South Staffs Water

South Staffs Water

Water Resources Management Plan 2019

making water count

Contents

List of appendices 4

1. Executive summary 7

1.1 Purpose of this document 7

1.2 What is a Water Resources Management Plan? 7

1.3 Putting customers at the heart of our plan 8

1.4 Background to the South Staffs region – scope of the plan 12

1.5 Our WRMP in the wider context 13

1.6 Baseline demand for water 14

1.7 Baseline supply forecast 16

1.8 Baseline supply/demand balance 17

1.9 Deciding on future options 17

1.10 Our proposed programme 18

1.11 Final supply/demand balance 19

2. Introduction to the Water Resources Management Plan 21

2.1 What is a Water Resources Management Plan? 21

2.2 The process of developing a Water Resources Management Plan 21

2.3 Statutory pre-consultation 22

2.4 Public consultation on the draft WRMP 24

2.5 Environment Agency liaison 24

2.6 Timetable 25

2.7 Links to other plans and context 25

3. Plan scope 29

3.1 Challenges for South Staffs Water 30

3.2 Planning period 30

3.3 Water resource zone integrity definition 30

3.4 Planning scenarios 32

3.5 Climate change 33

3.6 Other licensed water undertakers in our area of supply 33

3.7 Severn Trent Water 33

3.8 Water trading and other options 34

3.9 Retailers 35

3.10 Sensitivity analysis 36
3.11 Governance and assurance of the plan 36
4. Our WRMP in the wider context 39
4.1 Links to other policies and programmes 40
4.2 Customer expectations 42
4.3 Response to context 42
5. Customer engagement 47
5.1 How we have engaged with our key stakeholders 48
5.2 Overview of customer engagement activities for this WRMP 50
5.3 Customer priorities 53
5.4 WRMP engagement 55
5.5 Summary of customer priorities 57
5.6 Acceptability of our plans 62
5.7 Key overall conclusions 63
6. Baseline demand for water 68
6.1 Summary of the baseline demand forecast 69
6.2 Total population and property projections 70
6.3 Metered household property projections 72
6.4 Void properties and demolitions 74
6.5 Household occupancy rates 75
6.6 Baseline household demand 76
6.7 Baseline non-household demand 79
6.8 Baseline leakage forecast 80
6.9 Minor components of water use 81
6.10 Dry year demand 81
6.11 Critical period (peak week) demand 83
7. Baseline supply forecast 87
7.1 Overview of South Staffs Water 88
7.2 Deployable output 93
7.3 Time-limited licences 96
7.4 Links to our drought plan 97
7.5 Outage 110
7.6 Climate change 113

7.7 Water transfers 119
7.8 Raw water losses, treatment works losses and operational use 120
7.9 Reductions in deployable output 122
7.10 Abstraction reform 132
7.11 Drinking water quality 132
8. Headroom 135
8.1 Review of headroom components 135
8.2 Data analysis and results 137
9. Baseline supply/demand balance 140
9.1 Baseline dry year annual average supply/demand balance 140
9.2 Baseline critical period supply/demand balance 141
10. Deciding on future options 143
10.1 Overview 143
10.2 Problem characterisation 144
10.3 Modelling method and data inputs 145
10.4 Options development 156
10.5 Feasible options included in DMF 163
10.6 Customer support for options 174
10.7 Modelling results 174
11. Proposed programme 184
11.1 Demand management proposals 185
11.2 Final planning demand forecast 191
11.3 Supply proposals 191
11.4 Resilience proposals 191
11.5 Strategic environmental assessment of proposed options 192
11.6 Summary of proposed programme 193
12. Final supply/demand balance 196
13. WRMP19 tables – commentary 199

List of appendices

Appendix A	South Staffs strategic environmental assessment (SEA) report and annex 1 is the SEA post adoption statement The SEA appendices, HRA and WFD reports are available on request
Appendix B	South Staffs Aquator model update (for Environment Agency only)
Appendix C	PR19 foundation research full report, June 2017
Appendix D	SSC WRMP project methodology, v1
Appendix E	SSC WRMP engagement debrief – full, October 2017
Appendix F	SST customer research findings – summary
Appendix G	Population forecasts methodology summary
Appendix H	WRMP19 South Staffs household consumption forecast
Appendix I	South Staffs and Cambridge meter under-registration report
Appendix J	Draft WRMP19 South Staffs non-household consumption forecast
Appendix K	South Staffs peak review dWRMP19
Appendix L	Hydrology update for the River Blithe
Appendix M	GW DO changes table (for Environment Agency only)
Appendix N	SSW synthetic drought series and resilience of SSW water supply system
Appendix O	South Staffs outage analysis
Appendix P	South Staffs climate change impacts on supply
Appendix Q	South Staffs headroom analysis
Appendix R	SSC problem characterisation
Appendix S	Decision-making framework modelling report and accompanying annex 1
Appendix T	South Staffs demand management options and accompanying annex (both for Environment Agency only)
Appendix U	South Staffs supply-side options (for Environment Agency only)
Appendix V	Technical note on supply option screening, v1
Appendix W	WRMP19 methodology for estimating supply scheme costs
Appendix X	Resilience report for SSW water supply system

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 South Staffs Water's 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 the South Staffs 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 sets 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 submitted 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 have also taken 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 in the West Midlands, Staffordshire and Worcestershire.

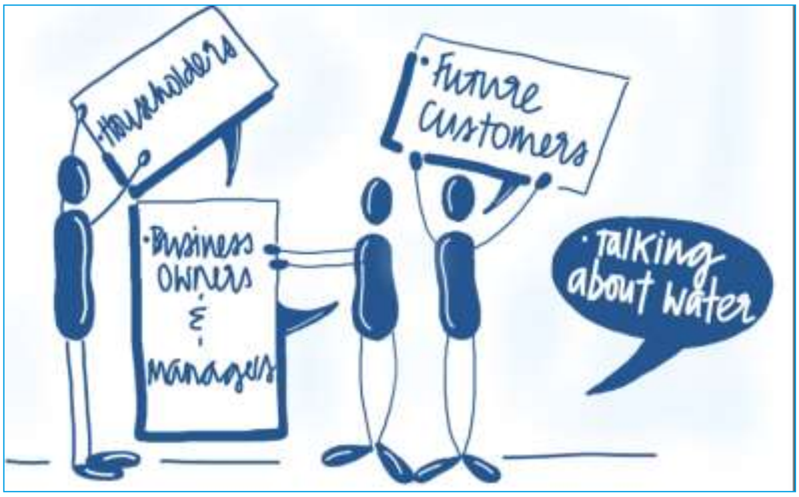
Ultimately, our WRMP is centred on a balanced view of our customers' priorities on a range of important issues. These are set out in section 1.3 below.

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 Independent Customer Panel[1] – the panel set up to represent our customers and challenge our plans, 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:

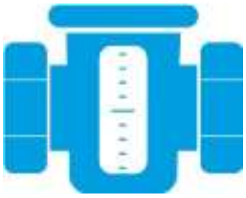
- having clean, high-quality water supplies;
- being sure that water will always come out of the tap;
- their bills being fair, accurate and affordable;
- receiving great customer service;
- protecting the natural environment; and
- helping those customers who may need extra support.

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 our 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 such an important 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 40 years. We know that the last temporary use ban was more than 40 years ago, so many customers in our region have not 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 80 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 our 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:

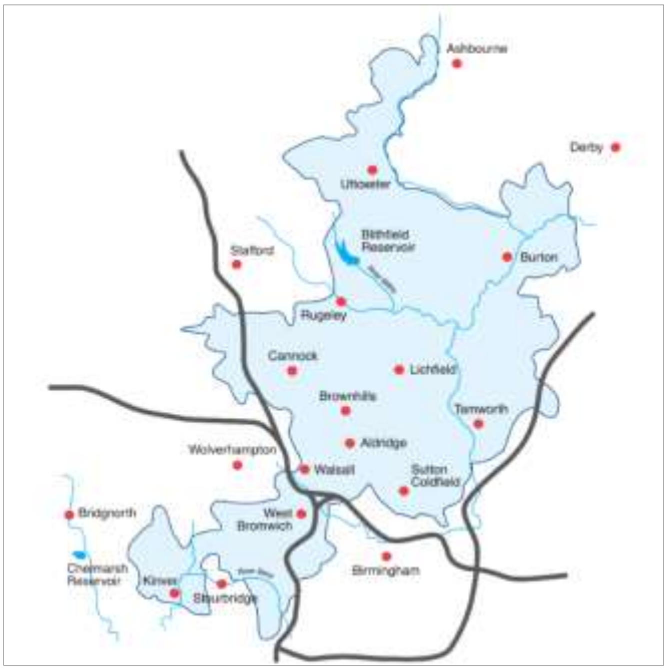
- the Independent Customer Panel;
- the Consumer Council for Water (CCWater);
- Cyfoeth Naturiol Cymru (Natural Resources Wales);
- Defra;
- the Environment Agency;
- Natural England;
- Ofwat; and
- Severn Trent Water.

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

1.4 Background to the South Staffs region – scope of the plan

We are responsible for the public water supply across parts of the West Midlands, Staffordshire and Worcestershire, serving about 1.3 million people every day. Our region stretches from Ashbourne in the north to Halesowen in the south and from Burton-upon-Trent in the east to Kinver in the west. It is divided into 20 water supply zones.

The map below shows the extent of our region.



Our resources comprise two surface water sources –the River Severn and Blithfield Reservoir. Our surface water sources provide about 50% of our total water resources.

We also have 25 available groundwater resources, which are situated mainly in the central and southern areas of the region. These take water from the Sherwood Sandstone aquifer. Drinking water is provided to our customers by 31 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 bulk water supplies to Severn Trent Water – including a significant volume from our River Severn Works – 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 need to make significant investment in our two major water treatment works to make sure that we have enough high-quality water to meet demand and to ensure the long-term resilience of our network.
- We are facing an increased demand for water because of 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.
- 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 setting out an ambitious WRMP, based on new and innovative approaches, to reduce demand in our region. This includes:

- a transformational 25% reduction in leakage by 2024/25 and a reduction of more than 40% across the 25-year planning period;
- nearly doubling the percentage of our customers who have a water meter over the lifetime of this WRMP; and
- reducing the volume of water every person in the region uses each day (known as 'per capita consumption' – or PCC) by one litre per person per day (1l/p/d) by 2024/25. Compared with the other regulated monopoly companies in England and Wales, our household customers use on average among the lowest volume of water each day, and our ambition is to reduce that level even further.

In the 12 months to November 2018, we also carried out a trial called WaterSmart with 15,000 households in our Cambridge region 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.

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 approximately 238,000, with roughly 127,000 new homes being built from now until 2045.

We also forecast that occupancy rates will fall over the same period – from 2.48 to 2.36 on average – and that in our baseline scenario PCC will fall from 131l/p/d to 127l/p/d. Overall household demand is forecast to rise by 24 megalitres of water a day (Ml/d) by 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 in the baseline scenario the level of metering in our region will increase from 41% in 2020/21 to 66% in 2044/45.

In terms of leakage, our baseline demand forecasts include leakage continuing at the current performance commitment of 70.5Ml/d across the period covered by this WRMP.

For non-household and other business customers, we are forecasting a 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 population estimates and climate change impacts. Forecast demand plus target headroom is the minimum volume of water we need 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 40 years. For example, the last time we asked our customers not to use hosepipes was in the 1976 drought, but we plan to meet unrestricted customer demands in a repeat of the conditions experienced during the 1995/97 drought as we did at the time.

That said, we are mindful that most customers in our region have not experienced a temporary use ban, and the likely impact (if any) it would have on them. But we do know that any reduction 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 ground and surface water 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' (DYAA) and 'dry year critical period' (DYCP – peak week) scenarios (as defined in section 1.6 above).

Since our 2014 WRMP, our water available for use (WAFU) has decreased by approximately 30Ml/d. Around half of this reduction is because of a reduction in the availability of groundwater sources.

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 roughly 9Ml/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 by 2024 under average conditions and by 2023 for peak conditions.

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 that 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;
- replacing our water treatment works;
- identifying new groundwater sources;
- identifying new surface water sources, such as the River Trent; 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.

We had previously identified a need to invest in our two major water treatment works to ensure we can continue to provide customers with reliable, high-quality water supplies over the long term. So, this gave us an opportunity with the WRMP 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 WRMP programme.

Table 1 Key elements of our WRMP

Key element of our plan	What we will do
Leakage	By 2024/25, we will reduce total leakage on our network by 12Ml/day from the 2019/20 performance commitment level of 70.5Ml/day. This is a transformational 25% reduction, which we will achieve through a combination of pressure management and active leakage control. We will develop a live network where data can help identify leaks more quickly and improve performance and use other innovative techniques. We are targeting a reduction in leakage of more than 40% across the 25-year planning period.
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 average of more than 4,000 households a year to switch to a water meter over the lifetime of this WRMP. This will give us a final plan target level of 76% of customers with a water meter 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.

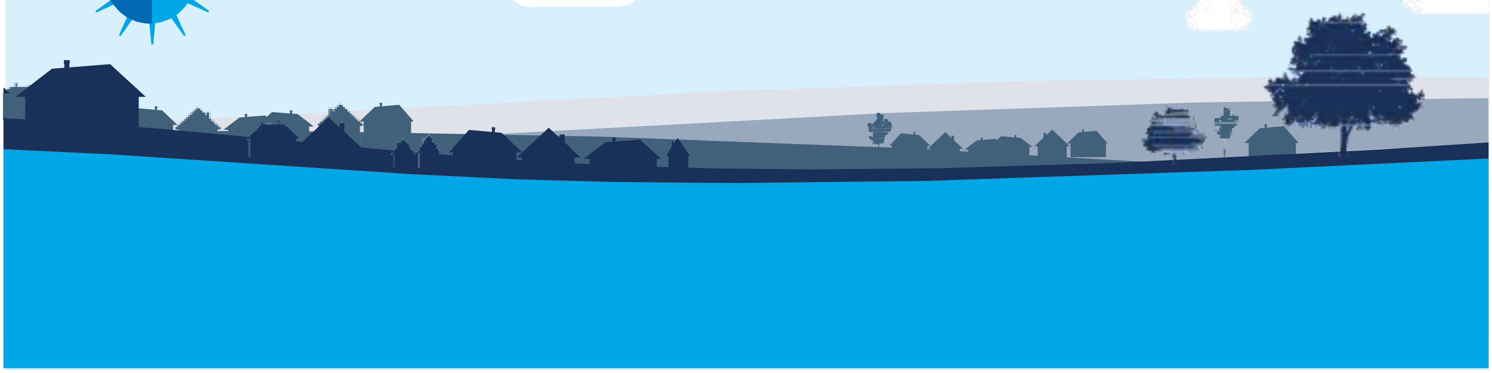
Key element of our plan	What we will do
Water efficiency	We will reduce baseline PCC by 1l/p/d by the end of the five-year period from 2020 to 2025. We will work with developers to explore incentives for them to include rainwater harvesting and greywater recycling within new sites. We will continue to 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 benefits from the 'WaterSmart' trial that we ran in our Cambridge region in the 12 months to November 2018.
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 will invest in our two major treatment works to ensure high-quality, secure and reliable water supplies and to maintain existing capacity now and in the future. We will reduce the volume of groundwater we are entitled to take from the environment by about 6Ml/day where necessary to avoid the risk of causing deterioration to the environment. We will invest in new treatment processes at two of our groundwater sources, which will enable them to be brought back into supply.
Resilience	We will liaise with our neighbour, Severn Trent Water, to further explore a bulk supply trade to provide additional resilience to our water supply system – especially during the period of investment in our two major treatment works.
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 our 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 South Staffordshire Water now incorporates the supply area of Cambridge Water, this WRMP applies only to the original South Staffordshire Water region and a separate plan has been prepared for the Cambridge 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 Secretary of State (SoS) at Defra. Companies submit draft WRMPs and make them public; this is followed by 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 final 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 300 customers in our South Staffs region and 200 customers in our Cambridge 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.
- Severn Trent Water.
- United Utilities.
- Anglian Water.
- Bristol Water.

There are no licensed water undertakers who supply water through 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 and Cannock Council. 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 need to follow Defra's guiding principles. • We should outline the challenges we are facing and address issues of long-term resilience.
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.
The environment	• We should use an SEA in the development of the WRMP. • We should protect, conserve and, where possible, enhance the historic environment. • We should include sustainability changes to help protect and improve the 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.
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 impacts of demand-side measures on the amenity horticulture, dairy and livestock sectors.
Other	Our outage allowance needs to be reviewed in light of high recent reported outage values.

Our WRMP has taken these comments into account.

2.4 Public consultation on the 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 included:

- 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;
- Severn Trent 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 about the 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 it the 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.

2.7.2 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.

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.

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 was 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 and Natural Resources Wales drought plans. In particular, we have sought to identify any river support schemes managed by the Environment Agency or Natural Resources Wales that might affect our ability to abstract water and whose operation may be restricted in a drought. In our case, the principal scheme of interest is the Clywedog Reservoir – Shropshire Groundwater Scheme – River Severn system. Operation of this system in normal and dry years is accounted for in our Aquator model (Aquator is a computer model widely used in the water sector to calculate the amount of water available in different scenarios) and its influence on abstraction used in our calculation of DO as described in section 7.

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 Water Industry National Environment Programme (WINEP) of 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 our Cambridge region and we have considered it appropriate to do the same for this 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 Humber and Severn and we have considered flood management measures identified by the Environment Agency and the other statutory partners (county and metropolitan borough councils) for the following areas.

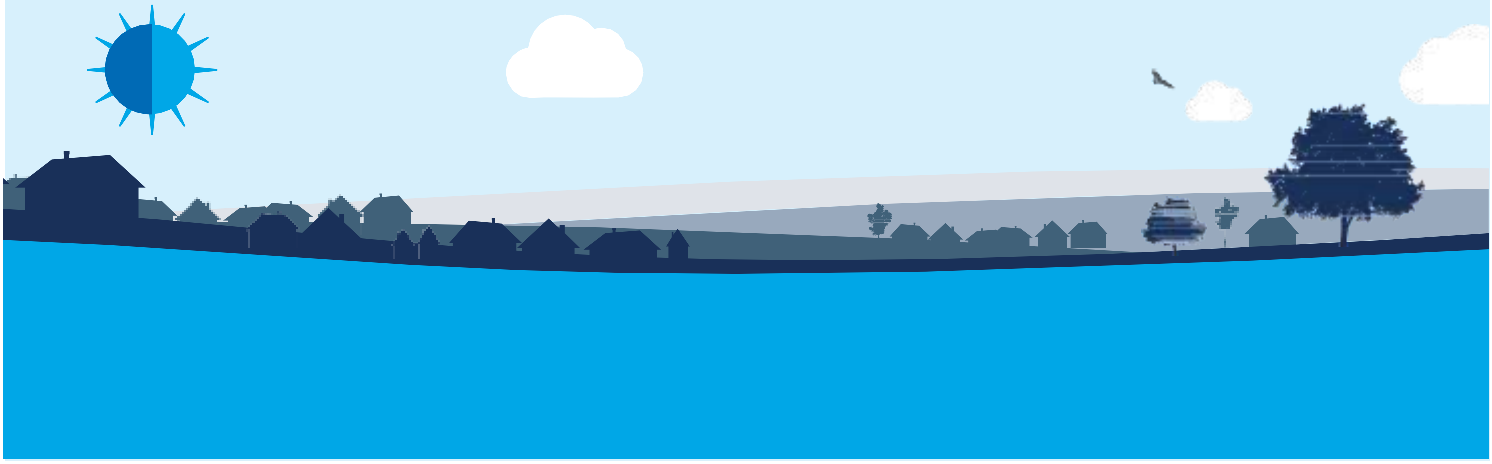
- **Humber:** West Midlands Flood Risk Area, Staffordshire Trent Valley management catchment, Tame, Anker and Mease management catchment.
- **Severn:** the Worcestershire Middle Severn Catchment.

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 plan to make significant investment in our two major treatment works and need to make sure we make the right decisions to secure the long-term serviceability of our resources.
- 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 critical period peak week (CP) 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 Severn Trent Water, with whom we have a shared resource, and with retailers providing customer services to non-household water customers.

We have explored the potential for options for additional water supplies with interested parties such as the Coal Authority and the Canal and River Trust.

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 South Staffs Water

We are currently reviewing the investment needs of our two major treatment works over the next 10 to 20 years. This is predominantly a business plan consideration as it is about the way we maintain and improve our assets to ensure long-term serviceability and ensure that we are able to meet the predicted demand for water.

We are faced with:

- 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.

3.2 Planning period

This plan covers the period 2020/21 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 Annual Review[3] 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. The region has two surface water treatment works – our River Severn Works and our Central Works – and 25 available groundwater sources, which are mainly situated in the southern and central areas. All these sources are linked by an integrated supply system. A map of the area of supply is shown in figure 1 below.

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

The supply area has varying topography and the supply system has been developed over time to provide security of supply to all customers. This has been achieved by the linking of the strategic service reservoir supply areas with large diameter mains, booster stations and remotely controllable valves to enable the transfer of water throughout the region’s supply area.

The region has 20 supply zones with potable water storage provided by 31 service reservoirs and water towers. Water sources feed directly into some supply zones and zonal transfer boosters move water to zones with no direct resource input and between supply zones at times of peak demand or asset maintenance. Strategic control valves operate in a similar way to zonal transfer boosters but transfer water under gravity.

As an example of zonal flexibility and integration, we have the ability to transfer water from the River Severn Works, which is situated outside the supply area at the south-west corner, through the supply system to Outwoods, Castleway, Hopwas and Glascote supply zones. This is achieved by transferring water through the strategic reservoir system. Water transfers from storage reservoirs, which receive River Severn Works water, through large diameter trunk mains towards the north of our area. The water then gravitates further northwards through a 36” main connecting to our Central Works and gravitates to Outwoods for boosting onto Castleway or to Hopwas for boosting onto Glascote.

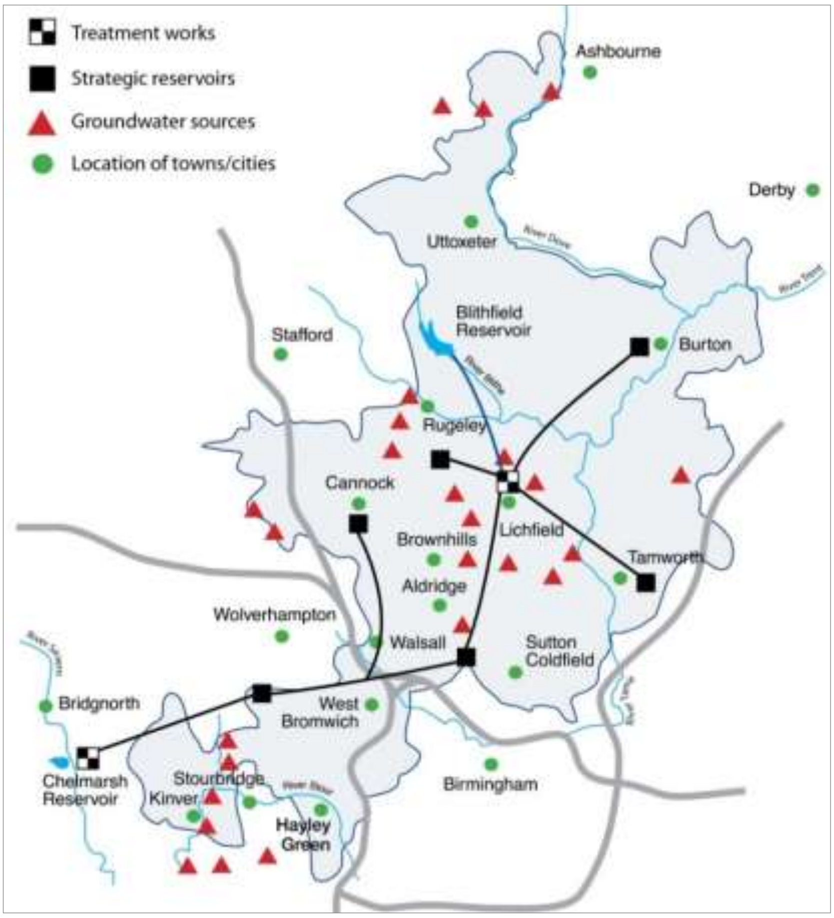
The northern most extreme of the region’s area of supply is the Uttoxeter area. Supplies to this area can be fully maintained by controlled gravity flow from a storage reservoir, which receives Central Works water.

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. Our water resources allocation model, (Aquator), is set up to represent this ability to transfer water throughout the area of supply.

The River Severn Works is a shared resource with Severn Trent Water. The water is abstracted by us at the River Severn Works and transferred to Severn Trent Water through four mains connections to meet demand in Wolverhampton.

Figure 1 South Staffs region supply area and WRZ



3.4 Planning scenarios

The Environment Agency's water resources planning guidelines detail 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 developed supply and demand forecasts for the peak week scenario since 2004. It is this scenario which influences requirements for peak treatment capacity at our two main treatment works. This is particularly important at this time as we are making decisions about future investment in these works.

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 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 the 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 are no inset appointments in our area of supply. Therefore, account of implications arising from other licensed water undertakers has not been necessary and is not considered further within this plan.

3.7 Severn Trent Water

Severn Trent Water borders our area of supply on all sides and we have a number of shared interests which require close liaison and a consistent planning approach within our respective WRMPs. We have met with Severn Trent Water as part of the preparation of this WRMP to discuss and agree a number of issues.

