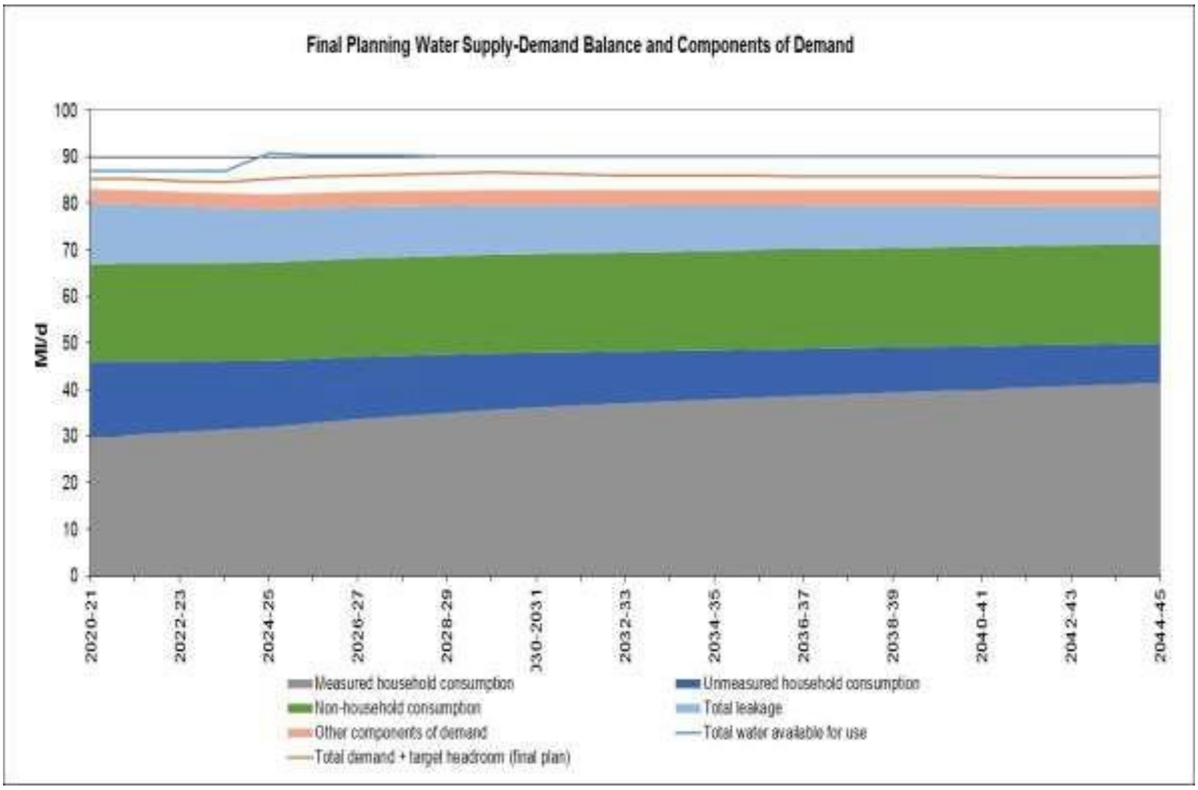


12. Final supply/demand balance

Our proposed programme delivers an 8Ml/d reduction in demand and an increase in supply of 4Ml/d, together with greater levels of local resilience and overall resilience for the supply/demand balance.

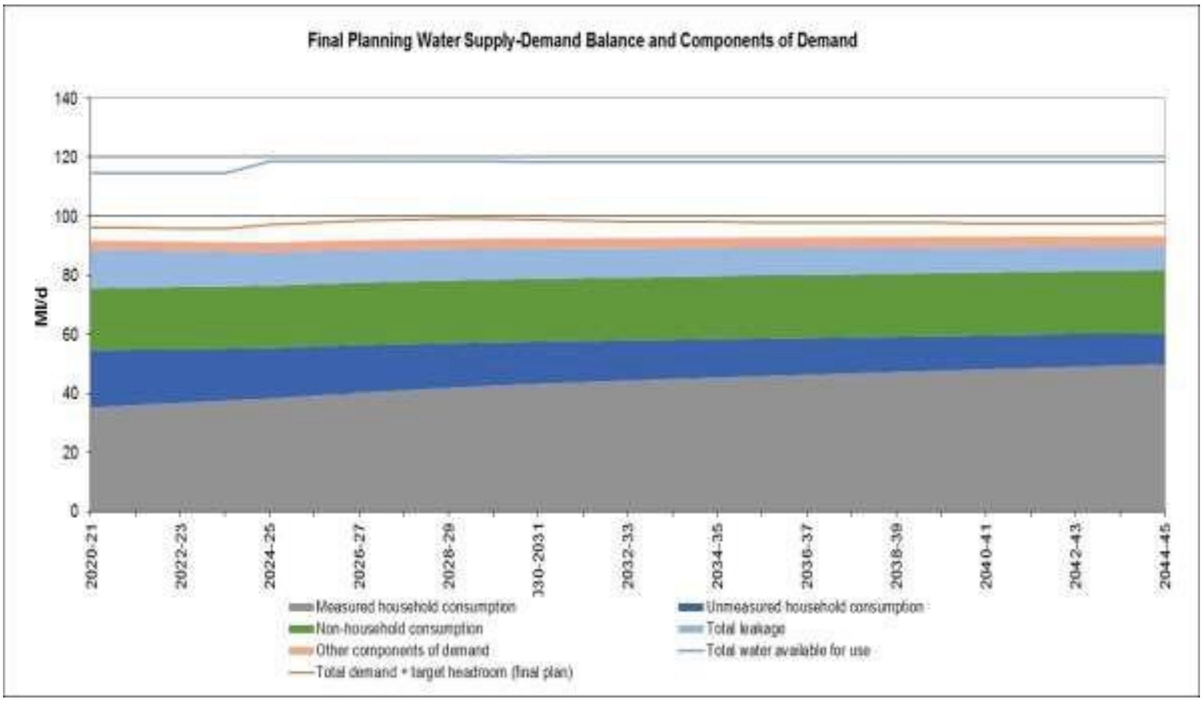
The chart below shows the final planning supply/demand balance for the DYAA scenario. A surplus will be created and maintained.