3.7.1 River Severn Works abstraction licence arrangements

Our River Severn abstraction is a shared resource with Severn Trent Water. We describe how we have reflected the arrangements in the supply/demand balance for each company in section 7.7.2. We have confirmed with Severn Trent Water that the way in which this is modelled by both companies is consistent. Severn Trent Water has advised us that it is considering how to make the best use of the River Severn Works in future and we have taken this into account when testing the robustness of our plan to future changes.

3.7.2 River Severn modelling

Our water resources model used for calculating DO does not include a hydrological model of the River Severn catchment. The River Severn inputs are taken from the Severn Trent Water model. We provide Severn Trent Water with relevant data and information regarding our own operations in order for the River Severn component to be accurate. Severn Trent Water provides data to us for DO estimation and for estimation of the impact of climate change on supply. We have used the latest updates from Severn Trent Water, based on rainfall run-off modelling in the preparation of this WRMP.

The detail regarding the modelling of the River Severn and the shared River Severn Works resource can be found in section 7 and **appendix B** describing the calculation of DO.

3.7.3 Bulk supplies

We export a number of small bulk supplies to Severn Trent 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. These regular and emergency bulk supplies are in addition to the joint resource at our River Severn Works.

We have met with Severn Trent Water to agree planning assumptions on the scale of the imports and exports for the planning period.

3.8 Water trading and other options

During the pre-consultation stage of the development of the WRMP we have had contact with neighbouring water companies and water companies who utilise the same water resources as us to explore opportunities for water trading in terms of being a recipient of a trade. We have considered options from United Utilities and Severn Trent Water and these options are included in our feasible list described in section 10.

We have also explored with the Coal Authority and the Canal and River Trust whether there are opportunities for water trades with them. These options are also included in section 10.

We continued to look for any further options for trading or provision of alternative demand management options during and since the public consultation for our draft WRMP.

For example, since we published our draft WRMP, we have met with an abstractor in our region from a different sector with a view to purchasing either an abstraction licence or a licence and the associated assets. We cannot give more details here as our discussions are covered by a non-disclosure agreement and are ongoing.

In addition, we have studied in detail other 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. Since publishing our draft WRMP we have opened dialogue with another organisation from a different sector. We will continue to discuss the viability of trading in this location to further enhance resilience and sustainability.

To assist third party trading in the future we publish our Water Resources Market Information (MI) in tables alongside our WRMP. We invite 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.

3.9 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 they see water efficiency as a key part of their service offering. For smaller customers this may be through making advice available while larger customers may choose chargeable add-on services such as tailored water audits. The responses indicate that, at this stage, retailers are still developing their plans and are not in the position to define a water saving target to include in our demand forecasts. We will work with retailers where appropriate to ensure consistent messages and advice can be offered and will update our demand forecasts as more detail becomes available.

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 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.

3.10 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.

3.11 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 draft 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 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 update to this statement 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 25% reduction in leakage by 2024/25;
- a reduction in leakage of more than 40% across the 25-year planning period;
- more effective engagement around the benefits of opting to be metered to drive greater meter installation; and
- a commitment to reduce per capita consumption (PCC) by 1l/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 assessment of drought resilience throughout the planning period shows that our supplies are resilient for a range of droughts across the 25-year planning period and will remain so even in the event of future sustainability changes to prevent 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.

We will continue to identify and progress any further options for trading or provision of alternative demand management options.

Innovation

Our proposals are based on new and innovative approaches. Our 'WaterSmart' trial and the rainwater harvesting development at Eddington in our Cambridge region 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.

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 WRMP	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
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 the 2014 water resources management plan (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

Statement or document	Owner	Key points of relevance for WRMP	Publication date
PR19 methodology	Ofwat	Specific water resources guidance: • Companies are to publish market information requirements alongside WRMPs and to submit their bid assessment framework 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
DWI long-term planning guidance and other relevant guidance such as that relating to requirements for pesticide removal	DWI	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 draft WRMP takes account of all statutory drinking water quality obligations, and that the WRMP includes plans to meet their statutory obligations in full.	
UKWIR Resilience planning	UKWIR	UKWIR (2013) Resilience planning: good practice guide. This provides an important reference for us to consider all potential non-drought resilience issues. For example, it includes a list of hazards.	2013

Statement or document	Owner	Key points of relevance for WRMP	Publication date
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	**Water Resources East (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 25% reduction in leakage by 2024/25;
- a reduction in leakage of more than 40% across the 25-year planning period;
- 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 PCC by 1l/p/d by the end of 2024/25.

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. This means that the exact mix of actions may be different to that presented in this plan.

We undertook a trial with 15,000 households in our Cambridge region of operation to assess the benefit of tailored water use messages to customers. This 'WaterSmart' trial used 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.

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 its 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 volume 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. We have liaised with the Environment Agency to identify existing raw water transfers that present a risk and have agreed to include investigations as part of the WINEP process in the AMP7 period (2020/25). We have assessed the risk to spread of INNS for all options within the plan and ensured that risks are fully mitigated when considering scheme details and costs.

4.3.3 Options

We have considered options to balance supply and demand that can be provided by third parties. We have liaised with the Canal and River Trust and the Coal Authority to explore potential sources of water. We have explored opportunities with Severn Trent Water and United Utilities.

A number of third party options have been included in our feasible list of options described in section 10.

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 and will remain so even in the event of future sustainability changes to prevent deterioration. The operation of our River Blithe pumpback scheme is proven to be a significant contribution to our drought resilience.

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

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 is the largest in the UK. We have committed to reduce leakage over the first five years of the planning period and will review our approach to leakage reduction during this time. 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

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 members of the:

- Trent working group;
- Severn working group; and
- Water Resources East (WRE) group.

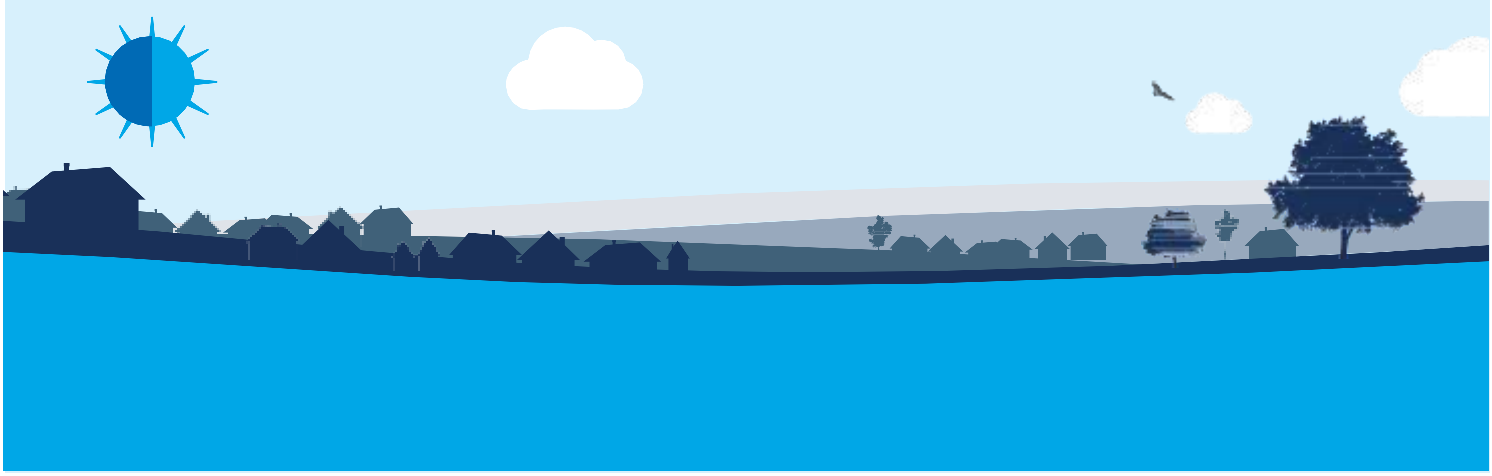
These groups have been considering the needs of different sectors and regions for water from those catchments to identify solutions which best meet the needs of all.

We are actively engaging and working with the local agricultural sector to educate and encourage appropriate use of chemicals in catchments that provide public water supplies. We started this work in 2015, focusing in the catchment around our Blithfield Reservoir. We are rolling this out to some of our groundwater catchments and have agreed to work with Severn Trent Water in the River Severn catchment as this is a source we both use and we can share resources to get best results.

We will continue to work collaboratively wherever appropriate. For example, we work with WRE stakeholders from all sectors (agriculture, industry, power generation, etc) to develop long-term solutions that could potentially result in development of shared assets and innovative financing models that result in a fairer way of sharing the costs. We are part of this group because of our Cambridge WRZ, but also because of the importance of the Trent catchment to our Staffs WRZ. We hope that regional water resources planning of this sort will show what the most cost-effective and sustainable solutions are to meet the needs of all stakeholders in the region. Reporting on the first phase of WRE completed in September 2018.

Section 5:

Customer engagement



5. Customer engagement

Overview of customer engagement findings

The key findings from our customer engagement work underpins our WRMP 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 said they want us to focus on are:

- ensuring the continuity, quality and reliability of their clean water supply;
- delivering excellent customer service;
- offering fair and accurate bills;
- reducing leakage from pipes;
- 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 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 volume 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 have made this a central commitment in our PR19 business plan.

We have adopted a 25% reduction in leakage in our 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 40 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 80 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 91% of customers said water is a precious resource.

We have committed to reduce PCC by 1l/p/d over the AMP7 period through undertaking a comprehensive programme of water efficiency initiatives, including incentivising developers to build more water efficient homes.

We describe our plans for water efficiency 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 details 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 31 customers (household and small business owners) to gain feedback on preferences and service level expectations. Invited the same customers (30 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 305 customers via 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 were 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. Refer to the table below for full details of our core WRMP and wider customer engagement programme.
Focused discussion with the Independent Customer Panel	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 included more publicity of the consultation process 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 the 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	Headline methodology used to engage with customers	Insights collected
Foundation research to establish customers' priorities	Qualitative study of 6 focus groups covering 52 customers. (Covering household and non-household by key demographic split).	May – June 2017
	Quantitative survey of 291 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	Headline methodology used to engage with 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). 11 large corporate customers and key industry stakeholders attending round-table discussion event. 305 domestic customers (quotas set to key demographic splits) reached through an online survey.	July – Aug 2017
Metering uptake study to understand customer reasons for not switching to a water meter	Quantitative telephone study with 101 household customers in the Sutton Coldfield area 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: six reconvened focus groups to co-create a quantitative survey with 1,096 household customers and 213 business customers (covering all key demographic splits and weighted to regional demographics).	Nov – Oct 2017
	Wave 2: two focus groups to help further refine a quantitative survey with 532 household customers and 187 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 515 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: four focus groups to explore differing customer views in greater depth. Stage 3: online and phone interviews with 270 household customers to understand responses to selected propositions (covering all key demographic splits and weighted to regional demographics). Additional follow up quantitative survey of 821 household customers from an online survey run from our website (random, non-representative sample).	Nov 2017 to Mar 2018

Engagement work stream	Headline methodology used to engage with 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 evening workshop event with 32 customers (covering household and non-household by key demographic splits). Followed by a quantitative phone survey with 318 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 26 customers (covering household and non-household by key demographic splits). Followed by a quantitative survey with 559 household customers and 12 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 25 household customers (random, non-weighted sample).	Feb – Apr 2018 June 2018
Testing customer acceptability of our business plan and associated bills for 2020-2025	Stage 1: Qualitative study of six, facilitated focus groups with 47 customers (covering household and non-household by key demographic split). Stage 2: Quantitative survey with 625 household customers and 122 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 10 customers covering developers, self-lay providers, NAV and an industry representative. Full-day forum with 14 customers covering developers, self-lay providers, NAV and other key industry stakeholders.	Nov 2017 Jul 2018
Young Innovators' Panel	Two full-day workshop sessions and presentation of ideas in response to a real business task to a panel of company and industry experts. 19 sixth form students drawn from 13 schools across the region taking part.	Jul – Oct 2018
Customer service tracker to establish customer perceptions	Quantitative telephone study covering 300 household and 151 business customers (covering all key demographic splits).	Apr 2017 – Mar 2018

Engagement work stream	Headline methodology used to engage with customers	Insights collected
of our service performance	Quantitative survey of 2,547 household customers from an online survey run from our website (random, non-representative sample).	Feb – Apr 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

For full details of our customer engagement activities listed above refer to **appendix F**.

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 C** for sample, approach and methodology). While the study was qualitative in nature, the in-depth discussions with more than 50 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 as a result of extreme temperatures

Important areas we need to continue focusing on now	Important areas we need to focus on in the next 5-10 years and beyond
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 demand and supply-side options. This study ran during July and August 2017 (see **appendix D** 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 Reaserch. These were:

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

At the end of the first workshop (that is, after the information was given to participants) customers' priorities were reassessed. This resulted in increased importance being placed on installing more meters, which showed a significant swing to be the most important area overall. Encouraging people to use less water also increased significantly in importance.

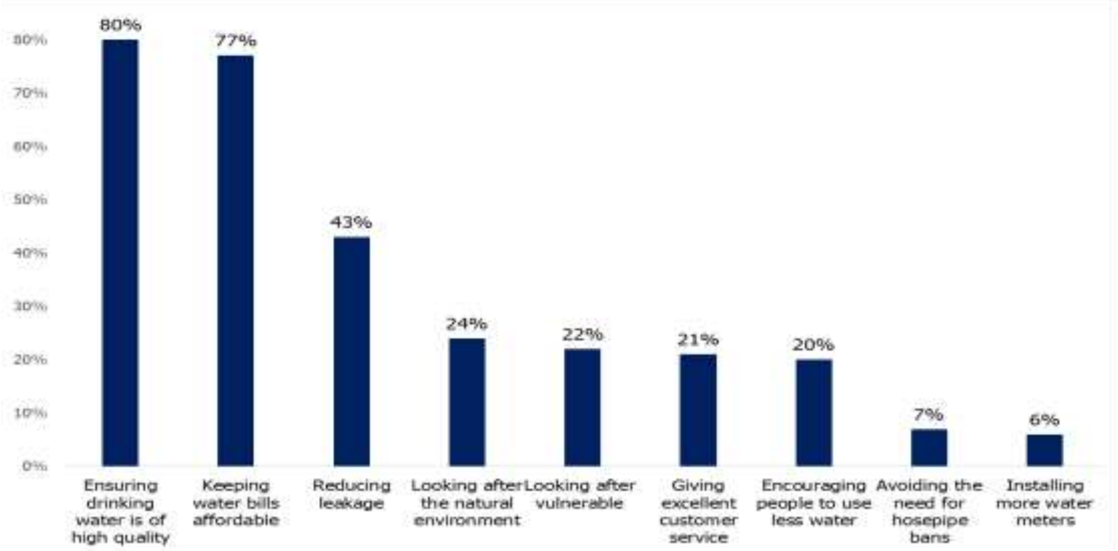
Figure 2 Voting highlighting customers' top three priorities

Base: 31 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. Again, the result was the same hierarchy of priorities.

Figure 3 Results of online survey highlighting customers' top three priorities



Base: 305 South Staffs HH customers.

From a WRMP perspective, more than 20% of customers also placed the following issues in their top three priorities.

- Reducing leakage.
- Looking after the natural environment.
- Encouraging people to use less water.

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 – 13% versus 20%.
- Those aged 60 or above were more likely to choose leakage in their top three – 52% versus 43%.

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 we need areas to focus on – more variation in customer support
Providing 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 F**.

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.

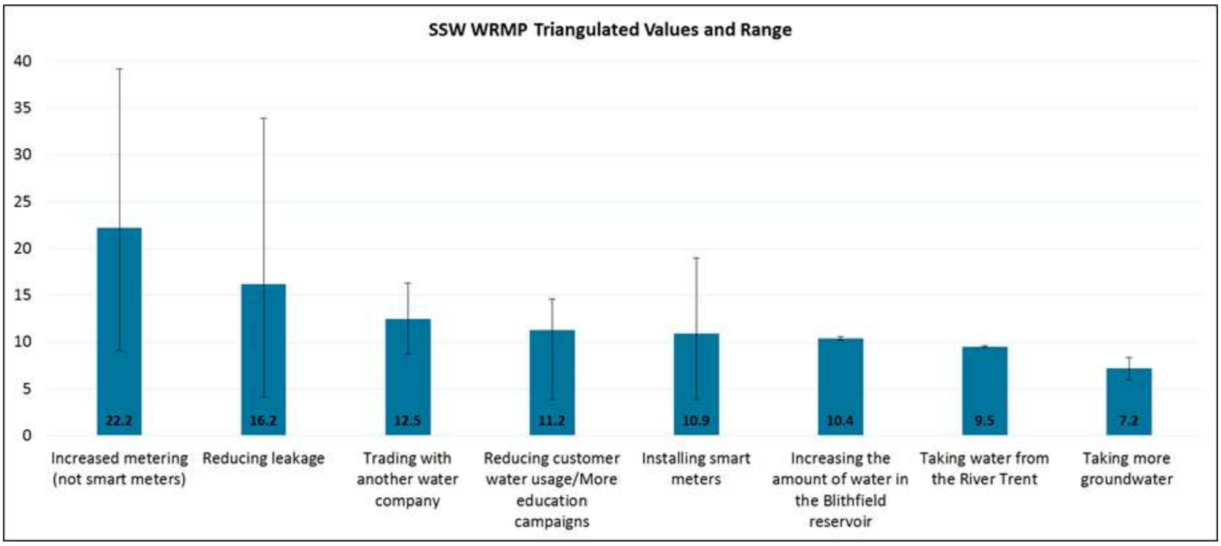
In addition to our wider priorities engagement we also commissioned independent, expert support from one of our research agency partners, Accent and PJM Economics, to review all our customer engagement activity related to our WRMP to develop the index.

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 4 shows our final WRMP priority values, which have been re-scaled to sum to 100, and their associated ranges.

Our customer priorities index shows that 'increased metering' is the highest-rated priority among customers, followed by 'reducing leakage'. '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 4 Final WRMP priority values and ranges – scaled to 100



We also sensitivity tested the scenarios being considered and it revealed that customers prefer demand-side options to supply-side ones, the exception being 'trading water', which is already in existence as an option with our neighbours Severn Trent. 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.

Based on the sensitivity testing, the 'Main' values shown above are the preferred values we used 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 for supply- and demand-side options, please refer to **appendix F**.

5.5.1 Using willingness to pay research to shape our plans

We used our willingness to pay (WTP) customer valuations for reducing leakage, increased metering and installing smart meters options 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 followed an innovative 'seven-step' approach, which included involving customers in the development of the survey content and design 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). Bill impacts to deliver the service improvements shown were in £ for household (HH) customers and in % change terms for non-household (NHH) customers. 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 business customers was a large-scale quantitative survey that assessed customers' willingness to pay through SP choice experiments.

In Wave 2, the levels of service improvements displayed to respondents were amended to test a lower level, with new attributes relating to retail and community included. In addition, around one-third of respondents completed the SP exercise in the context of a lower bill. We also added in a package choice exercise to allow us to scale the values obtained from the discrete choice experiments (DCE).

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 was for water hardness among both HH and NHH customers. This reflects the feedback in our customer service tracker.

The WTP valuations were then subject to a robust triangulation approach by our partners, Accent and PJM Economics. This focused on using a wide range of supporting evidence, including our day-to-day contact data, to arrive at better estimates of the true WTP values. We also triangulated scaled and unscaled WTP values within our investment optimiser tool to allow sensitivity testing.

Table 8 provides the full details of normalised, unscaled WTP figures (per year) among our customers, which have been subject to this 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.

For those measures comparable on a per property level, we found that both household and business customers expressed a higher priority for ensuring a safe drinking water supply and avoiding flooding from a burst pipe. We also found that customers' valued avoiding drought restrictions more than avoiding temporary use bans.

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	£1,004	£449	£1,453
Flooding from a burst pipe	Property affected	£435	£383	£818
Taste and smell of water	Property affected	£303	£242	£546

Attributes	Unit	Combined Unit value: HH	Combined Unit value: NHH	Combined Unit value: MAIN
Discoloured water	Property affected	£288	£113	£401
Unexpected temporary loss of water supply	Property affected	£183	£190	£374
Low water pressure	Property affected	£79	£114	£193
Water hardness	Property affected	£37	£27	£63
Lead pipes	Property affected	£23	£21	£44
Temporary use ban	1% change in risk	£295,831	£343,002	£638,833
Drought restrictions	1% change in risk	£377,167	£683,113	£1,060,281
Leakage	Ml/d	£31,919	£59,303	£91,222
Water metering	Household	£11	Not covered	£11
Giving customers control of their water usage	Household	£0.44		£0.44
Protecting wildlife habitats	Hectare	£9,585	£8,464	£18,049
Managing impacts on rivers and streams	Hectare	£4,675	£5,974	£10,649
Traffic disruption	Roadworks incident	£644	£1,102	£1,746

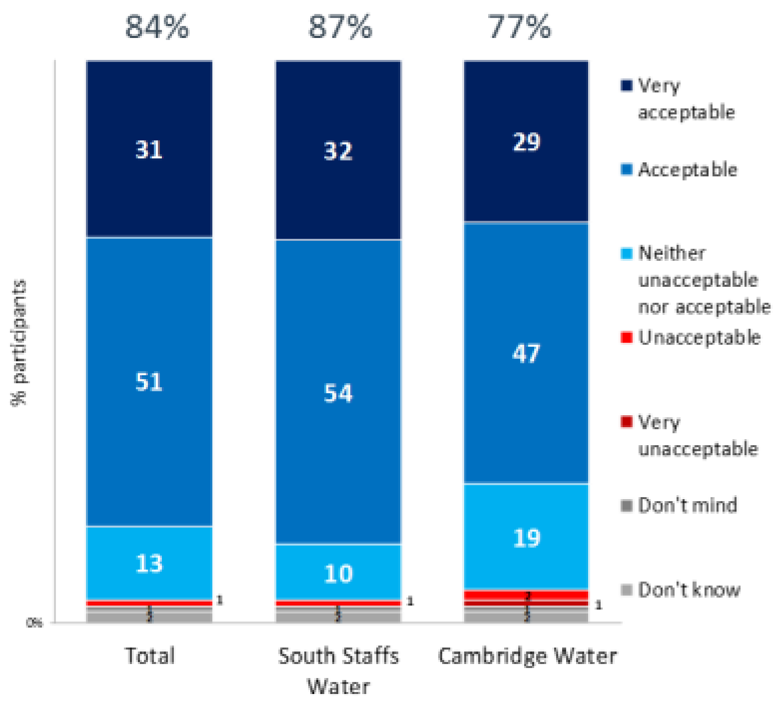
Note: Combined Unit value: MAIN refers to the WTP triangulated values from Wave 1 and Wave 2. Drought restrictions, smart metering and traffic disruption were not included in the Wave 2 study.

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 be 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 5 shows that 87% of the 625 household customers in our South Staffs region found our plan acceptable. The figures was 84% among the 122 business customers.

Figure 5 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: 625 household customers.

We also asked our HH and NHH customers if they agreed that our proposed 2025 performance commitment targets in our PR19 business plan 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 25%	61%	57%
Reducing how much water each person uses by 1 l/p/d	69%	45% (note that 45% said don't know)
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 the table below. We have also signposted our response to these findings.

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' needs and expectations
Level of metering	Increased metering, viewed as a necessary and important approach for us to carry out. 73% of customers support metering as the fairest way to charge for water usage – rises to 83% among informed customers. Support is lower, 63%, 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' needs and expectations
Compulsory metering	No overwhelming evidence that customers want us to adopt a compulsory metering approach. Only 27% of unmeasured customers support this (84% 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. 43% are 'for' smart meters. 19% 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. 87% agreed this at the workshop. 56% 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 78% 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 41% of household customers' expectations.	We are proposing to reduce leakage by 25% 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.

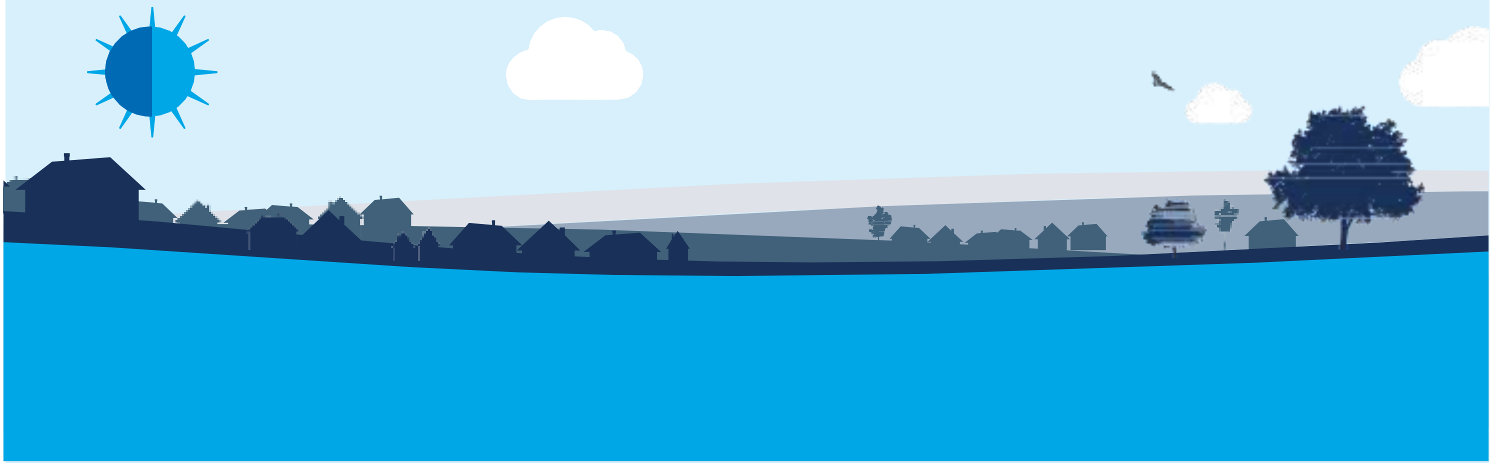
Area of focus	What customers and other stakeholders told us	Our plans to meet our customers' needs and expectations
Levels of service	No evidence that customers want us to improve the level of service for temporary use bans – or TUBs (1 in 40 years) and non-essential use bans – or NEUBs (1 in 80 years). Current levels viewed as easy to cope with. 38% of household customers supported more frequent bans versus 5% who wanted an improvement in service levels. Figure who support more frequent bans rises to 67% 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. 56% of customers agree they could do more to reduce their own usage – rising to 86% among informed customers at the workshop group. Low awareness of our current activities and only 47% agree that we are currently effective at helping them to save water. 51% are 'for' us offering services to help them reduce water consumption as an option.	We propose to target a 1l/p/d reduction in average PCC by the end of 2024/25. See section 11 for our water efficiency proposals.

Area of focus	What customers and other stakeholders told us	Our plans to meet our customers' 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. Just over 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 the draft WRMP are included in **appendix F**.

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. At this stage, it does not account for customers' views on what they want us to do in these areas going forward and does not include any proposed 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 our demand management proposals is described in section 11.

Baseline household demand

Household population is forecast to increase by 238,000 and 127,000 new homes are forecast to be built between the base year and 2045. This is an increase of 22% in connected household properties. Households are getting smaller with average occupancy falling from 2.48 to 2.36. A household micro-component model has been used to forecast average PCC. Average dry year PCC is forecast to fall from 131l/p/d to 127l/p/d.

Overall dry year household demand is forecast to rise by 24Ml/d by 2044/45 from 2017/18.

Baseline non-household demand

A trend-based model has been used 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. Baseline household consumption is therefore lower than would occur without this activity.

Our proposals for further water efficiency are described in the 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 where practicable.
- 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 will rise from around 41% in 2020/21 to 66% 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 70.54Ml/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 DYAA and peak week scenarios but both of these are built up from the normal year demand forecast. The following commentary is based on the development of the normal year annual average forecast and highlights how this is converted to DYAA and peak week.

The baseline demand forecast is built on latest forecasts of population and properties in conjunction with the continuation of existing policies around metering and leakage management. At this stage, it does not account for customers' 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 our proposed programme of leakage reduction, metering and water efficiency is described in section 11.

We have followed the Environment Agency's water resources planning guideline 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 the end of the planning period distribution input in the baseline dry year scenario is forecast to increase by almost 25Ml/d. Household water demand is forecast to rise by around 24Ml/d and non-household consumption by around1Ml/d.

Over the 25-year period starting 2017/18 total household population is forecast to rise by approximately 238,000 people and it is forecast there will be an additional 127,000 homes by 2045. Under our baseline metering strategies household meter penetration would rise from around 42% in 2020/21 to around 67% (excluding voids) by 2044/45.

The household demand forecasts include assumed savings as a result of water efficiency activity. Our demand forecasts estimate that average PCC under dry year conditions will remain below 131l/p/d across the planning period dropping from 131l/p/d in the base year to 127l/p/d at the end. Under the normal year scenario, it is lower still.

Non-household demand is forecast to remain relatively stable with slow growth over the plan period.

Total leakage is included in the baseline demand forecast at the current performance commitment of 70.54Ml/d.

Normal year demand has been converted to dry year demand by the application of a dry year factor of 4.1% to household demand. This factor was derived from a review of climatic factors and per household consumption. The adjustment has been applied to both the measured and unmeasured household demand in a normal year.

We commissioned consultants Atkins to reassess household consumption in the critical period (peak week) by applying the 2006 UKWIR 'Peak Water Demand Forecasting Methodology 06/WR/01/7'. This work produced peak week household demand (PWHH). We also reviewed the alternative approach of using a peak ratio. We have used a hybrid of these two options to derive peak week demand.

The central estimate of the impact of climate change on demand is included in the household demand forecast. The uncertainty associated with the impact of climate change on demand is included 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 our 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.

The project was carried out in four main stages.

1) Area reconciliation

The geographical area covered by South Staffs Water was defined in terms of individual unit postcodes. Postcodes that were found to straddle the boundary were split, and treated as partly 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. This process used area boundaries as supplied by us to CACI, the South Staffs household billing file and postcode geography datasets held by CACI.

2) Trend-based forecasts

Forecasts were produced 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 guidance.

3) Plan-based forecasts

Forecasts were produced based upon Local Authority and County Council plans and forecasts. These fulfil the requirements for plan-based population, household and billed household forecasts as specified in UKWIR 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.

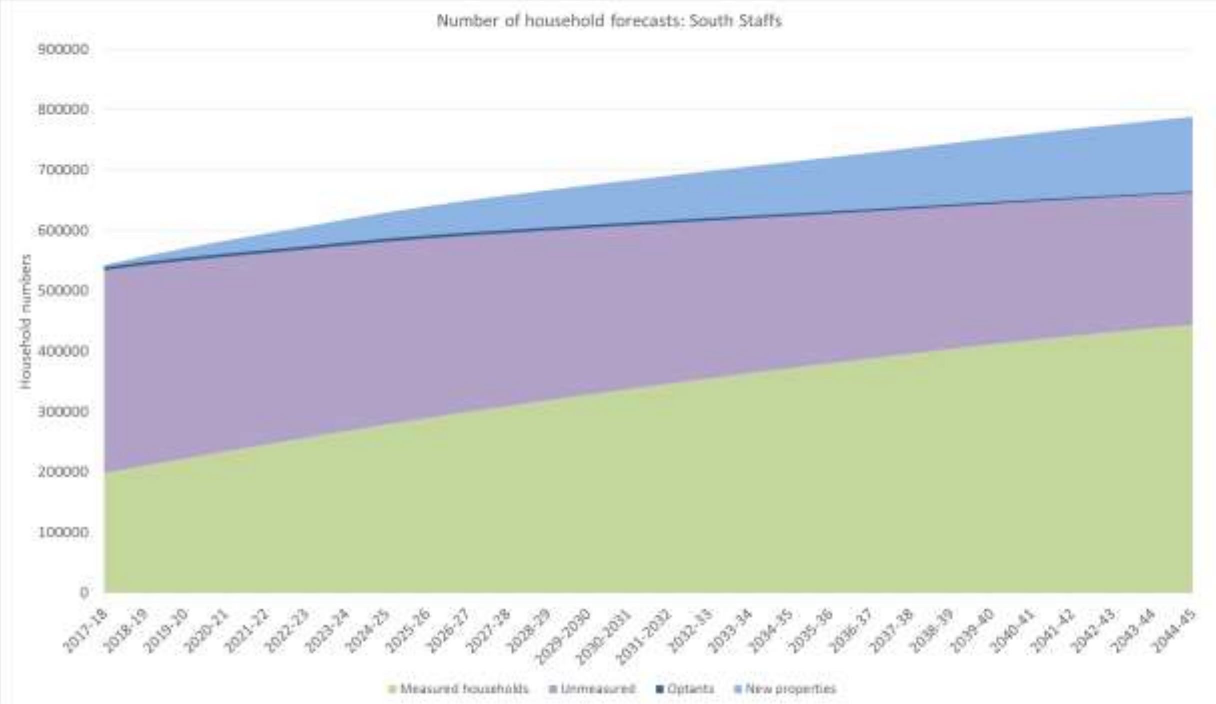
4) Reconciliation of plan-based forecasts with most recent billed household counts

The plan-based forecasts were adjusted 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 G**. This covers our South Staffs Water region and our other region in Cambridge as the work was carried out by CACI to cover both regions. Base year household population and property figures taken from our customer database and consistent with those reported in the '2018 Annual Review' were used to reconcile the base year data.

The forecasts show that household population is expected to increase by 238,000 people by 2045 and that there are approximately 127,000 new homes forecast to be built. This is an increase of 22% in connected household properties.

Figure 6 Household numbers forecasts



6.2.1 Non-household population and properties

Growth in new non-household properties is assumed to be on average flat over the planning period based on the average growth experienced in recent years. This includes where unmetered 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 2,980 to 2,580 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. This is referred to as 'communal population' in the WRMP. 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.

By 2044/45 there will be 246,000 more measured households arising from new connections and meter optants. The number of unmeasured households falls as households opt to have meters installed. 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 42% of billed properties in 2020/21 to 67% by 2044/45 (excluding voids).

6.3.1 Free meter optants

We have reviewed the actual number of meter optants experienced over the last 12 years and the latest forecasts for the remaining years of the AMP6 period (2015/20) to guide the likely number of optants going forward. 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 are relatively stable.

Table 11 Meter optant numbers

Period	Actual/latest forecast number of meter optants
2005/06	5,224 (Actual)
2006/07	6,185 (Actual)
2007/08	4,344 (Actual)
2008/09	7,215 (Actual)
2009/10	6,322 (Actual)
2010/11	4,587 (Actual)
2011/12	5,992 (Actual)
2012/13	6,632 (Actual)
2013/14	6,028 (Actual)
2014/15	5,652 (Actual)
2015/16	4,044 (Actual)
2016/17	5,564 (Actual)
Average 2005/6 to 2009/10	5,858
Average 2010/11 to 2014/15	5,778
Average over whole dataset	5,649

We have based our forecasts on the continuation of this average number of optants for the first five years, with it slowly reducing over the planning period to an average of approximately 3,000 a year for the final five years of the period. An eventual 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 roughly 112,000.

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. Therefore, these are included within the optant figures.

6.3.2 Change of occupier metering

We introduced change of occupier metering in 2010/11. The actual number of properties metered under this policy has been low as a result of the decline in the housing market at the time of introduction. It has since proven a difficult policy to administer and is not one supported by customers. This policy has not been enforced since 2013/14. The actual number of installations under this policy is shown in the following table.

Table 12 Change of occupier metering numbers

Period	Actual/latest forecast number of change of occupier meters
2010/11	2,144 (Actual)
2011/12	1,951 (Actual)
2012/13	1,498 (Actual)
2013/14	1,653 (Actual)
2014/15	0 (Actual)
2015/16	0 (Actual)
2016/17	0 (Actual)
Total	7,246

We considered reintroducing the change of occupier policy as one of the demand management options in our list of feasible options, but did not select it.

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 our 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 to 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 2.48 people/property in 2017/18 to 2.36 people/property in 2044/45.

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

Table 13 household occupancy rates

Customer group	2017/18 occupancy	2044/45 occupancy
All households (weighted average)	2.48	2.36
Unmeasured households	2.58	2.91
Measured households	2.30	2.2

The occupancy rate for unmeasured households is forecast to rise reflecting larger family units (growing families) who are unlikely to opt for metering.

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 rise slightly 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. The baseline household consumption forecast has been produced using micro-component modelling and forecasting, which is suitable for a zone with a moderate level of water resource planning concern. A new micro-component forecast model was developed for us for this WRMP by consultancy firm Artesia.

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. This method is used to calculate base year OVF per household consumption (PHC) values, which are then calibrated to the WRZ normal year PHC values.

Forecasts of the property, population and occupancy are established 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.

Micro-components are then forecast using a combination of longitudinal micro-component data and future market transformation programme derived micro-component values. These trends are applied to the normal year micro-component values. An additional occupancy specific trend is also added, to ensure that the varying occupancy within each of the household segments is captured.

Data from national studies was used 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.

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

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

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

A scenario approach to modelling uncertainty was used, to reflect the various uncertainties in consumption forecasts.

Best practice guidelines for household demand forecasting have been followed in deriving the baseline household demand forecast.

We provided the following data to enable Artesia to 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.
- Reported annual return data for reconciliation with the base year.

Full details of the micro-component modelling are included in **appendix H**.

The results of the micro-component forecast are in the following tables based on NYAA. Average household PCC (mean of all household types) reduces from 125l/p/d to 122l/p/d over the period 2020/21 to 2044/45.

Table 14 PCC forecasts (base year NYAA)

	Base year NYAA		
Household group	**Occupancy**	**PHC**	**PCC**
Unmeasured HH	2.58	333	129
Existing metered HH	2.32	279	120
New build metered HH	2.49	266	107
Optant metered HH	2.06	242	117
Total measured HH	2.32	278	120
Total HH	2.48	313	126

Table 15 PCC forecasts (2044/45 NYAA)

2044/45 NYAA			
Household group	**Occupancy**	**PHC**	**PCC**
Unmeasured HH	2.74	339	124
Existing metered HH	2.19	268	123
New build metered HH	2.23	261	116
Optant metered HH	2.08	254	123
Total measured HH	2.17	262	121
Total HH	2.36	287	122

Water efficiency savings are included within the 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. These activities are assumed to 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. Sensitivity testing using alternative future scenarios is also carried out and this is described in the Artesia report in **appendix H**. Our proposals for additional water efficiency activity are described in section 11.

Data included in the sector's 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;
- levels of meter penetration;
- climate; and
- method calculation.

This data demonstrated that the average PCC for our area was the lowest overall in 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 among the 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 24Ml/d by the end of the planning period. Dry year unmeasured household demand falls over the planning period reflecting 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 reflecting the increasing number of metered households because of switching and new supplies.

PHC and PCC forecasts are based on a normal weather year. Dry year and critical period adjustments are added to the external household use micro-component to reflect greater use in dry periods associated with garden watering, outdoor play and general outdoor maintenance. The adjustments are described in later sections of this chapter.

6.7 Baseline non-household demand

Since the start of the economic downturn in 2008 there has been a significant reduction in non-household demand. We lost a number of large users and have not gained any new large users. There has been little evidence of any significant recovery. Forecasting non-household demand with confidence beyond a five-year period is difficult because of a range of significant uncertainties. We commissioned Artesia to carry out modelling to derive non-household consumption forecasts to the year 2045.

Non-household consumption was analysed using a 'trend-based' approach at a high level, and subsequently, at individual sector level and consumption bands. Large users were also considered separately.

Consumption figures were tested 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.

A set of forecasts was provided 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. The most probable scenarios were used to calculate a mean forecast for use in the plan.

Full details of the approach to non-household modelling are included in **appendix J**.

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 made an allowance in the forecasts for supply pipe leakage.

The non-household water retail market opened in in 2017. This enables 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 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 market there is no information available on which to base any assumed water efficiency savings. The range of scenarios produced for the non-household consumption forecast have been used to provide the uncertainty estimate to include in headroom. It is considered 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 70.54Ml/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 between companies can be compared more easily. This work is supported by Ofwat, the Environment Agency, Natural Resources Wales and CCWater.

Companies need to make changes to their current reporting to align with the new, more consistent, reporting definitions, and 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; during this period the industry wide approach will be assured 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 volume of water lost through leakage. As such it will rebalance the components of the base year water balance and the demand forecasts going forward, but will have no impact on our future plans for balancing the supply and demand for water.

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).

The estimate of water use for these categories is based on our own specific data for the base year and is assumed to remain constant over the planning period and for all demand scenarios.

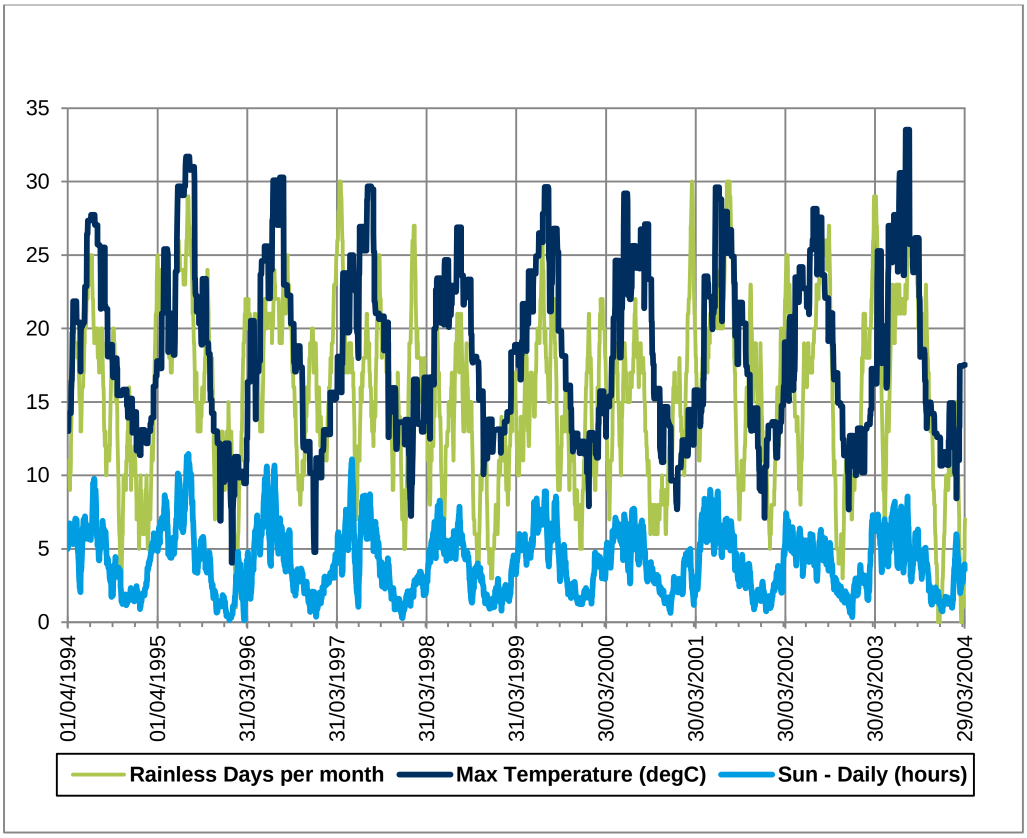
6.10 Dry year demand

Normal year demand is converted to dry year demand by applying a dry year factor to household demand. This factor was derived from a review of climatic factors alongside PHC. Studies consistently demonstrate that demand is directly related to sunshine hours and maximum temperature and the relationship with rainfall is significantly weaker.

Dry year was determined in a separate piece of work carried out for WRMP14 and remains unchanged for WRMP19 as we have not experienced a dry year in the interim.

The following chart shows how these data can be used to distinguish dry years from normal years for water resources planning purposes. Our reference dry year for PHC is based on 1995. The climatic data shows the adjacent four-year period from 1998/99 to 2001/02 best represents normal years, with reduced maximum temperatures and hours of sunshine.

Figure 7 Temperature, sunshine hours and rainless days 1994/2004



The average overall PHC for the normal year planning period is 338 litres per property per day (l/prop/d).

The resulting dry year factor is applied to the normal year household consumption forecast uplifting it to the dry year scenario. The adjustment has been applied to both the measured and unmeasured household demand in a normal year and is incorporated in the micro-component modelling carried out by Artesia on our behalf.

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

Table 16 Impact of the dry year adjustment on normal year demand

Household group and component	2020/21	2044/45
Unmeasured HH NYAA consumption	108Ml/d	74Ml/d
Unmeasured HH NYAA PCC l/p/d	129l/p/d	124l/p/d

Household group and component	2020/21	2044/45
Unmeasured HH DYAA consumption	112Ml/d	77Ml/d
Unmeasured HH DYAA PCC l/p/d	134l/p/d	129l/p/d
Measured HH NYAA consumption	64Ml/d	116Ml/d
Measured HH NYAA PCC l/p/d	120l/p/d	121l/p/d
Measured HH DYAA consumption	67Ml/d	121Ml/d
Measured HH DYAA PCC l/p/d	125l/p/d	126l/p/d
Total DYAA adjustment	7Ml/d	8Ml/d

All other elements of demand are considered to be unaffected by the characteristics of a typical dry year.

6.11 Critical period (peak week) demand

The critical period for us 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. More frequent shorter periods of high demand (peak hour and peak day) are effectively managed through network management and strategic storage supplies.

6.11.1 UKWIR 2006 peak week demand forecasting methodology

Atkins has previously assessed peak week household demand (PWHH) for us using UKWIR's 2006 methodology. A demand model was developed in 2007 for WRMP09 and subsequently updated in 2013 for WRMP14. With five years of additional data the model has been reviewed again to take account of most recent data and determine the impact of metering on peak week household demand.

The report detailing this review and the findings is included in **appendix K**.

The Atkins work found that temperature, sunshine and rainfall remain the key explanatory variables for peak week household demand. Meter penetration was also found to have a link although a much weaker relationship than the climatic variables. It was also determined that there were noticeable changes in demand from 2006 onwards suggesting that it is most appropriate to use data from 2007 onwards only.

A revised model was developed using the meter penetration relationship to allow an assessment of the impacts of future metering forecasts. The model produces predicted PWHH demand for 1 in 20 and 1 in 40 year events. The revised model showed a reduction in the predicted PWHH demand compared with the model used for WRMP14. The model was also used to determine how the PWHH demand would vary with increased meter penetration which is a forecasting option under UKWIR's 2006 methodology.

The return period for customer restrictions (temporary use bans) is 1 in 40 years and therefore the 1 in 40 year values were selected. As of 2020/21, we predict PWHH demand to be 265Ml/d which will increase to 297Ml/d by 2044/45.

This forecasting approach for PWHH demand cannot be used in isolation as the model does not account for changes in the total number of households or further changes in customer water using behaviour and therefore the outputs from the model need further interpretation before they can be used in the critical period demand forecasts.

At WRMP14 it was assumed that the proportion of PWHH demand to normal household demand in the base year remains constant over the planning period. Therefore, as normal year household demand increases over the planning period so does PWHH demand.

For WRMP19 the new model indicated a PWHH demand in the base year (2017/18) of 257Ml/d and predicted that it would rise to 297Ml/d by 2044/45.

6.11.2 Peak week household demand model

Artesia's per household micro-component model produces a peak week forecast. This uses a peak week factor which is applied to the components of use that are affected by summer weather. The peak week factor was derived using the ratio of the Atkins predicted base year PWHH demand against the Artesia modelled base year normal year household demand. This gave a ratio of 1.54. This ratio was applied across the period to convert normal year household demand to peak week household demand. This is an alternative forecasting methodology recognised by UKWIR's 2006 methodology.

While the Artesia per household micro-component model accounts for population changes and changing numbers of measured and unmeasured households, it does not reflect fully the relationship between meter penetration and peak week household demand.

6.11.3 Combined approach

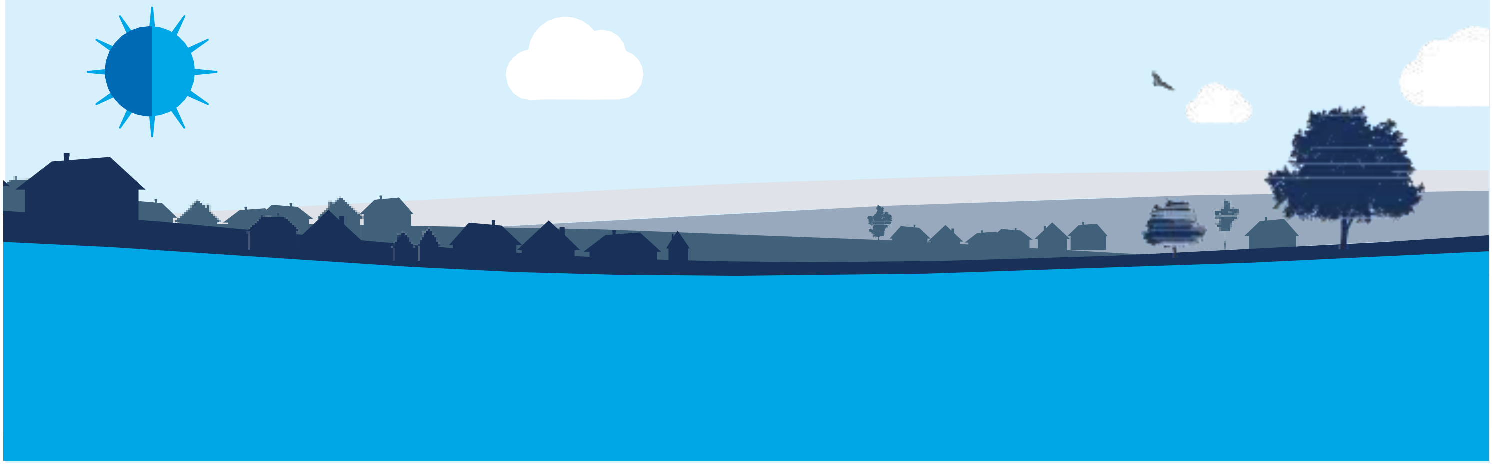
Because of the limitations of both approaches described above a hybrid was adopted for the baseline critical period demand forecast scenario. The Artesia peak week household demand forecast was adjusted by the equivalent reduction arising from meter penetration derived from the Atkins model. This approach was deemed to account for growth in population and also a greater influence of meter penetration.

Table 17 Baseline critical period demand forecast – combined approach

Approach	Base year	2044/45
Final WRMP	257Ml/d	297Ml/d

Section 7:

Baseline supply forecast



7. Baseline supply forecast

Overview of baseline supply forecast

Levels of service

Our base year water available for use (WAFU) has decreased since WRMP14 by approximately 30Ml/d. This is roughly split between changes to.

- surface water; and
- the availability of groundwater sources.

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. In all scenarios in the base year our modelling showed a surplus of supply over demand of around 45 Ml/d.