Figure 31 Final planning DYAA supply/demand balance and components of demand



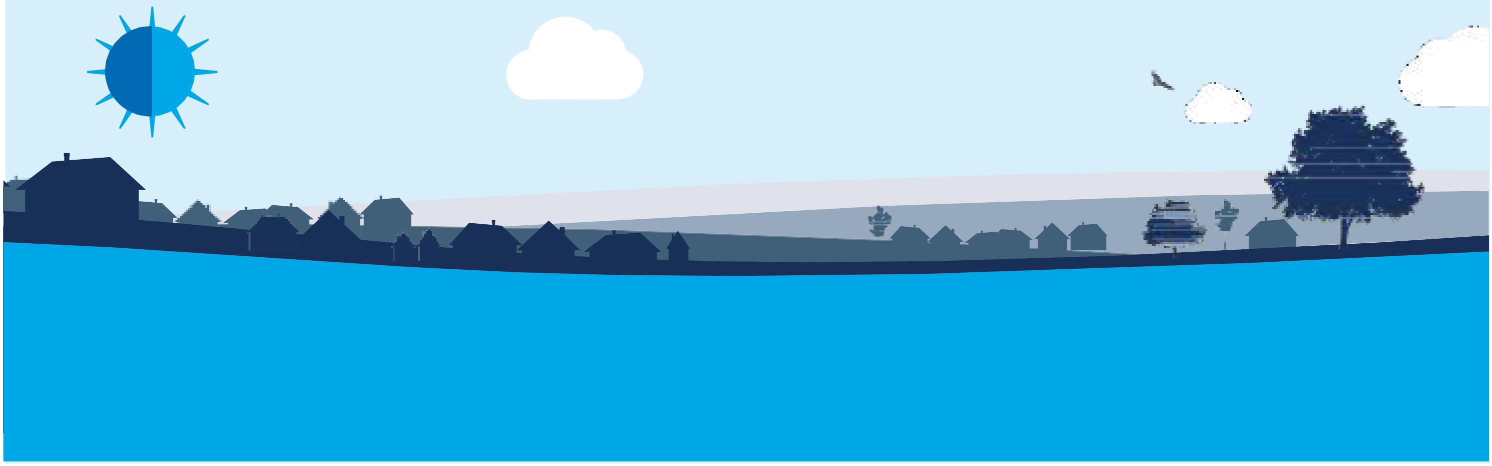
The chart below shows the final planning supply/demand balance for the critical period scenario. The surplus in the baseline is further increased as a result of the proposed programme for the DYAA.

Figure 32 Final planning critical period supply/demand balance and components of demand



Section 13:

WRMP19 tables – commentary



13. WRMP19 tables – commentary

We have completed version 15 of the WRMP tables issued by the Environment Agency in June 2018. We have made the changes we said that we would in the statement of response (SoR) which we published alongside a revised draft WRMP in August 2018.

There are a few points to note when looking at the tables.

- Because these tables represent what we expect to happen in either a dry year annual average (DYAA) or a dry year critical period (DYCP) scenario, actual outturn data is likely to vary depending on 'in year' conditions.
- We have applied the climate change factors shown in section 7.6.5 to the DYAA and DYCP yields in the final WRMP tables. We said we would do this in our SoR and it means that there is consistency between these yields and those in table WR6 of our PR19 data table submission.
- The DYCP AIC in Table 5 gives a false impression of the AIC of those options that only contribute during the DYCP as the spreadsheet assumes that the yield is effective for 365 days in the year, which is not the case.
- We have completed a Critical Period (CP) Table 10 for this final WRMP which we did not do for the draft WRMP.

We have published the final versions of our WRMP tables as well as numerous appendices to accompany our final WRMP19.