We have also tested our drought resilience over the whole planning period with our forecast changes in demand and supply. Our analysis suggests a slightly reduced drought surplus over the planning period of no less than 33Ml/d.

Our analysis shows our supplies are resilient for a range of droughts across the 25-year planning period and will remain so even in the event of future sustainability changes to prevent deterioration. The operation of our River Blithe pumpback scheme is proving to be a significant contribution to our drought resilience.

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

Impacts of climate change on supply

We have assessed the impact of global warming and climate change on our future supplies. Our resource zone can be classified as 'medium' vulnerability to climate change; however, we have adopted a medium to high vulnerability approach to be consistent with outputs from the Severn Trent Water regional model which we use.

A selection of 20 scenarios were chosen from the UKCP09 climate change database for each of the 2030s and 2080s time slices and DO results for 'No restrictions' and 'Levels of service' successfully obtained.

We have predicted a central estimate and upper and lower range of values for use in understanding the most likely future DO, and also the uncertainty around this central estimate.

The central estimate of the impact of climate change on supply is a reduction in DO of 9.5Ml/d by 2045.

Treatment works operational use

We have reassessed the treatment works operational use (TWOU) allowance for this plan and this has significantly increased since WRMP14. However, this is largely offset by licence conditions which allow abstraction for treatment works process use. So there is no material impact on DO. That said, we recognise the need to continually improve our processes to reduce this.

Overview of baseline supply forecast continued

Sustainability reductions

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

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. For our Cambridge region the Environment Agency has advised the reductions should be considered as a reduction to our baseline DO assessment, because not including this element would present an unacceptable risk to the environment and to our water supplies. For consistency, we have adopted this principle in this region also.

We have included in our baseline assessment of DO a reduction of 6Ml/d.

Outage

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. The outage allowance values for DYAA and DYCP outage are 8.3Ml/d and 5.6Ml/d, respectively.

7.1 Overview of South Staffs Water

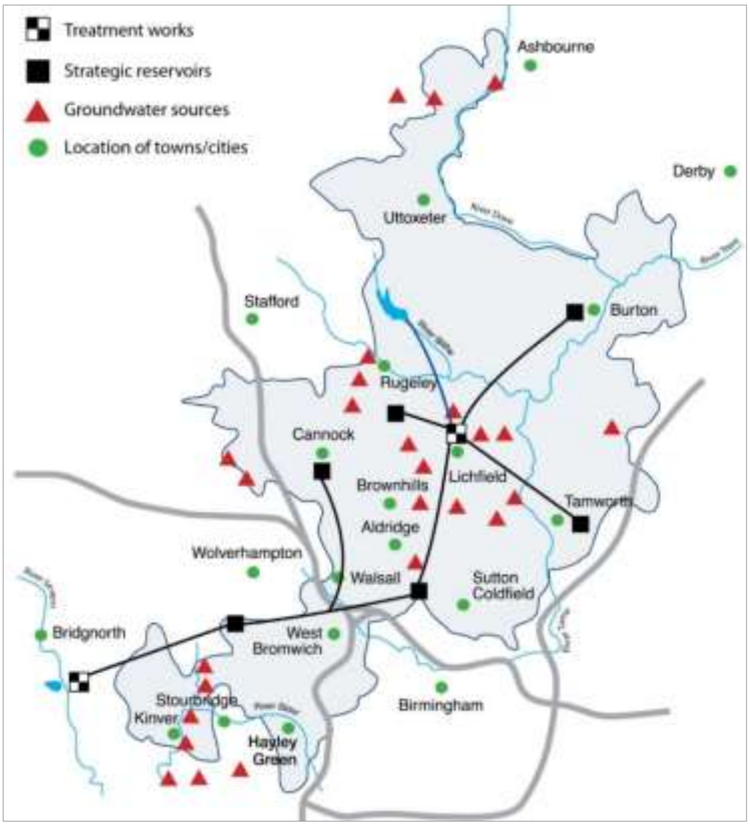
7.1.1 The supply area

South Staffs Water is responsible for public water supply across part of the West Midlands, serving some 1.3 million people. The area of supply stretches from the edge of Ashbourne in the north, to Halesowen in the south, and from Burton upon Trent in the east to Kinver in the west.

7.1.2 Planning area – the water resource zone

In May 2017, following assessment using the WRZ integrity guidance (Environment Agency, July 2016), we agreed with the Environment Agency that we would continue to represent a single resource zone. A map of the area of supply is shown in figure 8 below.

Figure 8 South Staffs area of supply



7.1.3 Sources of supply

We have two surface water sources – River Severn and Blithfield Reservoir – and 25 available groundwater sources, which are mainly situated in the southern and central areas. All these sources are linked by an integrated supply system. Surface water sources provide approximately 50% of our water resources in the dry year and the remainder comes from our groundwater sources, abstracting from the Sherwood Sandstone aquifer.

We have a number of small bulk imports and exports with Severn Trent Water, some of which are used daily and others which are for emergency use only. Our River Severn treatment works is jointly funded with Severn Trent Water and we discussed this arrangement in section 3.7.1.

7.1.4 Levels of service (LoS)

Our published levels of service are 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. The last time we asked our customers not to use their hosepipes was in the drought of 1976, but we plan to meet unrestricted customer demands in a repeat of the conditions experienced during the 1995/97 drought. We equate this to a frequency of restrictions of once every 40 years in this area.

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 below.

Table 18 Levels of service assessed against deployable output

Restriction	Our proposed levels of service (LoS)	Reference levels of service
Temporary use bans (formerly hosepipe bans)	1 in 40 years	1 in 10 years
Non-essential use bans (Ordinary Drought Order)	1 in 80 years	1 in 40 years
Rota cuts or standpipes (also known as level 4 restrictions)	not anticipated/ < 1 in 200 years	Not applicable

To demonstrate compliance with 3(b) and 3(c) of the 2017 WRMP Direction we have included the following tables and text.

Table 19 Annual average percentage risk of restrictions – planned levels of service

Restriction	Annual % risk 2020/25	Annual % risk 2025/30	Annual % risk 2030/35	Annual % risk 2035/40	Annual % risk 2040/45
Temporary use bans (formerly hosepipe bans)	2.5%	2.5%	2.5%	2.5%	2.5%
Non-essential use bans (Ordinary Drought Order)	1.25%	1.25%	1.25%	1.25%	1.25%
Rota cuts or standpipes	not anticipated / <0.5%	not anticipated / <0.5%	not anticipated / <0.5%	not anticipated / <0.5%	not anticipated / <0.5%

The annual average risks shown in the table above are based on our levels of service and the following assumptions.

- We are not proposing any changes to our current levels of service between now and 2045.
- We continue to meet, or exceed, these levels of service.
- 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 demand- or supply-side options that mean that we can still maintain these levels of service for our customers.

As stated in **appendix B**, we use the frequency of temporary use bans (TUBs) of not more than 1 every 40 years on average to determine our Level of Service Deployable Output (LoS DO). We have used our Aquator model to simulate the water balance of the system by relating the application of TUBs to the crossing of the relevant control curve of Blithfield reservoir – that is, when reserves at Blithfield go down below the control curve, TUBs are activated and the associated demand saving percentages applied.

We have simulated our system during a historical period of 131 years (1884 to 2014), in which time we allowed a maximum of three TUBs. This meant that the demand value that would have led to a fourth TUB determined our LoS DO. Hence, our LoS DO is the maximum possible value that would not cause more than three TUBs during our simulation. The resulting 338Ml/d caused the model to apply TUBs in only three years (1896, 1934 and 1976). Therefore, the related annual percentage of risk was 3/131x100 = 2.3%. At 339Ml/d there would be a further TUB (in 2011) and hence failure to meet our LoS.

Likewise, we have modelled the implementation of drought permits and the activation of non-essential use bans in Aquator by using the appropriate Blithfield control curves as triggers. However, during our simulation from 1884 to 2014 these controls were not crossed so the related annual percentage risk is null.

With respect to TUBs, the estimated LoS DO (338Ml/d) is above the demand of the system during the 25-year planning period, implying that the annual percentage of risk is likely to be lower. The impact of climate change on flows, in turn, might increase the risk of TUBs towards the end of the planning period, whereas the supply augmentation measures established in AMP6 should reduce the risk once implemented. To determine the annual percentage risk of TUBs over the 25 years as requested by the Environment Agency, we have modelled the following three scenarios in Aquator.

- Current water demand (299.2Ml/d as reported in table 9 of our draft WRMP for the year 2020/21), historical flows and current infrastructure and operation (as adopted to obtain the LoS DO).
- Future water demand (301.5Ml/d as reported in table 9 of our draft WRMP for the year 2044/45), climate changed flows (scenario 14 for the 2080s as defined in appendix P) and current infrastructure and operation (as adopted to obtain the LoS DO).

- Future water demand (301.5Ml/d as reported in table 9 of our draft WRMP for the year 2044/45), climate changed flows (scenario 14 for the 2080s as defined in appendix P) and future infrastructure and operation after AMP6 (including additional 6.35Ml/d from SOPW/SHPW).

For the purposes of populating the following table we used climate change scenario 14, which leads to the median impact on the LoS DO (a reduction of 21Ml/d), and is therefore the most representative 'central case' scenario. Using the 2080s flows is precautionary as the effect at the end of the 25-year planning period would be lower.

Our results show that:

- TUBs are not activated in any of the three scenarios. As the LoS DO in current and future conditions is well above the demand level, reserves at Blithfield do not fall below control curve 4a;
- the TUBs annual percentage of risk is therefore null over the 25-year planning period;
- we would not 'appeal for restraint' in scenario 1. However, the impact of climate change would mean that if flows decreased as estimated for the 2080s, there would be 15 years with 'appeals for restraint' along the 1920 to 2014 period with the current infrastructure and 10 with the improvements established in AMP6. The frequency for the year 2044/45 would be lower; and
- considering that year 2015 is representative of the current flow regime and that year 2085 would be associated with climate change perturbed flows for the 2080s, the table below shows the evolution of the annual percentage of risk of the different demand restriction measures.

Table 20 Modelled annual percentage of risk of demand restrictions

Restriction	Annual % risk 2020/25	Annual % risk 2025/30	Annual % risk 2030/35	Annual % risk 2035/40	Annual % risk 2040/45
Appeal for restraint	1.7	1.9	2.6	3.4	4.1
Temporary use bans (formerly hosepipe bans)	Not anticipated	Not anticipated	Not anticipated	Not anticipated	Not anticipated
Non-essential use bans (Ordinary Drought Order)	Not anticipated	Not anticipated	Not anticipated	Not anticipated	Not anticipated
Rota cuts or standpipes	Not anticipated	Not anticipated	Not anticipated	Not anticipated	Not anticipated

Source: Mott MacDonald.

7.1.5 Planning scenario

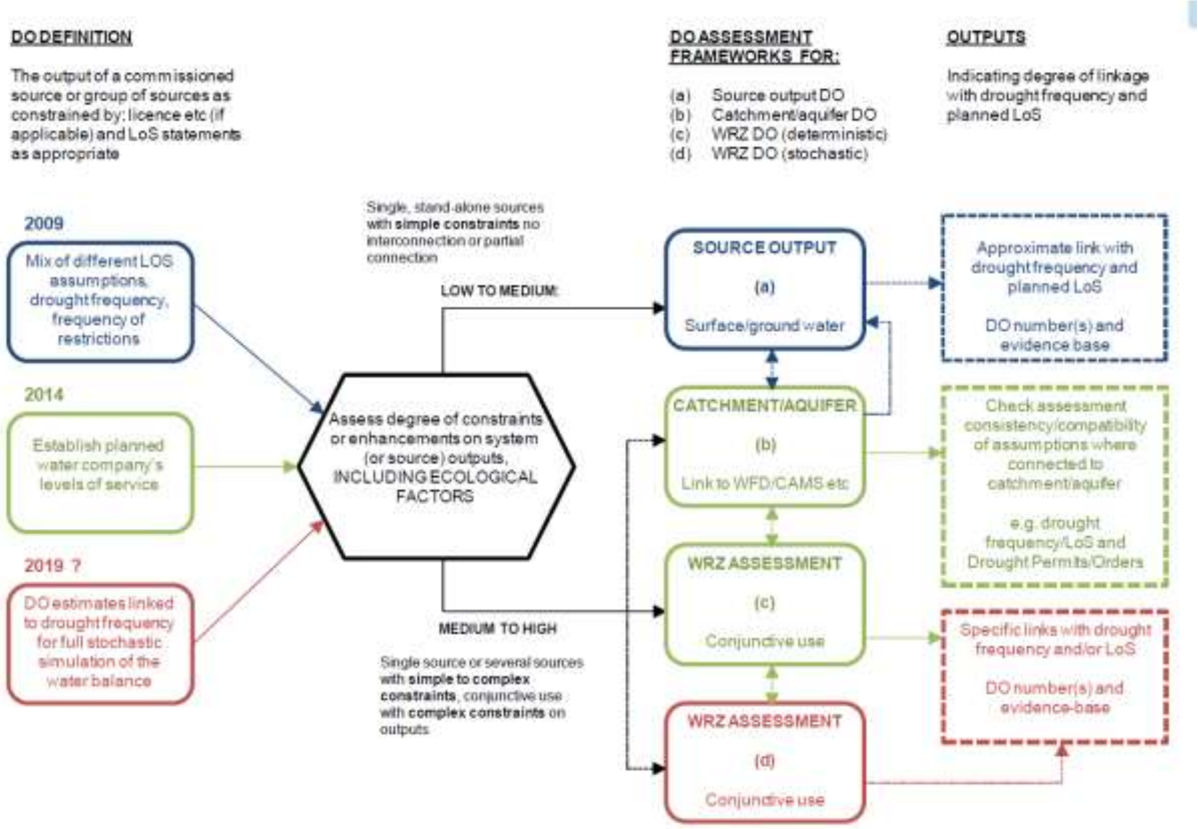
We plan for both the DYAA and peak week scenarios and derive DO using our water resources allocation model, Aquator, and employing behavioural analysis.

7.2 Deployable output

7.2.1 Method selection

Based on the UKWIR and Environment Agency study ('Water Resources Planning Tools' 2012), otherwise referred to as WR27, we have determined the level of analysis required to assess DO which is proportionate to the nature of our supply system and the risk to both supplies and the environment.

Figure 9 Deployable output analysis



A WRZ (conjunctive use system) assessment framework has been selected for the following reasons.

- A conjunctive use model was used for previous WRMP submissions and therefore there is data and intelligence from previous model building and refinement studies available.

- There is a medium to high degree of constraints on outputs with some elements (groundwater) having simple constraints and others (surface water) having complex constraints.
- There is a requirement to evaluate our existing levels of service and options for alternative levels of service.

A catchment/aquifer assessment framework is not currently required to assess ecological needs. However, our model has the capability to carry out this task if required in future.

The DO of our supply system has been assessed using best practice techniques within the report No. 14/WR/27/7, 'Handbook of Source Yield Methodologies' (UKWIR, 2014).

7.2.2 Deployable output assessment method

7.2.2.1 Description of method

Conjunctive use has been simulated using an Aquator computer model for PR19. This is a mass balance water resources allocation model with a number of interconnected components which computes flows and volumes on a daily time step. The components include:

- source nodes (including groundwater sources, reservoir and river intakes);
- transmission links (raw and treated water trunk mains, booster stations and service reservoirs); and
- demand centres.

Individual parameters define the behaviour of each component and have been set using our own data and experience.

Environmental flows are represented by river nodes. The flows used by the model for the Upper and Lower River Blithe to determine behaviour of the Blithfield-River Blithe pumpback supply system have been determined using HYSIM rainfall run-off modelling. Other inflow sequences have been determined by behavioural analysis using the Severn Trent Water strategic regional model and these have been made available to us.

The conjunctive use model assesses the impacts of customer levels of service by applying restricted demand patterns triggered by control curves which conserve resources, allowing a higher DO to be obtained on average. These measures apply over the planning scenario (dry year average and peak). The frequency of any restriction is closely linked to DO and is determined by the highest average demand that can be sustained over the period of record (for us, this is 131 years) before a further year with restrictions is required. For example, a 1 in 40-year restriction would occur no more than three times within this period.

7.2.2.2 Work carried out for PR19

We have carried out a review of our water resources modelling for PR19. The model update process comprised the following steps.

- Hydrology update – recalibration of the hydrological models (HYSIM) and extension of the period of data:
  - update of the River Blithe model using improved climatic datasets;
  - inclusion of direct reservoir rainfall and evaporation component;
  - calibration of model to reservoir mass balance and downstream observed flows and validation against recent upstream flow gauging; and
  - extension from 1920 to 2010 period (90 years) to 1884 to 2014 (131 years).

- Update and refinement of the model components:
  - reassessment of groundwater performance since PR14;
  - updates to groundwater sites affected by nitrate blend schemes;
  - exclusion of groundwater sites out of supply because of pesticide contamination;
  - modifications to operation of the River Blithe pumpback;
  - inclusion of Blithfield potable infusion measure;
  - update to groundwater and surface water treatment works losses;
  - update to our central works minimum flow requirement; and
  - improvements to simulation of licence constraints at River Severn works.

- Changes to model rules to better represent actual system operation.

A report detailing the hydrology update work is included in **appendix L**.

No adjustments to groundwater baseline DO values have been made in the model as a result of the AMP6 National Environment Programme (NEP). While indicative changes to abstraction licences have been discussed and are published in the NEP Phase 5 release from January 2016, the final design of schemes is yet to be agreed. The expected impacts on our supply forecast are discussed in section 7.9.

Appendix M includes a list of groundwater DOs for each site. 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 is only available to the Environment Agency.

7.2.3 Baseline deployable output results

The estimated DOs are shown in the following table, together with those from the previous WRMP.

Table 21 Estimated deployable output – WRMP14 and WRMP19 (Ml/d)

	Deployable output Ml/d		
	WRMP14	WRMP19	Change
No restrictions (NR)	342	333	-9

	Deployable output Ml/d		
	WRMP14	WRMP19	Change
Company levels of service	368	338	-30

The water available for use (WAFU) of the system has decreased in comparison with WRMP14, by approximately 30Ml/d. The key changes are as follows.

- reductions as a result of improvements in assessing surface water output; and
- reductions of groundwater yields.

Changes to other system information and model representation have approximately cancelled each other out. However, it is notable that the implementation of model changes to allow simulation of Blithfield under normal year conditions was not straightforward. Better and more accurate simulation of the River Blithe pumpback, Blithfield conservation, and the West Bromwich booster capacity was required. This was because, by giving priority to Blithfield in normal conditions, the initial storage at the start of a drought was reduced, implying that the temporary use ban curve might be reached sooner. The further model improvements allowed the more aggressive supply from our River Severn Works to the northern part of the system we carry out during Blithfield conservation to be better simulated, in comparison with the WRMP14 modelling.

It is noted that there were two significant drought events in the data extension periods (1896 and 2011), while the number of allowable temporary use bans has only increased by one (from 2 in 90 years for WRMP14 to 3 in 131 years for WRMP19).

7.3 Time-limited licences

We have three time-limited licences. These are outlined in the table below.

Table 22 Time-limited licences

Licence	Time-limited quantity (annual average Ml/d)	Time limit date
River Severn Works	11	31 March 2034
River Blithe pumpback scheme	30	31 March 2021
Broome Lodge (for augmentation flows only)	2 (0)	31 March 2021

Abstraction from the Broome Lodge borehole is for the purpose of augmenting water levels in the nearby pools and rivers and is neither used for public water supply nor affects the operation of other boreholes.

The River Blithe pumpback licence was renewed in 2018 which reduced permitted annual abstraction volumes therefore had no impact on peak transfer capacities. We are currently reviewing mitigation measures in the River Blithe with the aim of identifying and implementing options to achieve Good Ecological Potential in the water body downstream of Blithfield Reservoir (which is a Heavily Modified Water Body under the WFD). These measures may require us to further amend the licence or to put in place other measures to protect fish passage at the River Blithe pumpback site.

Part of the River Severn Works licence is time limited to 2034 (11Ml/d). Our baseline forecast assumption is that both licences retain their present influence on DO across the planning period.

7.4 Links to our drought plan

7.4.1 Measures included within deployable output analysis for WRMP

The DO analysis in Aquator for the WRMP includes selected drought measures in accordance with Environment Agency guidelines (see following table). Supply-side measures that are modelled include operation of the River Blithe pumpback, conservation of Blithfield Reservoir (operational changes to make more use of River Severn works), and transfer of potable water to Blithfield. Demand-side measures that are modelled include:

- appeals for restraint;
- temporary use (hosepipe) bans; and
- non-essential use bans.

Operational measures that are primarily designed to optimise supplies and reduce waste (such as ensuring all sources are working and reducing leakage) are not considered separately as this is implicit within the model. Similarly, drought permits on the Rivers Severn and Blithe/Trent are not included in line with Environment Agency guidelines.

The Aquator model imposes these measures triggered by drought control curves based on reservoir storage levels in Blithfield Reservoir. The constraints on these measures are outlined in **appendix B** and are largely based on experience of the 2011 drought and/or UKWIR guidance.

The Aquator model run used to determine the base year levels of service DO value includes three drought years in 1896, 1976 and 2011. Each of these are characterised by a requirement to impose temporary use (hosepipe) bans and one (1976) also requires the imposition of a non-essential use ban. In addition to these levels of service events, other measures corresponding to lower trigger levels are more frequently modelled in these drought years and other, less severe drought years where TUBs were not required. For example, appeals for restraint are imposed in 20 years out of the 131-year record.

Table 23 Drought measures included within the WRMP and drought plan

Trigger level	Drought measure	Supply-/ demand-side	Comments	WRMP	DP
1	Appeals for restraint	Demand	Extra promotion of water efficiency and increased publicity campaign	Yes	Yes
1	Increased leakage detection and repair	Demand	Yield dependent on conditions and leakage levels	No	Yes
1	Operation of River Blithe pumpback	Supply	Yield based on model parameters – no drought permit/order needed	Yes	Yes
1	Ensure existing ground and surface water sources fully operational	Supply	Yield dependent upon conditions and operational readiness – no drought permit/order needed	No	Yes
1	Conserve Blithfield Reservoir	Supply	Yield based on model parameters – no drought permit/order needed	Yes	Yes
1	Maximise use of enhanced groundwater treatment sites	Supply	Yield dependent upon conditions and operational readiness – no drought permit/order needed.	No	Yes
1	Transfer of potable water to Blithfield Reservoir	Supply	Yield based on model parameters – no drought permit/order needed but Environment Agency consent to discharge required	Yes	Yes
2	Review potential for bulk supplies to/from Severn Trent	Supply	Yield dependent upon conditions and operational readiness – no drought permit/order needed	No	Yes
3	Temporary use (hosepipe) ban	Demand	Yield estimated from UKWIR studies	Yes	Yes
3	Enhanced pressure management	Demand	Yield dependent on conditions and leakage levels	No	Yes

Trigger level	Drought measure	Supply-/ demand-side	Comments	WRMP	DP
3	Non-essential use ban	Demand	Yield estimated from UKWIR studies	Yes	Yes
3	Implement drought permit on the River Blithe/Trent	Supply	Included in table 10 not DO estimate	(Yes)	Yes
3	Implement drought order at River Severn Works	Supply	Included in table 10 not DO estimate	(Yes)	Yes
3	Operation of Blithfield Reservoir at low levels	Supply	Yield not currently well understood	No	Yes
n/a	Rota cuts	Demand	Civil emergency measure only	No	No

It should be noted that references to table 10 above relate to a worksheet within the WRMP excel spreadsheets that we publish alongside our WRMP narrative on our website, not table 10 in this document. Table 10 in the WRMP tables 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.

7.4.2 Additional measures within our drought plan

The additional measures we can draw on in the event of a drought that are not included within this WRMP are:

- **the River Blithe/Trent Drought Permit**, which allows us to operate the River Blithe pumpback when flows in the River Trent at North Muskham fall below the 'Hands off flow limit'; and
- **the River Severn Drought Permit**, which allows us to abstract from the river at low flow conditions when the Environment Agency is seeking reductions in abstraction under their River Severn Drought Order.

The benefits of these measures can be estimated and have been included within table 10 of the WRMP tables.

In addition, our drought plan identifies the possibility of operating Blithfield Reservoir at low levels – that is, below historic minimum operational levels. Following works in the 1990s there are no remaining hydraulic constraints to this procedure, but there are uncertainties over water quality in the reservoir at these levels which may limit the volumes of water that can be safely treated. Accordingly, there is little certainty over yield and this measure has not been included in table 10 of the WRMP tables.

7.4.3 Determination of extreme droughts

The WRMP evaluated historic drought events within the 131-year record for which we were able to obtain climatic data for Aquator modelling.

Based on an initial analysis of the combined impact of the River Severn and Trent catchment flows on our supply system, the 1975/76 drought would have a return period of around 200 years, whereas the 2010/11 one would be around 50 years. We discuss the 1895/96 drought return period in more detail later in this section, but we note that assigning return periods to droughts is far from straightforward. For example, selecting different time periods within a long drought gives different return periods.

We have also looked at more extreme droughts as part of work carried out in parallel with Severn Trent Water. This considered 200 randomly generated rainfall sequences from the UKCP09 weather generator that allows the investigation of extreme events. These were correlated with appropriate evapotranspiration data and inflows to Blithfield Reservoir modelled in our HYSIM rainfall run-off model. From the 200 flow series, extreme value statistical analysis was used to select six datasets for analysis with Aquator as follows.

Table 24 Extreme drought datasets

Event	Duration (months)	DO (Ml/d)	Change in DO (Ml/d)
1 in 200-year	18	342	+9
	24	319	-14
	30	313	-20
1 in 500-year	18	332	-1
	24	328	-5
	30	311	-22

It can be seen that the impact of 18-month droughts of a 1 in 200- or 1 in 500-year frequency are not materially worse than observed in the historic record. A 24-month duration 1 in 500-year drought is seen to have a lesser impact than a 24-month 1 in 200-year drought, which was found to contain a short-term dry event within the rainfall sequence. As a result, the two 30-month sequences have been chosen to test the resilience of our supply system to extreme events.

Reports detailing our work on extreme droughts are included in **appendix N** and **appendix X**.

7.4.4 Assessment of resilience in base year

We have evaluated our resilience to drought based on our current resources in the base year. We have considered four drought scenarios: two within the historic period (1976 and

2011) that we used to estimate our DO, and a further two scenarios that were artificially generated from Met Office models to consider extreme droughts with a greater severity – that is, up to a 1 in 500-year event.

We used our Aquator model and its associated datasets to evaluate the performance of our supply system and the contribution of our various drought management measures. These are shown in table 10 of our WRMP tables. The key features are:

- in all scenarios in the base year we have a healthy surplus of supply over demand of around 50Ml/d;
- the contribution of the River Blithe pumpback is an important measure but is reduced in most droughts unless its associated drought permit is implemented; and
- while our full range of demand-side measures – (appeals for restraint, temporary use and non-essential use bans) are used in these scenarios, their impacts are reduced under most droughts. This is because the way our simulations use our current drought curves generally means these measures are applied mid-way through the drought rather than at the start of the summer demand period.

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 proposed programme of works (as detailed in section 11).

The assumptions that we made when we carried out this analysis are:

- baseline demand rises modestly by around 25Ml/d from 300Ml/d in the base year to 325Ml/d in 2044/45;
- our proposed programme includes savings from demand management of around 5Ml/d through activities helping our customers reduce consumption;
- the net effect is that demand-side drought measures are therefore likely to be at least the same across the planning period if not higher;
- our proposed programme includes a significant reduction in leakage by around 12Ml/d by the end of AMP7 and further savings of around 6Ml/d from 2040 (these leakage reductions are now more ambitious but this correctly reflects what we assumed in our extreme drought modelling);
- our DO is likely to fall by around 15Ml/d over this same period because of sustainability changes and climate change;
- we will be installing a new pesticide removal plant to increase supplies by 6Ml/d. This is a groundwater source which is not vulnerable to climate change and whose licence is assessed as currently sustainable by the Environment Agency; and
- that planned capital maintenance on FRPW, KIPW1 and our central works will increase supplies in the peak scenario to provide extra resilience.

Additionally, AMP7 and AMP8 reductions in treatment works losses are likely to provide more resilience. Even without this there is a surplus over the planning period of at least 6Ml/d.

The analysis we carried out and that we describe in **appendix N** considered different drought durations. Our experience, together with the model simulations we ran over the 131-year historic record, indicates that our system is not vulnerable to short-term droughts. If Blithfield Reservoir is full in the spring, we should not need restrictions in the year ahead. We may see availability issues, if the reservoir is drawn down during the summer and does not refill during the winter, leading to a potential need for restriction events during the second summer. We therefore considered a range of durations from 18 to 30 months.

The timing of a critical period for a drought event may vary. The 1975/76 drought broke in late August (and September 1976 was very wet), but in other droughts the critical date (start of recovery from the maximum drawdown) may be in September or October, or possibly later. The exact duration of a critical event may also vary (a 'two summers, one winter' drought might be between around 16 and 20 months), and there is no reason why it would correspond to calendar months. There is therefore no 'right' start or end date for assessing critical events. We selected the start of October because of the importance of winter refill.

We selected the synthetic droughts we have used on the basis of accumulated flow during the defined duration. Two events of a specified duration may have the same accumulated flow but produce different estimates of DO because the temporal distribution of flow during the period is different. Furthermore, the antecedent conditions would not necessarily be the same and this could have an impact on DO. The baseline 1976 event has an estimated return period of about 200 years, so synthetic events with accumulated flow approximately equal to the 1-in-200-year volume might give DO estimates above or below that from the 1976 event.

Our lower DO estimate for the 1 in 200-year 24-month event compared with the 1 in 500-year 24-month event was related to a particularly severe short-term event within the period. Our system is not vulnerable to this kind of severe short-term event, if it occurs within a period of 'normal' flows.

We have tested this by selecting six-month (April to September) periods from our synthetic reservoir inflows that approximately correspond to return periods of 200 and 500 years, and running our Aquator model with Blithfield initially full. We carried out Extreme Value Analysis (EVA) with our historical record to produce a Gamma function fit. It should be noted that the worst six-months drought on record occurred in 2011, with an estimated return period of around 100 years.

By searching the synthetic flows series, we selected the following scenarios for analysis.

- 200 years: scenario 77 and 82.
- 500 years: scenario 11 and 120.

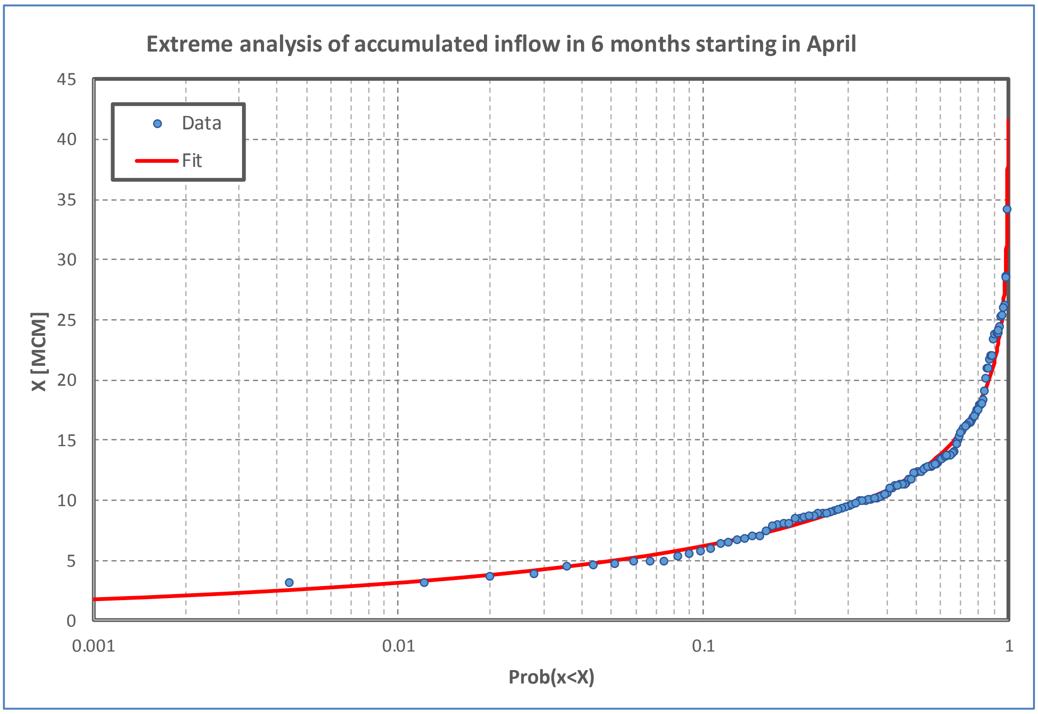
We chose two scenarios for each return period to allow for temporal variability within the six-month period. We carried out No Restrictions DO runs to identify the demand value that would lead to TUBs during the simulation from 1 April to 30 September. We set out the results in the following table.

Table 25 No restrictions deployable output for synthetic drought scenarios

Event	Accumulation period (months)	Scenario	DO (Ml/d)
1 in 200-year	6	77	347
	18	82	352
	24	99	319
	30	64	313
1 in 500-year	6	11	337
	18	172	332
	24	124	328
	30	167	311

Source: Mott MacDonald.

Figure 10 Gamma fit to accumulated inflows to Blithfield during six months starting in April



Source: Mott MacDonald.

The shorter duration is associated with higher no restrictions DO values meaning that they are less critical than longer dry periods. On this basis, we believe that our system is not vulnerable to isolated short-term drought events.

The rainfall record shows that the last part of the 19th century was very dry. We have extended our flow series back to 1884 to expand the number of historical droughts on which to base our estimation of DO of our system. This longer record increases the statistical significance of our results.

By starting the simulation of our system in 1884, we identified a severe drought in 1896. The impact of that drought on our system, should it occur nowadays, would result in the second lowest no restrictions DO, only slightly less above the 1976 DO. In order to give details about the likelihood, severity and duration of the 1896 drought we note that all of these factors are interrelated. Different drought durations (or even onsets) would result in drought magnitudes that could have different likelihoods (or return periods) when compared with the complete historical record. In order to characterise the 1896 drought in a systematic way, inflows to Blithfield have been accumulated during 6, 9, 12, 18, 24 and 30 months starting in October, January and April during the whole historical record. We conducted an EVA by fitting different statistical distributions and selecting the one that best represents the minima. Subsequently, we obtained the return periods of the accumulated values during the 1896 drought based on the preferred distributions and have presented the results in the following table.

Table 26 Estimated return period of 1896 drought

Duration (months)		Starting in	
	October	January	April
6	60	180	45
9	240	85	115
12	160	55	190
18	60	140	220
24	90	75	120
30	90	170	180

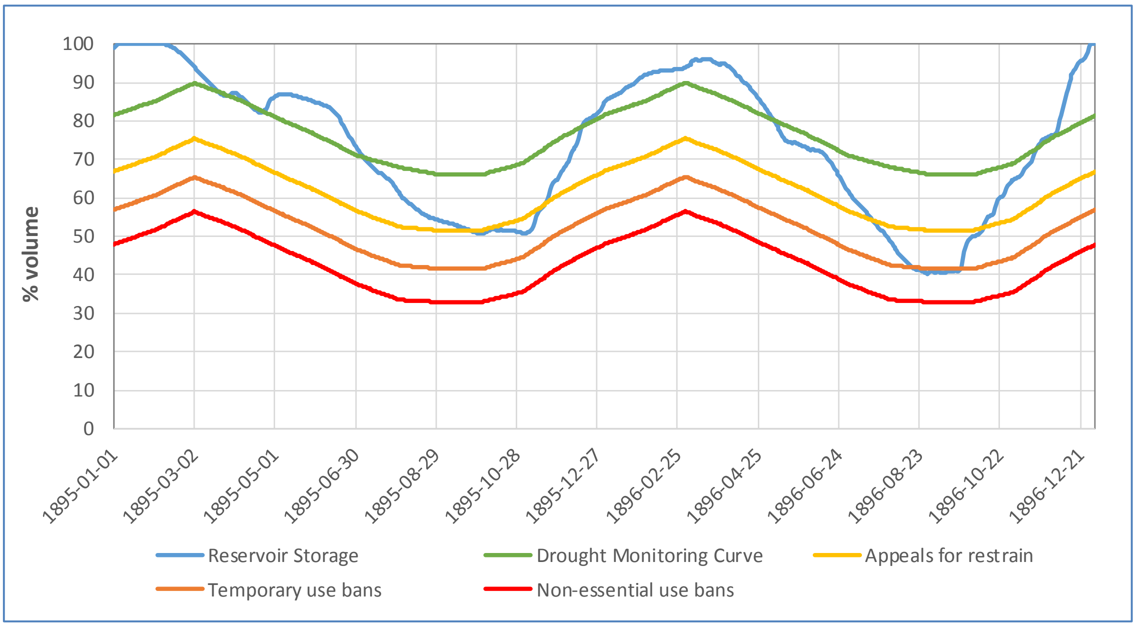
Source: Mott MacDonald.

There is notable variability – for example, the winter and spring of 1896 were extremely dry with a return period of the accumulated inflow close to 200 years. The subsequent summer was not particularly severe, but the preceding autumn (1895) was very extreme and the nine months starting in October 1895 had an accumulated inflow with a return period over 200 years. This diminishes to 160 years if we include the summer of 1896. This meant that Blithfield would not fill up in the winter of 1896 and the limited inflow during spring would also lead to a quick drawdown that would be sustained in the first part of the summer until the TUBs control curve was crossed in mid-August. The inability of Blithfield to fill up was also a consequence of dry conditions starting in April 1895, as the next 12 months until April

1896 experienced an accumulated inflow close to 200 years' return period. This return period is 220 years if spring and summer of 1896 were added.

In summary, for the particular conditions of our supply system the critical period during the 1895-96 drought (of those studied) was from April 1895 to September 1896, with the accumulated inflow to Blithfield having a return period of over 200 years. The critical period shown in the following graph is slightly different (from late February 1895 to early September 1896) and has an estimated return period is about 100 years. This illustrates the difficulty of assigning a return period to a particular drought.

Figure 11 Evolution of Blithfield during the 1895/96 drought with a LoS DO demand

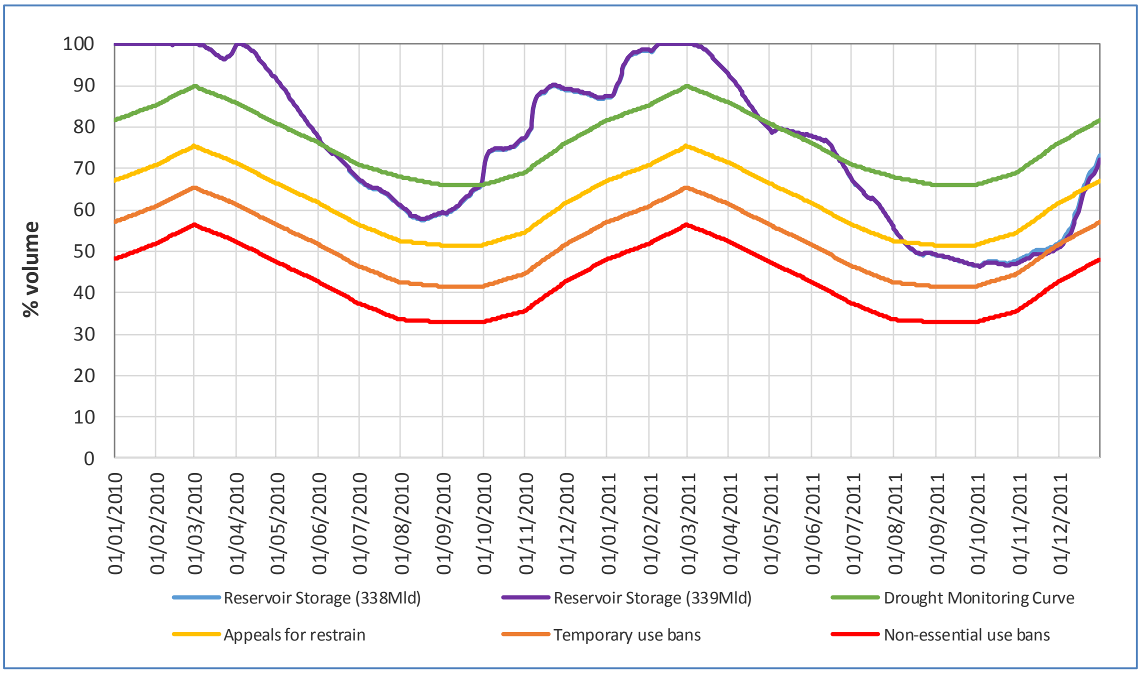


Source: Mott MacDonald.

The DO of our system is constrained by several factors starting with the capacity and operation of the different infrastructure, but also dependent on the hydrology (frequency and magnitude of droughts) and the Level of Service we provide to our customers (no more than one TUB in every 40 years).

All these factors have been introduced into our Aquator model, which we have used to determine our LoS DO by testing different levels of demand and choosing the maximum one that does not lead to more than three TUBs during the 131 years of simulation (1884-2014). Hence, a demand value of 338Ml/d implies three TUBs: in 1896, 1934 and 1976, whereas a demand value of 339Ml/d incurs another TUB in 2011 (see the figure below). As with the other TUB events, this follows a winter, where our reservoir hardly filled due to a drier than average winter. This additional TUB is what ultimately constrains the LoS DO of our system.

Figure 12 Evolution of Blithfield during the 2011 drought with demands of 338 and 339Ml/d



Source: Mott MacDonald.

7.4.6 Contingencies for extreme droughts

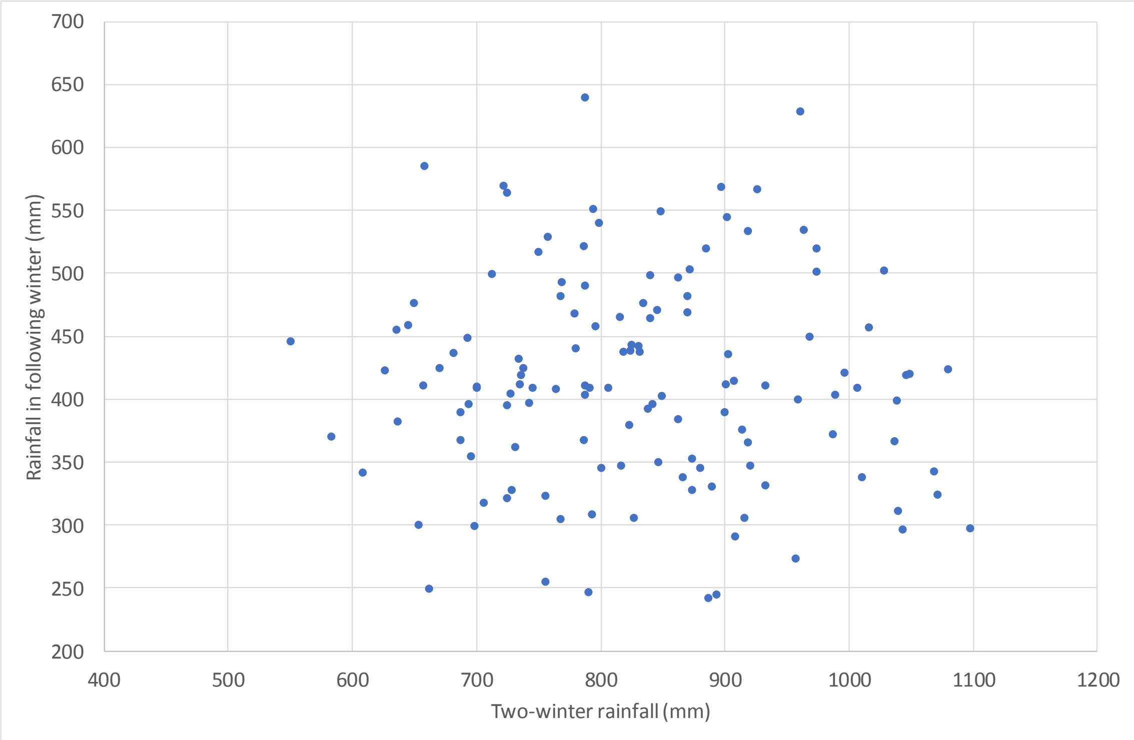
Our analysis shows our supplies are resilient for a range of droughts across the 25-year planning period. Accordingly, we are not putting forward any new drought management options in addition to those currently in our existing drought plan.

In our consideration of sustainability changes, in section 7.9 we outline the possibility that the Environment Agency may require further reductions in abstraction to prevent deterioration of the environment. Currently, we consider these are at worst an additional 11Ml/d, which would be still leave us able to manage an extreme drought scenario. However, it is likely, in this eventuality, we would seek to agree local mitigation measures to allow continued abstraction of some of these sites in a sustainable way to allow us to maintain our current levels of drought resilience.

7.4.7 Groundwater drought resilience

We have considered the likelihood of 'a third dry' or a 'very dry' winter scenario and whether these would bring significant impacts. We accept that, although the sandstone aquifer upon which many of our groundwater sources depend has a high level of resilience to both drought and climate change, this is not infinite. We have carried out analysis of the historic rainfall series for the Blithfield catchment (broadly representative of conditions affecting our groundwater sources) to look at the likelihood of a third dry winter. The following chart demonstrates that there is no correlation between the two-winter rainfall total and the rainfall in the following winter.

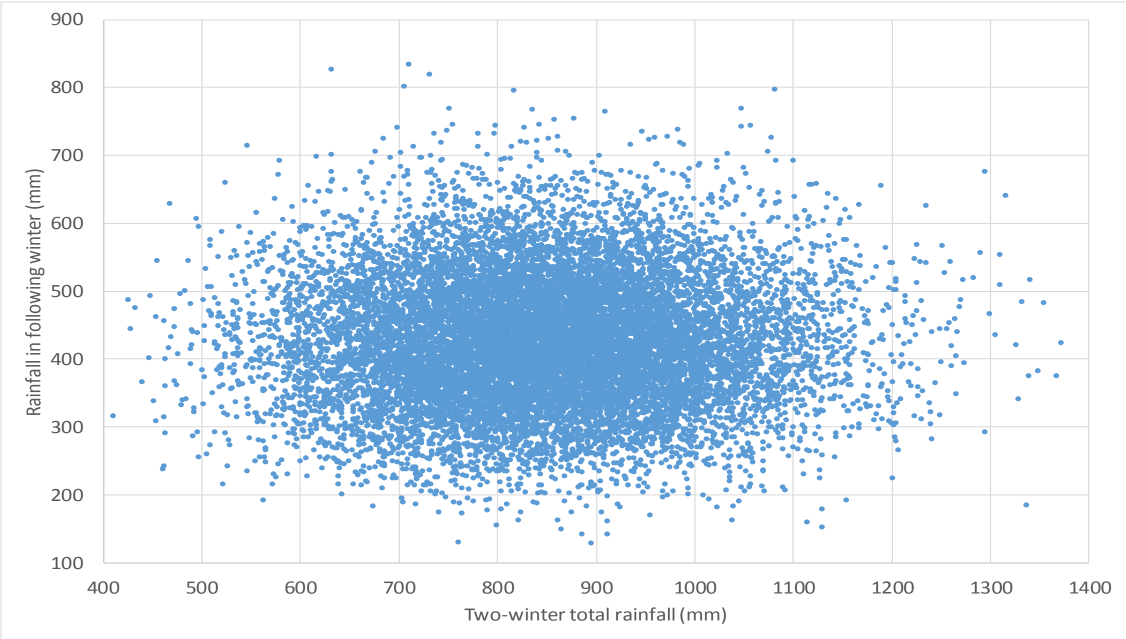
Figure 13 Inter-year relationship of winter rainfall (historic data)



Source: Blithfield Reservoir catchment rainfall series 1882 to 2015. (Developed for South Staffs Water by Mott MacDonald.)

We were not surprised that there was not a strong relationship between two-winter rainfall and the rainfall in the following winter as there is no meteorological reason for rainfall in one winter to be influenced by conditions in the previous winter(s). We calculated the R^2 as approximately 0.002. Where there is a strong correlation between sets of data the R^2 value is closer to one than to zero. We carried out a similar analysis using the stochastic rainfall data (200 x 73 years) we have used for our drought analysis. Stochastic rainfall data is data that we have produced with computer simulations to estimate rainfall patterns that we may experience in the future. This analysis confirmed that the absence of a relationship and the R^2 is approximately 0.0002. We have shown this in figure 14 below.

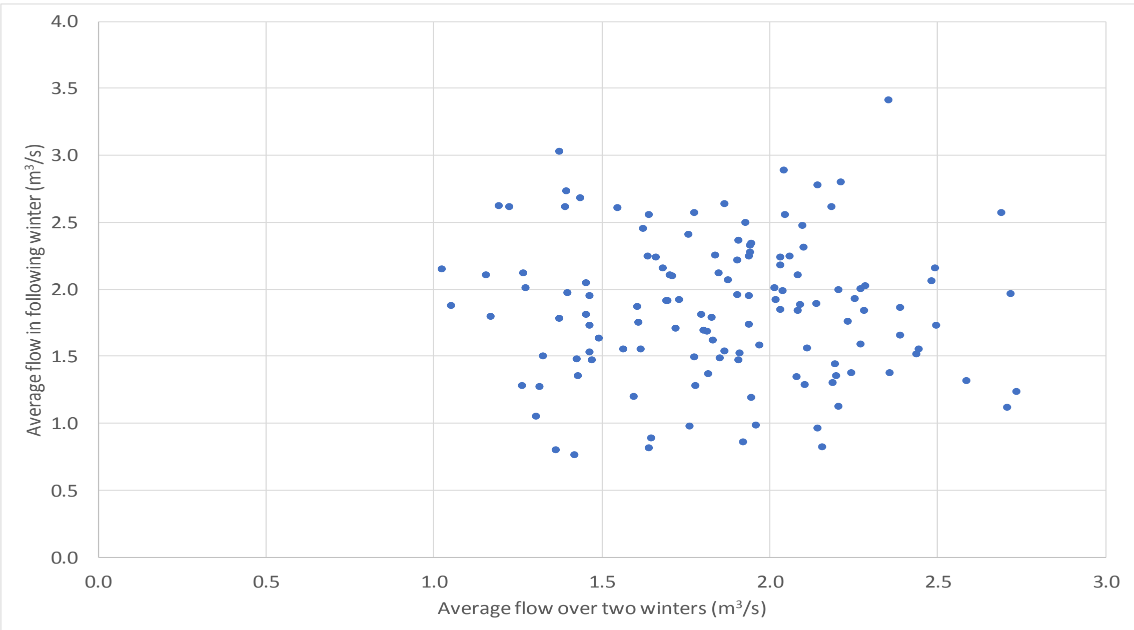
Figure 14 Inter-year relationship of winter rainfall (stochastic data)



Source: Stochastic data generated by Atkins for South Staffs Water and Severn Trent Water.

We repeated this analysis using flows from our rainfall runoff model and there was still no discernible relationship. The R^2 was approximately 0.001. We show this analysis in figure 15 below.

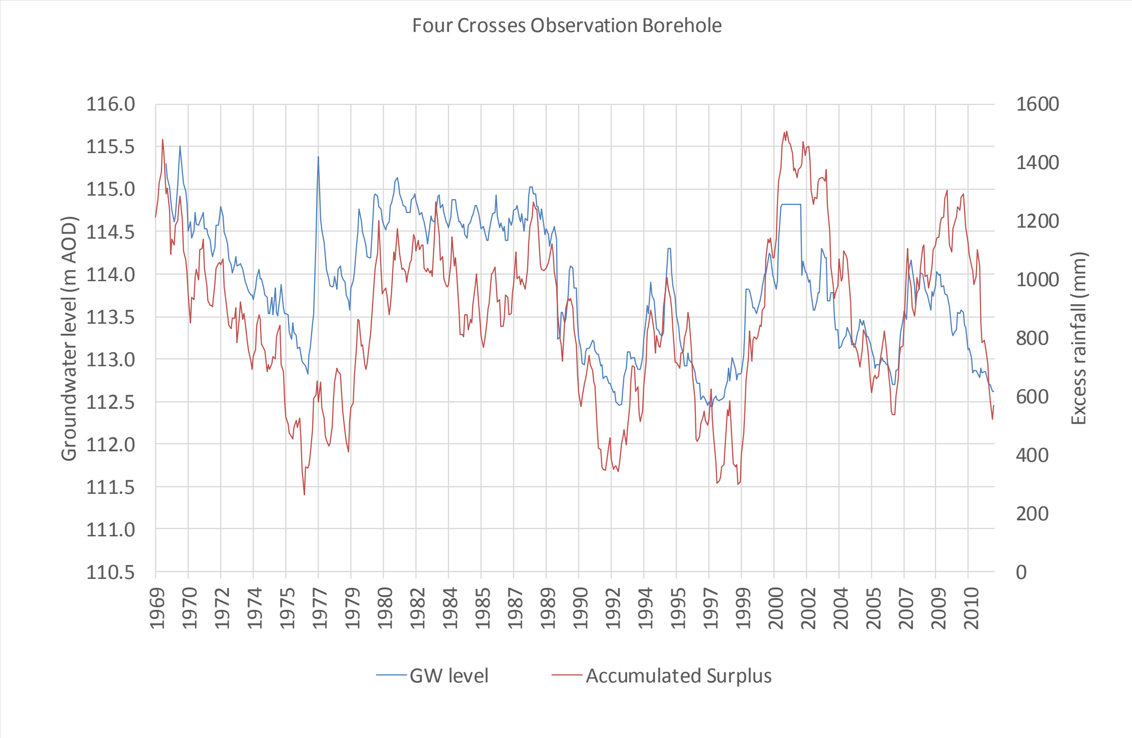
Figure 15 Inter-year relationship of winter flows (simulated using historic data)



Source: HYSIM rainfall run-off model. (Developed for South Staffs Water by Mott MacDonald.)

As part of our analysis of drought triggers, we found a very good correlation between groundwater levels and accumulated excess rainfall (rain less PET) over the previous four years. In figure 16 below, we show the results for one of the observation boreholes. Aquifer response takes much longer than reservoir response, so our approach of combining the maximum expected impact on groundwater yields with the variable surface water response to shorter droughts is probably too conservative.

Figure 16 Groundwater level and accumulated excess rainfall over previous four years



Source: Drought scenarios report produced for South Staffs Water by Mott MacDonald, August 2017.

We are not aware of any agreed method of accurately assessing the likelihood (or return period) for events of this sort. However, we estimate that the probability of a third dry winter event is the probability of the two dry winter event multiplied by the probability of a single dry winter, given that both events are independent. For example, if the two-winter event is the most severe historic event (1 in 200 years) and a third dry winter is (say) a 1 in 10-year event, the overall three-winter event is about a 1 in 2,000-year event. However, if the 200-year event (or any other event) has occurred, the chance of the following winter being a 1 in 10-year event is 1 in 10. At a seasonal level, what has gone before has no relevance to what may occur in the future.

To estimate what the return period of a 'very dry' winter is we used expert judgement and a review of the extreme drought analysis we carried out for our draft WRMP. We estimate that scenarios like this have an approximate return period of more than 500 years. This is equivalent to an annual probability in any individual year of less than 0.2%. Such events can happen but are extremely unlikely to happen. As the scenarios in the Environment

Agency/ESI report are outside of our historic record any estimate of return period has significant uncertainty and must be taken in this context.

7.5 Outage

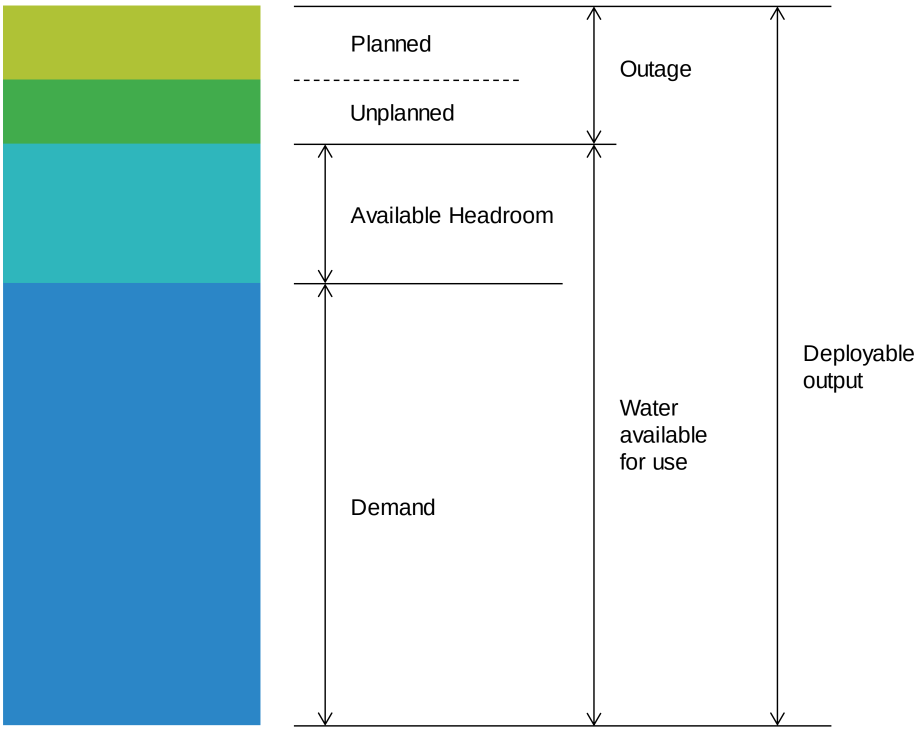
Within our WRMP we must include an assessment of outage, which is to accommodate potential short-term or temporary loss of the amount of water available for supply.

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).

The outage allowance is calculated according to a standard methodology developed and published by UKWIR[4] and in accordance with the expectations of the Environment Agency guidance[5].

Figure 17 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

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

[5] 'WRMP19 methods: outage allowance', Environment Agency, July 2016.

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 2001 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 demand conditions. The results have been calculated from simulations using 10,000 iterations; this is deemed sufficient to ensure repeatability of the results in the analyses.

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

Table 27 Outage assessment results

Percentile	DYAA Outage (Ml/d)	DYCP Outage (Ml/d
10%	2.3	0.8
20%	3.1	1.2
30%	3.8	1.7
40%	4.5	2.2
50%	5.2	2.7
60%	6.0	3.4
70%	6.9	4.2
80%	**8.3**	**5.6**
90%	10.3	8.0

For supply/demand balance modelling, the 80th percentile values for outage at both DYAA and DYCP are considered to be most appropriate for capturing a suitable level of risk to protect level of service in our resource zone. This is consistent with WRMP14 assumptions.

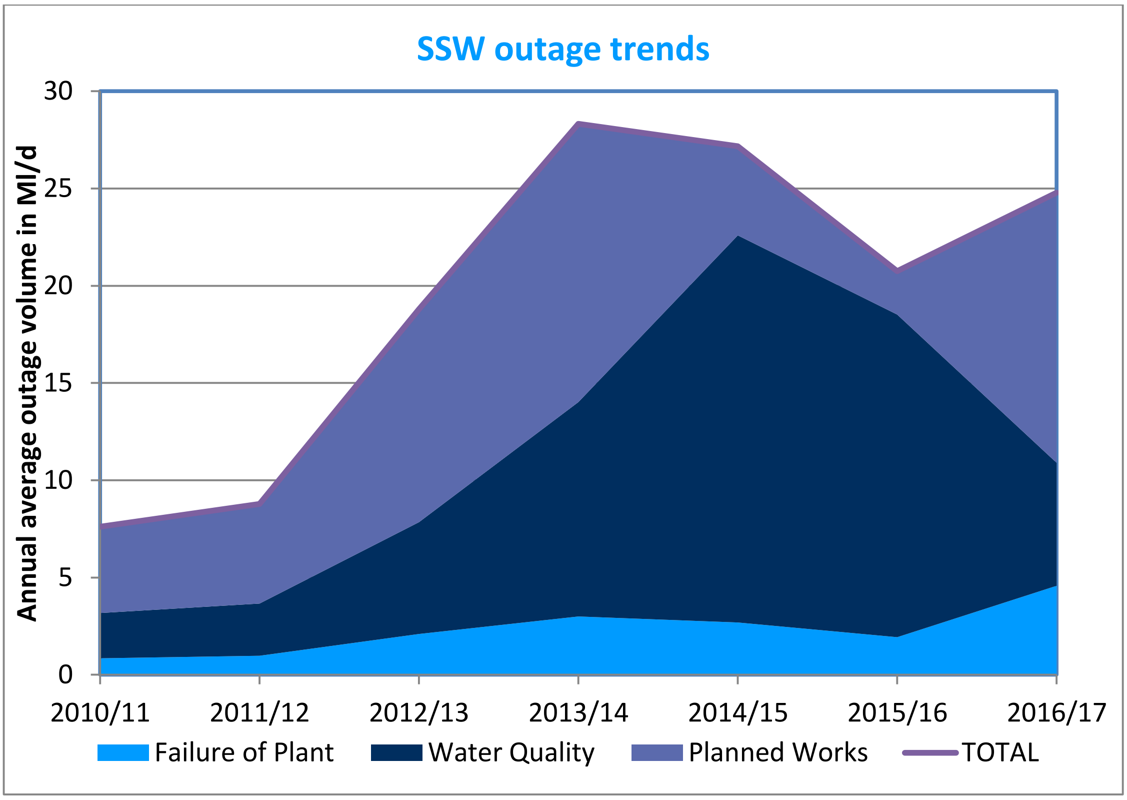
The corresponding values for DYAA and DYCP outage are 8.3Ml/d and 5.6Ml/d respectively. These values represent 2.2% and 1.2% of the 2017/18 DYAA and DYCP WAFU respectively.

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

7.5.2 Options to reduce outage

The outage allowances proposed for use in the supply forecast are a reasonable prediction of what can be achieved when compared with the levels we achieved during the most recent drought period (2011/12: 8.77Ml/d annual average and 4.26Ml/d peak week). As reported at the time, this was achieved by the cancellation of planned maintenance over the critical summer period.

Figure 18 Outage trends



In the years between 2012/13 and 2016/17 reported outage has risen up to 29.7Ml/d. However, apart from 2014/15 and 2015/16 this has largely been because of a rise in planned works. In these two years (2014 to 2016) we experienced a number of water quality incidents which later led to reductions in DO and have therefore not been included in the calculation of outage. Accordingly, we are confident that outage can be managed in a dry year to within the predicted levels and there is no requirement for additional outage reduction options.

7.6 Climate change

We have assessed the impact of global warming and climate change on our future supplies. We have chosen to update our assessment from WRMP14 using the Environment Agency (2017) method, 'Estimating the impacts of climate change on water supply', as this is most appropriate to the supply system, vulnerability and available modelling tools we have.

Our work on source yields has shown that the two surface water sources at Blithfield Reservoir and on the River Severn are vulnerable to drought. However, our groundwater sources rely on the Sherwood Sandstone aquifer where water levels remain very stable despite change in rainfall, because of the high storage within this aquifer. In the past we have operated one source which was vulnerable because of local conditions and other sources where vulnerability could not be ruled out. The operation of these sources will be significantly different going forwards. Accordingly, there is no need for a climate change assessment of our groundwater sources.

7.6.1 Vulnerability assessment and choice of method

Our climate change vulnerability assessment from WRMP14 has not changed. This determined that our resource zone can be classified as 'medium' vulnerability. A review of the WRMP14 results shows that its position on the sensitivity chart has not changed.

Table 28 Climate change vulnerability assessment

Uncertainty range (% change wet to dry)	Mid-scenario (% reduction in DO)		
	<5%	>5%	>10%
<5%	Low	Medium	High
6 to 10%	**South Staffs Water**	Medium	High
11 to 15%	High	High	High
>15%	High	High	High

A pragmatic assessment approach is required as any DO modelling is highly dependent on outputs from the Severn Trent Water regional model. This makes it important that for each climate change scenario considered, equivalent climatic conditions are modelled simultaneously on the River Trent and Severn as on the River Blithe. Accordingly, it was decided to adopt a medium to high vulnerability approach as required by the vulnerability assessment of Severn Trent Water for its Strategic Grid Resource Zone. This involved application of Approach 2.2 (targeted sample of UKCP09 based on DI analysis).

7.6.2 Details of assessment

The objective of this work was to produce climate change flow series for both catchments in the Aquator model, for 40 scenarios (20 for the 2030s estimate and 20 for the 2080s estimate). In contrast to WRMP14, we used our HYSIM model, taking account of an improved understanding of the hydrology of the Blithe. The 20 selected scenarios for each time slice represent a broad range of climate change projections with a focus on the driest scenarios.

Our supply system is dependent on the River Severn, the flows of which are regulated and abstracted by Severn Trent Water upstream of our intake. Therefore, an accurate representation of our system performance requires us to account for these artificial influences and suggests that a consistent approach in the characterisation of the effect of climate change is desirable. This was defined at a joint workshop, where, following an ongoing collaboration between us and Severn Trent Water, they agreed to provide climate change scenario choices and flow series to allow us to follow a similar methodology.

Aquator flows received from Severn Trent Water, together with climate change perturbed flows for the Blithe for the selected scenarios were then used to estimate the DOs of the 20 scenarios for each time slice. The Environment Agency's 2017 guidance for estimating the impacts of climate change on water supply states that the requisite approach is to use 2080s flows. However, given the high uncertainty of the 2080s projection, the Environment Agency permits the use of the 2030s time slice if the 2080s gives an unrealistic impact. Therefore, we included 2030s and 2080s flows in the study.

A selection of 20 scenarios were chosen from the UKCP09 climate change database for each of the 2030s and 2080s time slices. The initial 10,000 UKCP09 projections were reduced to 100 scenarios by applying a Latin Hypercube Sample. These 100 scenarios were subsequently 'smart sampled' using the mean April to September flow change in five exemplar catchments of the Severn region as a suitable drought indicator. The Severn region was considered to be the most suitable choice for the overall area of interest to Severn Trent Water; it would have been inappropriate to use the Humber region information for the River Trent area because the UKCP09 information is not spatially coherent between regions.

7.6.3 Assessment results

The two sets of 20 Aquator climate change models (2030s and 2080s) were run and DO results for 'no restrictions' and 'levels of service' successfully obtained. Each set of scenarios ranged from a wet or low emissions scenario (equivalent to the 95th percentile) to a dry or high emissions scenario (equivalent to the 1st percentile) with a bias in analysis towards the dry end (**appendix P** and **appendix X**). It can be seen from analysis of the resulting values, however, that the maximum and minimum values do not always coincide with these extremes. This is because of the sensitivity of the supply system yield to sequence of inflows, which varies between scenarios, as well as the total rainfall and river flows across the critical period.

Table 29 Climate change assessment results (DO)

Run	Baseline DO	2030s (minimum DO)	2030s (maximum DO)	2080s (minimum DO)	2080s (maximum DO)
No restrictions	333	314 (3rd percentile)	339 (90th percentile)	265 (1st percentile)	344 (95th percentile)
Levels of service	338	318 (3rd percentile)	349 (90th percentile)	291 (7th percentile)	353 (95th percentile)

The results for these scenarios have been plotted as histograms in the following figures. These show that in both scenarios the climate change scenario DO values are generally lower than the equivalent baseline DO values for both the no restrictions and levels of service cases. The predicted range in values is much wider in the 2080s (level of service 62Ml/d) than in the 2030s (level of service 31Ml/d). However, in both of these cases much of this is because of the presence of outliers. Accordingly, for the supply forecast, the central spread of 80% of the results has been further analysed. This has been used to predict a central estimate, upper and lower range of values for use in understanding the most likely future DO in future, and also the uncertainty around this central estimate.

Figure 19 2080s climate change predictions

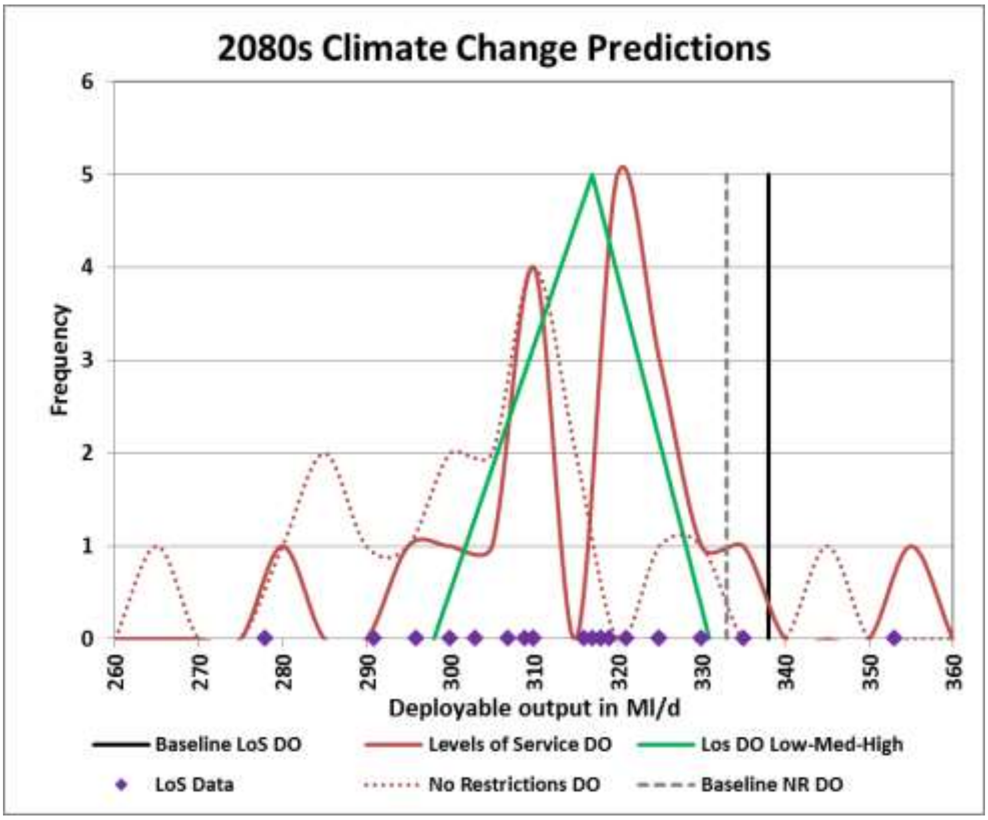
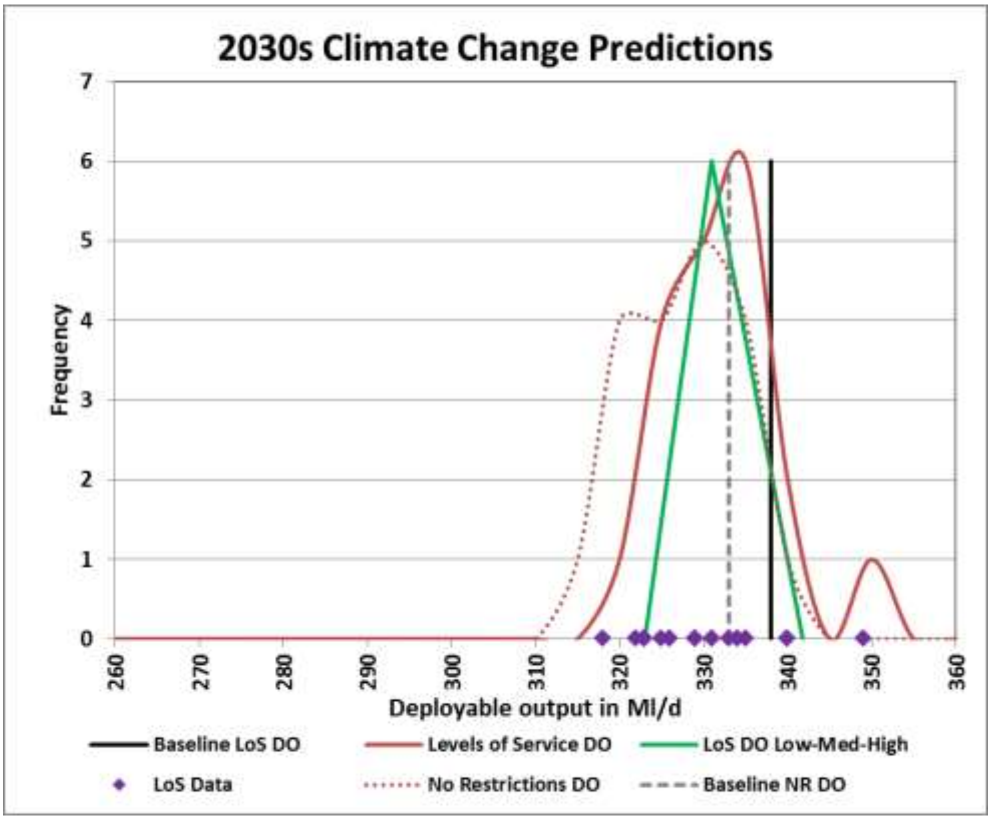


Figure 20 2030s climate change predictions



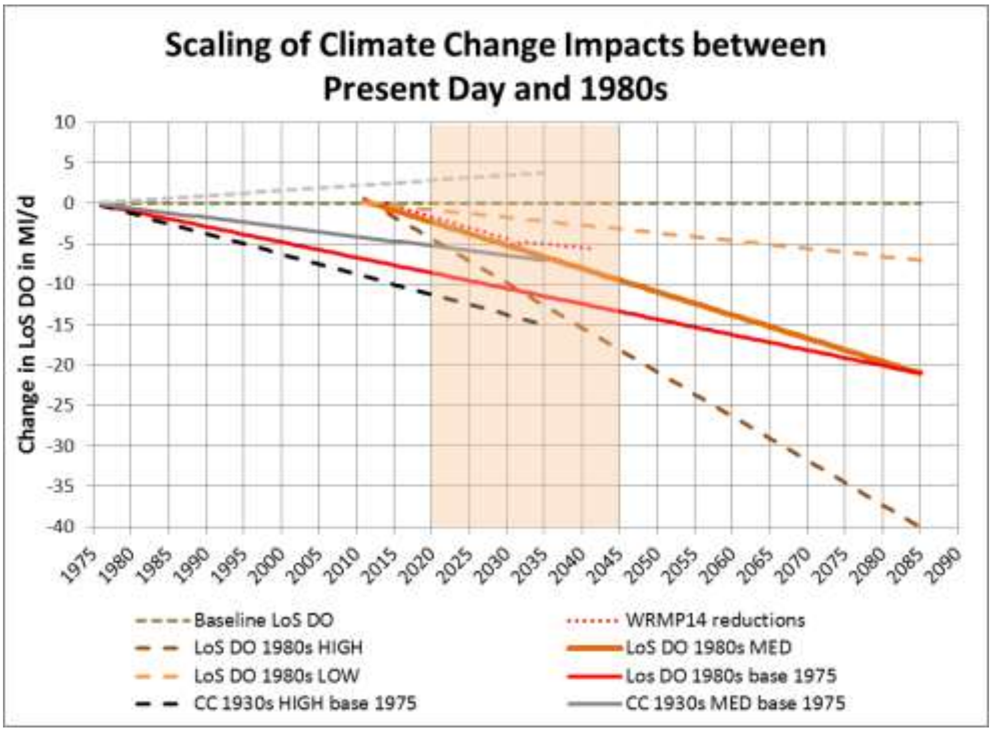
7.6.4 Implications for supply forecast

The future DO value is attributed to 2035 (2030s) and 2085 (2080s). There is also a need to scale these changes back to a past date when climate change impacts on yields is thought to be 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 (1990 to 2014). The Environment Agency[6] suggests selecting a datum of 1975 as this zero point.

In our case our baseline DO assessment shows that one of the three critical drought events is 2011/12. This means that our level of service DO is almost certainly affected by climate change and therefore the value we have determined already includes an implicit correction. Accordingly, we have used 2012 as our base year where the climate change correction is assumed to be zero. Figure 21 shows how the climate change correction increases from zero in 2012 to -21Ml/d in 2085. It also shows how this trend matches well with the 2030s climate change correction prediction (-7Ml/d at 2035). Moreover, it demonstrates the significant mismatch across the planning period (2020 to 2045) of between 7Ml/d and 4Ml/d if the 2080s impacts are scaled back to 1975.

[6] Environment Agency 'Water resources planning guideline: interim update', April 2017.

Figure 21 Scaling of climate change impacts between present day and 1980s



The uncertainty in the central forecast has similarly been scaled from 2085 back to 2012. This has been used in our calculation of headroom uncertainty (section 8).

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 30 Estimated greenhouse gas emissions from our baseline and final plan scenarios

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
South Staffs baseline tCO_2e per year	38,228	38,983	39,642	39,992	40,367	40,751
South Staffs final plan tCO_2e per year	37,662	37,181	37,771	38,052	38,357	37,853

Table 31 Estimated greenhouse gas emissions from our selected final plan options

tCO_2e per year	Year 1 2020/21	Year 5 2024/25	Year 10 2029/30	Year 15 2034/35	Year 20 2039/40	Year 25 2040/45
SHPW / SOPW	0	0	775	772	769	766
Bundle 20	48	410	545	685	832	984
Live Network	79	243	249	255	261	267
AMR enhanced free metering – committed	13	67	135	205	275	345
Water efficiency commitment	44	229	229	229	229	229

We have based these estimates on our distribution input (DI) forecasts and the 2018 UK Government GHG Conversion Factors for company reporting for water supply. Also, in order to signpost where further (group wide) information on this can be found outside of our WRMP, we report our estimates of green-house gas emissions annually to the Environment Agency as part of the CRC (Carbon Reduction Commitment) scheme. We submitted this for the 2017/18 reporting year before the 31 July 2018 deadline.

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 set out the factors we have applied to the yields in the table below.

Table 32 Climate change factors applied to our selected options

	2025-26	2030-31	2035-36	2040-41	2044-45
Factor applied to DYAA supply-side option DO	1.000	0.971	0.973	0.964	0.961
Factor applied to DYCP supply-side option DO	1.000	1.000	1.000	1.000	1.000
Factor applied to all demand-side option DO	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 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 the tables published alongside this WRMP.

The reason why we have a factor of 1 for our critical period is that we do not expect climate change to impact on a peak week output and the sustainability reduction of 2Ml/d is cancelled out by a 2Ml/d improvement. We presented this in the WRMP tables mentioned above.

We do not reduce the benefit of our demand-side schemes because, when we commit to a certain number of megalitres a 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 because of climate change. 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

7.7.1 Raw and non-potable water transfers

We have no raw water transfers to or from our supply system.

We have a non-potable water export, which is used for bottling purposes. We have used the base year volumes in 2016/17 and assumed zero growth across the planning period.

7.7.2 Potable water transfers

We operate around 30 potable water connections at the boundaries of our supply area with Severn Trent Water, which together constitute a net export of potable water. The majority of these are small in nature and are known collectively as the 'minor exports'. There is a much larger export to Severn Trent Water in the Wolverhampton area, which arises from the joint ownership of the River Severn Works.

The capacity of minor exports is up to 5Ml/d, but average usage has been consistently around 1Ml/d and is largely independent of seasonal demands. That said, volumes have increased occasionally to 2Ml/d during the peak demand months. As a result, the uncertainty around this value has been considered under headroom.

For WRMP purposes, in a DYAA (dry year annual average) scenario, this potable export from the River Severn Works to Wolverhampton:

- has a peak daily rate of 48Ml/d (under the current arrangements between us and Severn Trent Water);
- an average rate of 40.6Ml/d (under the current arrangements between us and Severn Trent Water); and
- a rate of 36Ml/d (as a modelled average across the Severn Trent Water 95-year Aquator base DO run).

We have an additional large emergency supply arrangement with Severn Trent Water near Perry Barr, which was put in place for the purposes of non-routine maintenance of its supply system. As such, we have not considered this within our supply forecast as it is not intended for use in a dry year. So, although this export of potable water and another export that supplies Severn Trent Water's Stafford WRZ, are discretionary, we operated both during 2018. For instance, we were able to assist our neighbouring company during the March freeze/thaw event and also during the sustained hot weather in summer 2018.

We have considered the feasibility of varying these transfer arrangements in a dry year either for exporting increased volumes or for importing water. We discuss the options we identified in section 10.

To deliver resilient supplies, we are working together with Severn Trent Water to provide the highest level of resilience possible to our customers. We both recognise that the best long-term solution for resilience in this part of the Midlands will come from a collaborative approach. We will continue to explore the different ways in which we could use shared assets on the River Severn, existing connections and other assets to give mutually beneficial outcomes.

All transfers are potable and meet drinking water quality standards.

7.8 Raw water losses, treatment works losses and operational use

The Environment Agency defines raw water losses as the net loss to the resource system(s) being considered, comprised of:

- mains/aqueduct (pressure system) losses;
- open channel/very low pressure system losses; and
- losses from break-pressure tanks and small reservoirs.[7]

Raw water operational use comprises regular water use – for example, washing-out of raw water mains because of sediment build up and poor quality source water. Treatment works losses is defined as structural water loss (leaks) and overflows, while treatment works operational use comprises the net loss from the treatment process.

In addition to the multi-stage treatment process which operates at our two surface water works, we have complex treatment in place at six groundwater sites (not including a further two sites which are currently mothballed).

All raw water transfers from the point of abstraction to the treatment works are through closed pipe transfers. Both our reservoirs have licensed requirements to release water for the purposes of maintaining water bodies downstream and these compensation flows are accounted for within the Aquator model and not considered here. Raw water is used

[7] 'Demand Forecasting Methodology. 95/WR/01/1', Environment Agency, 1995.

operationally at one site to clean band screens and this has been accounted under the treatment works operational use evaluation.

We first carried out a comprehensive audit of all of our treatment works for WRMP09 to identify all site discharges. We measured all continuous losses such as monitor or sampling waste and used engineering calculations to estimate intermittent loses such as those from filter backwashes.

We are currently in the process of installing accurate wastewater measurement systems on a number of sites to Environment Agency MCERTS standards for all significant discharges. Certification requires all meters to be calibrated and new environmental permits to be issued, and this will be complete by 2020.

These new wastewater meters allow a more accurate estimation of treatment works losses and operational use as a percentage of raw water onto each works, in particular from intermittent higher volume processes. The outcome of our WRMP19 review of losses is shown in the table below. These values were used in the Aquator model and in the starting year of our supply forecast.

Table 33 Operational losses – WRMP14 and WRMP19

Site	Losses (WRMP14)	Losses (WRMP19)	Comment
CCPW1	1.2%	5.3%	Revised value based on data from new wastewater meter
CRPW1	0.3%	0.3%	No change
FRPW	3.5%	4.1%	PR09 values validated by comparison of abstraction and distribution meter data
LHPW1	4.0%	5.4%	PR09 values validated by comparison of abstraction and distribution meter data
MGPWC	4.0%	3.7%	PR09 values validated by comparison of abstraction and distribution meter data
PHPW	2.5%	1.27%	Revised value based on estimates for new treatment technology benchmarked against similar works in our Cambridge region
SSPW	2.8%	–	Site mothballed
SHPW	1.4%	–	Site mothballed
Central Works	7.7%	7.6%	Revised value based on data from new wastewater meter
River Severn Works	3.8%	8.2%	Revised value based on audit of data from new wastewater meters and raw water use of band screen

The most significant of these changes for the WRMP19 forecast is that for the River Severn Works where recent data suggests the PR14 figure for a dry year case was underestimated. The losses at this site arise from changes to drinking water quality regulations in 1998[8], which meant that we could no longer re-treat filter backwash and related water losses. These losses are, however, largely mitigated by local abstraction licence arrangements which allow us to abstract more water for the purposes of the treatment process.

The losses listed in the table above are generally subject to the treatment technology available at the time of construction. Our PR19 business plan anticipates that future renewal of surface water plants (Central Works and River Severn Works) will result in reductions in losses to around 5% of raw water abstracted. Our forecast includes these reductions from the end of AMP8 when the renewal process is complete. Our forecast also includes for minor increases in some loss components, in particular at peak, accompanying introduction of a new nitrate treatment plant at KIPW1 and increases in plant capacity at FRPW and the Central Works. However, the general picture is for a long-term reduction in losses from 4.7% of total DO in 2016/17 to 2.9% by 2044/45.

7.9 Reductions in deployable output

7.9.1 Sustainability changes

We are committed to ensuring that our abstractions are sustainable and to minimise the 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 River Basin Management Plan (RBMP) objectives, the Environment Agency may require sustainability reductions to our abstraction 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 in six catchments across our supply area as part of the AMP6 NEP. Studies are at an advanced stage and a number of trials have been carried out into solutions. We anticipate the impact of these as follows.

[8] 'Cryptosporidium in Water Supplies Third Report of the Group of Experts to: Department of the Environment, Transport and the Regions, and Department of Health Third Report of the Group of Experts Chairman – Professor Ian Bouchier', November 1998.

Table 34 Impact of AMP6 NEP in six catchments

Catchment	Basis for sustainability change	Sustainability change	Change to DO
Blakedown Brook and Hurcott and Podmore Pools SSSI	More efficient use of existing compensation licence to allow effluent discharge to be cut back	None	None (continued relinquishment of HAPW site)
Checkhill Bogs SSSI	New augmentation release to maintain flows in Lower Bogs	2.5Ml/d to 4.0Ml/d	None**
River Blithe pumpback-Blithfield	Mitigation measures required against impacts of impoundment and downstream intake	None	None
Bourne Brook and Hopwas Hayes	Augmentation to maintain flows along Crane Brook	2.0Ml/d	None (continued relinquishment of SSPW site)
Rising Brook	Abstraction reduction to restore flows in upper reaches	2.0Ml/d	2.0Ml/d
Puxton and Stourvale SSSI	Mitigation works to improve habitats	None	None

** This scheme is likely to require reductions in long term abstraction (10-yearly licences) from nearby sources but the requirement for reductions in DO have not yet been demonstrated

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 shown in blue.

Table 35 PR19 WINEP 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).	0
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

Investment driver	Driver code	Description of measure	WINEP3 schemes
WFD hydrological regime	WFD WR Flow	Measures to protect (prevent deterioration) and improve the hydrological regime of WFD water bodies to meet environmental objectives.	20 (5 SC, 15 I&OA)
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 because of water company assets and/or operations.	4 (3 SC, 1 LM)
Groundwater and Contaminated Land Pressures	WFDGW 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.	24 (24 I and OA)
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).	3
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.	12
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.	6
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

Key: SC = sustainability change; I = investigation; I&OA = investigation and options appraisal; FP = fish passage.

Measures to protect and improve the environment are set out in the WINEP, formerly known as the NEP. In March 2018 the Environment Agency provided us with WINEP3 information, notifying us of requirements for the next five years. The number of schemes against each driver in the WINEP is shown on the table above.

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 22 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 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 should be excluded from target headroom.

The Environment Agency has identified a number of licences where increased use above recent abstraction rates could cause deterioration to water bodies, an action included in RBMPs, and these have been included on our WINEP for investigations in AMP7. These potential increases in abstraction are locally large, although in most cases cannot be achieved without significant investment in new plant or boreholes.

The WINEP does not include any certain sustainability changes. WINEP indicates that the 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.

We have been engaged in national debates with the Environment Agency and other water companies about this approach for the last two years and 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.

The Environment Agency has advised us that some short-term increased abstraction is acceptable to manage outage and meet peak demands in a dry year, but that there should be no increase in abstraction in catchments where there are already severe environmental pressures. While they accept that the aquifers in many of our catchments are very slow to react to abstraction changes they remain cautious about the impacts of increased abstraction in dry years (that is, retaining existing DYAA DO capacity).

For our Cambridge region, the Environment Agency has advised reductions should be considered as a reduction to our baseline DO assessment, as to not include this element as a likely reduction to DO would present an unacceptable risk to the environment and to our water supplies. We have taken the view that there is also a strong likelihood that allowed abstraction will be reduced or capped at a number of sites in this region and have therefore taken the same approach here.

We have considered three possible scenarios and have included the medium position within our baseline assessment of DO, which is a reduction of 6Ml/d. We will continue to work with the Environment Agency to better understand the risks and implement solutions.

- The low scenario assumes the risk of deterioration of water bodies can be mitigated by a combination of existing NEP measures, relinquishment of selected excess licences and acceptance of new and/or tightened ten-year licence conditions.
- The medium scenario assumes, in addition to the low scenario, some reductions in DO will be required in some vulnerable catchments. This is our baseline scenario.
- The high scenario assumes, in addition to the medium scenario, that DO values will be more widely reduced across most catchments. We have used this scenario to test our plan.

Table 36 Scenario testing on catchments under environmental pressure

Catchment	Reduction in DO (other sustainability changes)		
	Low	Medium	High
Blakedown Brook and Hurcott and Podmore Pools SSSI	None (loss HAPW site)	None**	1.0Ml/d**
Checkhill Bogs SSSI	None**	None**	3.0Ml/d**
River Blithe pumpback-Blithfield	None (reduction excess licence)*	None (reduction excess licence)*	None (reduction excess licence)*

Catchment	Reduction in DO (other sustainability changes)		
	Low	Medium	High
Bourne Brook and Hopwas Hayes	None (loss SSPW site)	2.0Ml/d**	3.0Ml/d**
Rising Brook	2.0Ml/d	2.0Ml/d	2.0Ml/d
Puxton and Stourvale SSSI	None	None**	3.0Ml/d**
KIPW1	None	None **(new augmentation licence)	None **(new augmentation licence)
Churnet and Dove	None (reduction excess licence)	None (reduction excess licence)	None (reduction excess licence)
Lichfield tributaries	None	2.0Ml/d**	5.0Ml/d**
Total	2.0Ml/d	6.0Ml/d	17.0Ml/d

**Imposition of new or reduced 10-year licences.

*A new Hands Off Flow Condition of 9 Ml/d for the purposes of fish passage has been proposed by the Environment Agency but the implications of this and other HMWB measures on operations are currently too uncertain to include here.

The following analysis is associated with Nethertown and compensation/environmental releases from Blithfield reservoir. The scenarios we modelled are as follows.

Nethertown licence

- Baseline: 29Ml/d of capacity with 2650Ml/d hands off flow (HoF) at North Muskham, one hour daily interruption in summer (from May to September) and three hours in winter.
- N1. Same as baseline but with three hours daily interruption all year round.
- N2. Operate Nethertown with 9Ml/d passing over fish pass with no daily interruption.
- N3. Operate Nethertown with 9Ml/d passing over fish pass with no daily interruption apart from dry years when one hour daily shutoff.
- N4. Operate Nethertown with 9Ml/d passing over fish pass with no daily interruption apart from dry years when three hour daily shutoff.
- N5. Operate Nethertown with 7Ml/d passing over fish pass with no daily interruption apart from dry years when one hour daily shutoff.
- N6. Operate Nethertown with 9Ml/d pass over fish pass at all times and no HOF at North Muskham.

Blithfield compensation flow

- Baseline: constant release of 22.7Ml/d.
- C1. Full. Adding 2 to 15 variations (see table below) to baseline. Ensure Nethertown is off during spate releases.

- C2. Fully mitigated. Adding 1 to 15 variations to baseline. Ensure Nethertown is off during spate releases and limit Nethertown during variation 1.
- C3. Partly mitigated. Adding 1, 2 and 4 to 15 variations to baseline. Ensure Nethertown is off during spate releases, and limit Nethertown during variation 1.
- C4. Partly mitigated during wet year only. Adding 1, 2 and 4 to 15 variations to baseline, but 4 to 15 only when above drought monitoring curve (DMC). Ensure Nethertown is off during spate releases and limit Nethertown during variation 1.

Table 37 Variations considered to Blithfield compensation flow

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Summer low flows	**Summer spate**	**Late summer high spate**	**Autumn spates**											
Start date	01/08	28/08	15/09	01/10	08/10	15/10	22/10	29/10	05/11	12/11	19/11	26/11	03/12	10/12	17/12
End date	23/08	30/08	18/09	01/10	08/10	15/10	22/10	29/10	05/11	12/11	19/11	26/11	03/12	10/12	17/12
Duration	22	2	3	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Rate (Ml/d)	15	100	300	170	170	170	170	170	170	170	170	170	170	170	170
Total volume	330	200	900	85	85	85	85	85	85	85	85	85	85	85	85

In the table below, we set out our results in terms of LoS DO for individual scenarios.

Table 38 Impact on LoS DO of different proposed scenarios of alternative Nethertown licence and Blithfield compensation flow

Component	Scenario	LoS DO (Ml/d)	Variation with respect to baseline (Ml/d)
Nethertown licence	N1	337	-1
	N2	333	-5
	N3	333	-5
	N4	333	-5
	N5	335	-3
	N6	351	+13
Blithfield compensation flow	C1	322	-16
	C2	324	-14
	C3	335	-3
	C4	336	-2

The results above are for individual scenarios, although we have also modelled the combined effect of scenario N2 in combination with compensation flow scenario C1. Our modelling showed that 'worst case scenario' for us in terms of retaining security of supply for our customers would decrease LoS DO to 319Ml/d (a reduction of 19Ml/d). The fact that we have modelled this scenario does not suggest that we consider this to be a preferred option but it is valuable to see how sensitive our system is to these possible scenarios. We have provided some further explanation below

- N1. Increasing daily interruption at Nethertown from one to three hours in summer implies a reduction of 1Ml/d.
- N2, N3 and N4. Applying a minimum residual flow of 9Mld at Nethertown would lead to a loss of 5Ml/d. The difference between 9 and 5 is explained by the fact that during a significant amount of time during droughts, pumping is restricted anyway by North Muskham HoF. Loss of DO would be independent of having a daily interruption, as during droughts, available water would be less than pumping capacity (reduced or not) once the 9Ml/d are discounted.
- N5. If the minimum residual flow is reduced to 7Ml/d at Nethertown, 2Ml/d are recovered.
- N6. Removing North Muskham HoF leads to an increase of LoS DO of 13Ml/d, even assuming a minimum residual flow of 9Ml/d. This is because pumping occurs continuously during drought with a minimum rate of 13.7Ml/d (difference between compensation flow and minimum residual flow).
- C1. Full compensation regime at Blithfield would lead to a loss of 16Ml/d because of the release of additional volume in comparison with the baseline.

- C2. Fully mitigated regime, including the period in August with lower than normal compensation flow, helps to recover 2Ml/d.
- C3. Partly mitigated regime, which removes the high late summer spate, allows recovering 11 additional Ml/d, implying a loss of only 3Ml/d in the LoS DO. In this scenario, the summer low flows period compensates partly the extra releases in the subsequent spates.
- C4. Partly mitigated during wet year only regime, limits the reduction of DO to 2Ml/d as autumn spates are not done in droughts.

As described above, we have made an allowance for total sustainability reductions across the water resource zone of 6Ml/d. None of this 6Ml/d was associated with Nethertown/ Blithfield. Although the 'worst case scenario' mentioned above could lead to a sustainability reduction of 19Ml/d we do not consider that implementing this in a short timescale is a plausible outcome; nor will it be necessary or cost beneficial.

We will not know for certain whether any sustainability reductions at Nethertown/Blithfield are needed and, therefore, whether our supply/demand balance is affected until our investigations are complete. In response to the letter received from Defra on 24 May 2019 we:

- Note that the final decision on the Nethertown and Blithfield WINEP scheme(s) will be taken in collaboration with the Environment Agency and will be informed by the CBA analysis which we shared with the local Environment Agency teams in June 2019.
- Have run a sensitivity scenario with an additional reduction of 19Ml/d being effective throughout the 25-year planning period. This would lead to a supply/demand deficit within AMP7 in both the DYAA and DYCP scenario. In a DYAA, this 19Ml/d additional reduction does not lead to any deficit after 2025 but in the critical period it would also lead to a small deficit in AMP8.
- Due to the need to balance security of supply with environmental improvements, in the extreme and unlikely scenario that a sustainability reduction of 19Ml/d is agreed, this could only be achievable with sufficient time allowed for a replacement scheme to be developed or effects from leakage reductions and water efficiency initiatives to be fully quantified. In this extreme scenario, a future effective from date could be a way of permitting the reduction without an immediate threat to secure supplies.
- The options that we would need include a greater focus on metering and water efficiency in our South Staffs region, the acceleration of supply options such as the SO/SH option (currently due to deliver in 2025/26).
- If appropriate, we would then investigate the most feasible supply and demand options set out in table 5 of our WRMP tables as well as any cross sector or intercompany transfer that our work with the Water Resources in the West (WRW) highlights.

We are committed to meeting our WINEP requirements and plan for both green and amber WINEP schemes. In our summer 2019 PR19 submission to Ofwat we will propose a cost adjustment mechanism that will allow for AMP7 expenditure made on Amber WINEP schemes to be recovered at the end of the AMP. We remain fully committed to working with the Environment Agency to ensure we agree an acceptable solution to the risk of causing deterioration against Water Framework Directive objectives. We will report progress on this and other aspects of our WRMP to the Environment Agency and Defra via the established annual review process.

7.10 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, the WINEP process will result in abstraction licences being sustainable, or that an agreed plan will be in place to make them sustainable.

7.11 Drinking water quality

Our WRMP also has to include the requirement to meet drinking water quality standards and compliance levels set by the Drinking Water Inspectorate (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. We produce water that meets the standards of the DWI and complies with the Drinking Water Directive.

Our monitoring of groundwater nitrate concentration trends predicts future increases at a number of sources, and we expect the need for additional treatment and/or low nitrate water blending in AMP7 to maintain our compliance with DWI standards.

7.11.1 Catchment schemes

Nitrate removal plants require refurbishment or replacement in the future as their asset life declines. We have a catchment management programme to provide a twin-track approach to mitigation of nitrate in the future. Our programme is targeted 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 an effective, sustainable long-term solution to mitigate water quality risks.

The Drinking Water Inspectorate (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.

7.11.2 WINEP drivers for catchment schemes

We have 12 schemes in WINEP3 under the Drinking Water Protected Area driver. These cover catchments currently under investigation in AMP6 to identify the feasibility of catchment management. Implementation will be focused where it is deemed possible that catchment measures can manage the problem of rising nitrate trends and reduce the need for replacement nitrate plants in the future. These schemes are likely to be further adjusted in our final plan as results from current investigations reach a conclusion.

Section 8:

Headroom

8. Headroom

Overview of headroom assessment

Target headroom

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 utility should introduce into the annual supply/demand balance to ensure that its chosen level of service can be achieved. We have used UKWIR's standard methodology ('An Improved Methodology for Assessing Headroom', UKWIR, 2002).

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.

DYAA target headroom starts at 7Ml/d in 2017/18, increasing along the 95th percentile profile to a maximum of 10Ml/d in 2029/30. The increase in risk acceptance beyond 2030 means that target headroom decreases slowly thereafter to 8Ml/d by 2045. DYCP target headroom starts at 12Ml/d in 2017/18, reaches its maximum of 14Ml/d in 2029/30. The increase in risk acceptance beyond 2030 means that target headroom fluctuates thereafter, finishing at 13Ml/d by 2045.

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 DYCP conditions. These components are listed in the table below.

Table 39 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).

Although we made an allowance for S4, bulk transfers, in our draft WRMP, we no longer do so. This is because we have agreed the transfer volumes and lowered the uncertainty associated with our bulk exports.

S5, gradual pollution of groundwater sources, is applied to allow for uncertainty associated with deterioration, rehabilitation and replacement of boreholes, uncertainty in future long-term trends in nitrate pollution, and uncertainty over coalfield mine water pollution at MGPWC. Temporary losses of DO relating to these factors are quantified and accounted for in the outage allowance.

S6 comprises uncertainty in the accuracy of supply-side data. For every groundwater source, the constraining factor for DO is identified:

- abstraction licence;
- infrastructure;
- pumping water level (potential yield);
- treatment capacity; or
- 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, but we have no such sources. There are uncertainties in a number of treatment processes, and water quality can limit DO subject to uncertainty in existing conditions (primarily sand ingress). Trend uncertainty is covered under S5. Surface water yield uncertainty is because of imperfect climate and hydrological historical data records and variability in surface water yield models.

Uncertainty of climate change on source yield (S8), is quantified using Aquator modelling of climate change scenarios on the DO of surface water sources. No groundwater sources are constrained by potential yield, such that there is no risk of climate change impacting groundwater source yield.

Although our Aquator climate change modelling includes a peak week demand, we have not used this or any value for S8 within our peak supply forecast uncertainty. This is because unlike annual average output, peak yields are only constrained by the hydraulic capacity of our surface water works.

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 revised draft 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.

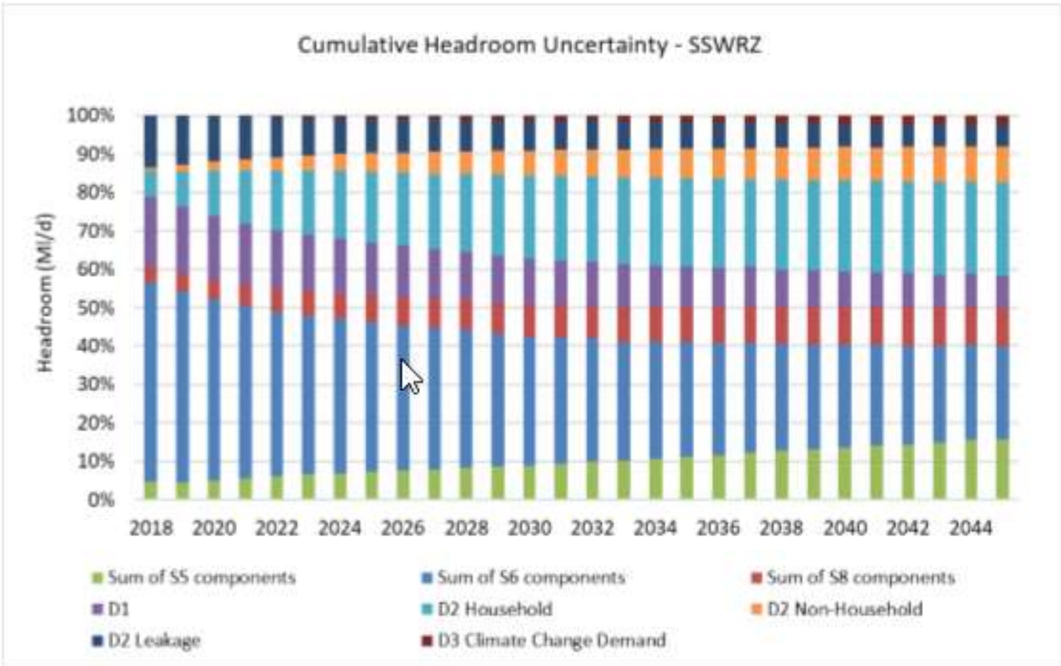
DYAA target headroom starts at 7Ml/d in 2017-18, increasing along the 95th percentile profile to a maximum of 10Ml/d in 2030. The increase in risk acceptance beyond 2030 means that target headroom decreases slowly thereafter to 8Ml/d by 2045. DYCP target headroom starts at 12Ml/d in 2017-18, increasing along the 95th percentile profile to a maximum of 14Ml/d in 2030. The increase in risk acceptance beyond 2030 means that target headroom fluctuates thereafter, finishing at 13Ml/d by 2045.

Table 40 Target headroom DYAA and DYCP – 2016/17 to 2044/45

Year	DYAA (in Ml/d)	DYAA (percentile)	DYCP/Peak (in Ml/d)	DYCP/Peak (percentile)
2017/18	7.05	95%	11.57	95%
2020/21	7.56	95%	11.47	95%
2025/26	8.75	95%	12.50	95%
2030/31	9.58	94%	13.74	94%
2035/36	8.75	89%	13.13	89%
2040/41	8.10	84%	12.94	84%
2044/45	7.77	80%	12.83	80%

The breakdown of target headroom by sub component in figure 23 shows that initially, uncertainty is dominated by the accuracy of supply-side data (S6) and to a lesser extent the accuracy of demand side data (D1). However, toward the end of the planning period there is a greater element of provision required for demand forecast variation (D2), gradual pollution (S5) and to a lesser extent climate change (D3 and S8).

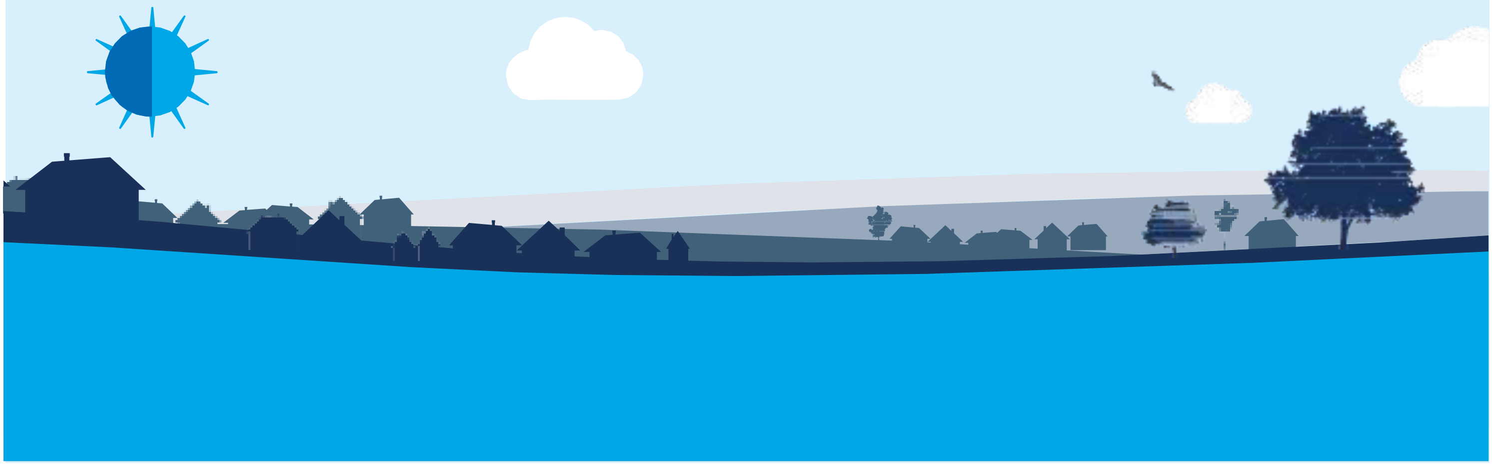
Figure 23 Breakdown of DYAA target headroom by sub-component



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

Section 9:

Baseline supply/demand balance



9. Baseline supply/demand balance

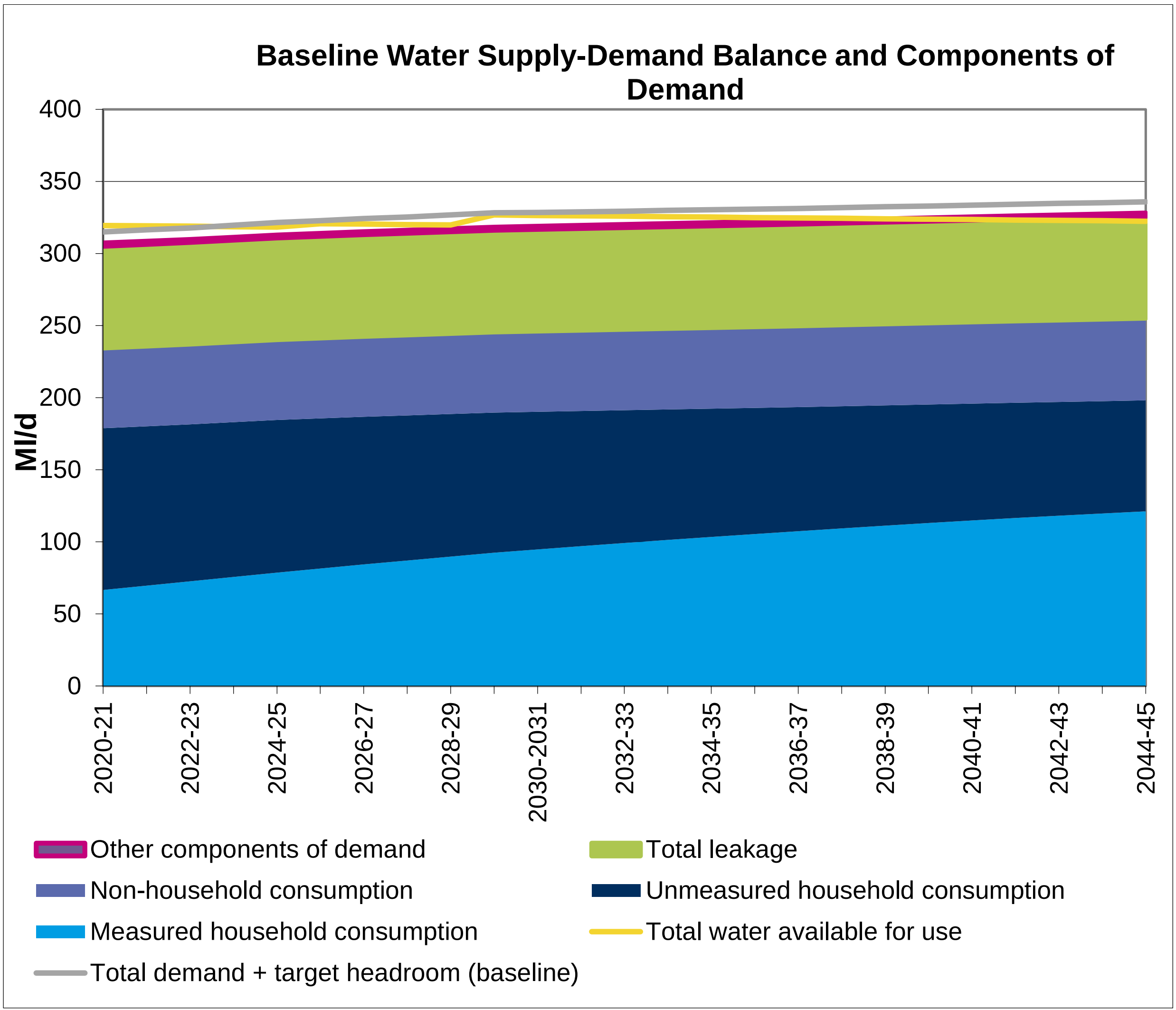
Overview of baseline supply/demand balance

Under the baseline scenario the supply/demand balance for the DYAA shows a deficit in 2023/24 and in 2022/234/25 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 improved modelling and groundwater source availability and reductions in DO to protect the environment. Target headroom is breached in 2023/24.

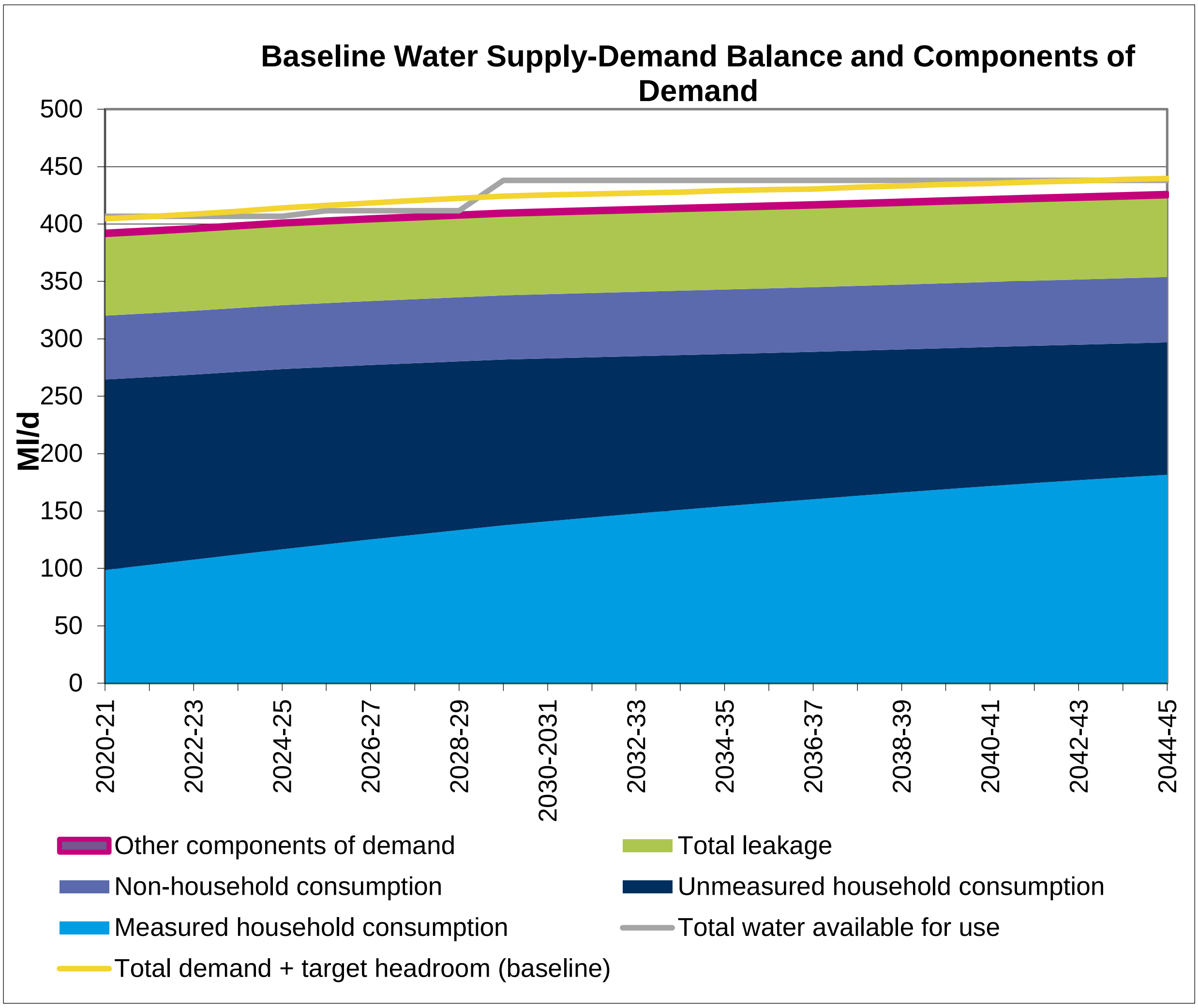
Figure 24 Baseline DYAA supply/demand balance and components of demand



9.2 Baseline critical period supply/demand balance

The following chart shows the baseline supply/demand balance for the critical period planning scenario. Target headroom is breached in 2022/23.

Figure 25 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.

We have developed an unconstrained list of options, including:

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

We screened and evaluated these to define our list of feasible options. We carried out an SEA on all feasible options to help inform the proposed programme.

We modelled all options 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 South Staffs Water identified that because of the need to invest in our two major treatment works to ensure long-term serviceability of resources 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 irrespective of any supply/demand deficit. This approach allows us to take an integrated view of key questions for decision-making regarding water resource assets.

- How do we ensure that our assets are fit for purpose?
- 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?

A full appraisal of capex, life cycle costs and opex (totex) for all options (existing resources and potential new resources as well as demand management options) ensures we can produce a least cost solution. The inclusion of other un-monetised attributes also allows us to optimise on other objectives and understand the value of differences. This multi-criteria approach and the decision-making framework (DMF) is described in detail later in this section.

Therefore, a full range of demand management options and supply options including all existing sources have been developed for modelling in the DMF. 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'; this provided a robust and consistent approach that we applied to both our regions of operation.

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 scale of 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 R**.

Figure 26 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 - SST	
	High (11+)				

Our WRZ is in the amber area of medium strategic needs (scale of the problem) and complexity scores (how difficult problem is). 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:

- a wider appreciation of drought resilience, which means that we may be vulnerable to droughts that are different to those experienced historically;
- wider resilience issues affecting our WRZ; there is a potential decline in the volume, quality and reliability of available water resource without the renewal of long-term treatment work assets; and
- high-level concerns because of regulatory pressures on abstraction licences, which are leading to licence claw back and sustainability reductions.

The significance of the WRMP problem characterisation is that it drives a need for more sophisticated decision making, 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 meeting 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. The aim was to provide 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.

Because of the need for potentially significant expenditure in our two strategic surface water treatment works, we looked to extend our analysis beyond the WRMP and include aspects of asset management. This enables us to appraise our whole supply capability and ensure that we make a robust and flexible decision, for now and in the future.

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 WRMP19 based on the experience from WRMP14. We assessed in the problem characterisation that our area would have been classified as green at WRMP14 and therefore moving 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-side option, 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; these are treated as 'gateways' in the model (quantity and quality). These gateways are linked back to our customer priorities and hygiene factors and triangulate well with all our other PR19 engagement, together with our ongoing day-to-day customer insight work.

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

10.3.1 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 in order 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 megalitres 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.

10.3.2 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 have 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.

Two options for assessing quality benefit were considered.

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).

Option 1 was discounted 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 the 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.

10.3.3 Multi-criteria

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

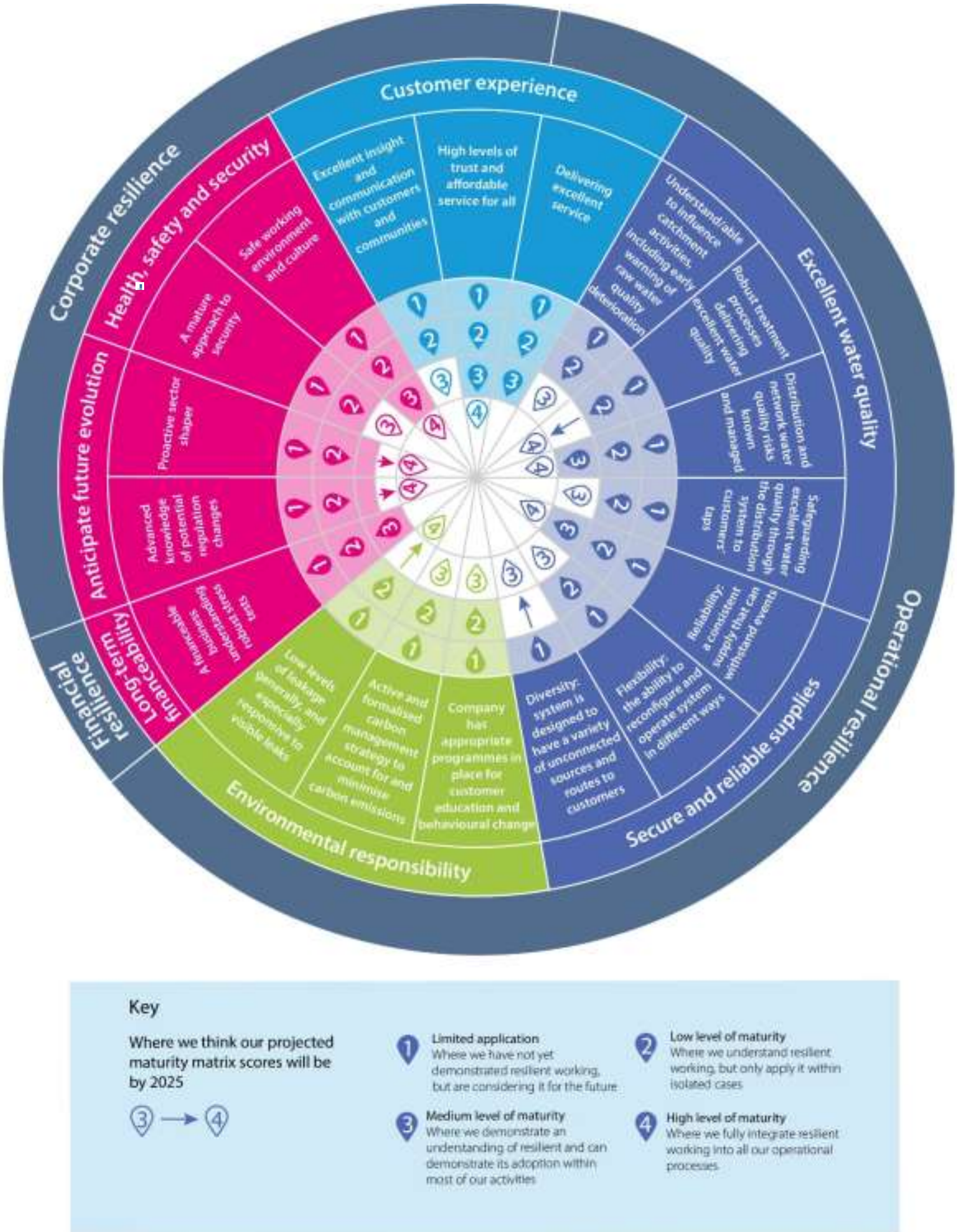
- **operational resilience** – each option was scored on how the delivered solution would improve reliability, flexibility and the diversity of our supply capability;
- **deliverability** – each option was scored to assess the operational certainty of the solution, if any third party consents were required;
- **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 a measure of disruption on local communities; and
- **customer preference** – this was gained from our customer engagement programme.

10.3.4 Resilience

We have reviewed 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. 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 27.

Figure 27 Resilience lens segments – revised since draft WRMP



10.3.4.1 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 28.

Figure 28 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, no regrets decision has been made.

10.3.4.2 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 deliverability is defined as follows.

- **Third party approvals** – the degree of difficulty involved in obtaining permission to carry out the option and the likelihood that the options 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 figure 29.

Figure 29 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

10.3.4.3 Environmental sustainability

Environmental sustainability is an important part of our existing decision making and operations, with a specific 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 the following elements.

- Lifecycle carbon.
- Biodiversity.
- 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 30 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 15/16 value)*
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 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. We have an AMP7 performance commitment to actively manage land to protect wildlife, plants, habitats and catchments. This should provide biodiversity benefits, for example at the Blithfield SSSI.

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 31.

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 31 Biodiversity scoring

Biodiversity

Hectares Affected		hectares		
	Implementation Phase	Operational Phase	1	Detrimental
Biodiversity			2	No Change
			3	Improvement
Biodiversity Score	=[implementation + operation] x hectares			

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 sector 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 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 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 classed as over abstracted). The framework needs to 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.
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; and
- 4 – Reduction in abstraction – for example, demand management.

The sustainable abstraction scoring method is shown in figure 32. 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 highly water stressed.

Figure 32 Sustainable abstraction scoring

Sustainable Abstraction

Volume of abstraction impacted (Ml/d)	80		
Water Sensitivity Score	3	1	Over Abstracted
		2	No water available
		3	Water Available, no deterioration or impact on WFD
		4	Reduction in abstraction (e.g. demand management)
Sustainable Abstraction Score		= Volume x Water sensitivity	

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

10.3.4.4 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.

10.3.4.5 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 a simple indicator has been utilised as shown in figure 30. 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 T**.

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;
- **metering** – more free meter options, change of occupier metering and compulsory metering with different types of meter.

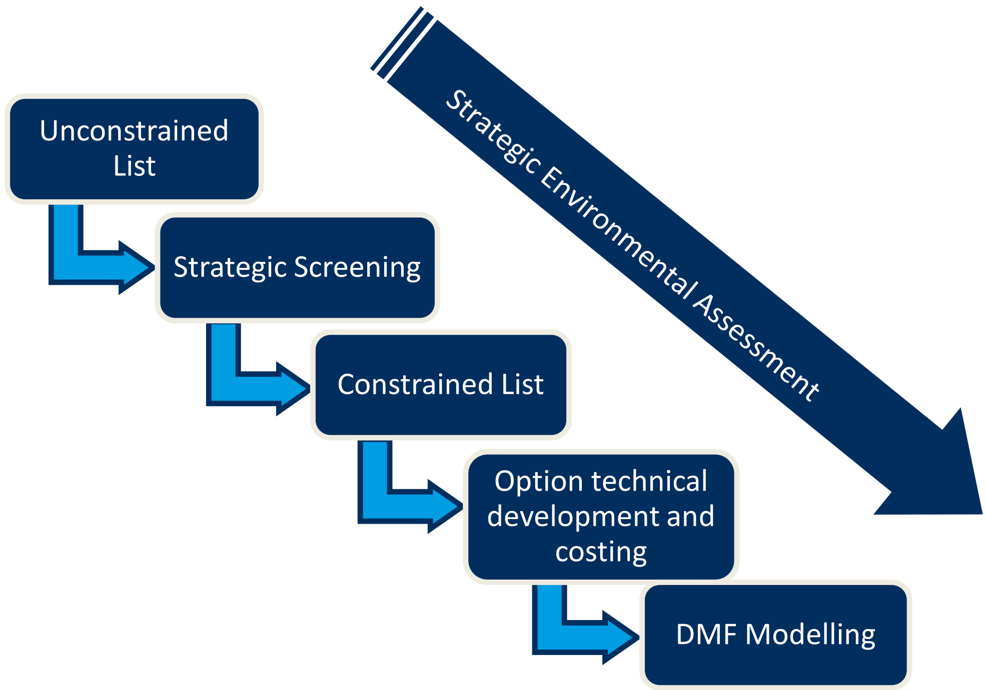
Supply options have been developed with the assistance of consultants Atkins. Details of the process of developing options and the pro formas for all feasible options are included in **appendix U**. In accordance with Defra instructions and the Security and Emergency Measures Directive Advice Notes and 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** – replacement boreholes based on asset condition, new treatment processes based on deterioration of groundwater quality;
- **new groundwater sources** – some new peak capacity at existing sources and some new abstractions in virgin locations;
- **new surface water sources**;
- **trades with third parties** – neighbouring water companies, the Canal and River Trust, and the Coal Authority; and
- **replacement treatment works** at various capacities.

Options development has followed a dual streamed process from unconstrained through to constrained where SEA has been carried out alongside options development.

Figure 33 Options development process



Stages of options development included:

- identification of unconstrained options through brainstorming events including both internal expertise together with leading industry consultants;
- Environment Agency involved in both demand management options and resources options identification;
- Initial screening using criteria such as feasibility, etc;
- Further review of screening following more detailed scheme description;
- Environment Agency views sought on resources options; and
- SEA scoping occurring concurrently.

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

Table 41 WRMP options considered

Option type	No. of un-constrained options	No. of streamlined options	No. of feasible options in DMF	Comments
Maintenance of existing groundwater	27	27	27 sources with multiple options	Options relate to capital maintenance of existing sources including replacement boreholes and new treatment requirements to maintain existing DO
Maintenance of existing surface water – including production losses	112	24	2 sources with 45 options – with variations in size, location and delivery	Options relate to maximum capacity of works and treatment processes and number of works treating the two existing source waters, together with alternative phasings for constructions
New groundwater	98	23	10	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			5	Options to increase surface water abstraction at existing locations for treatment at existing treatment works are included as well as options for new surface water

Option type	No. of un-constrained options	No. of streamlined options	No. of feasible options in DMF	Comments
				intakes and new associated treatment plants
Third party water and trades			5	Identified from approaches to and discussions with other water companies, Canal and River Trust, Coal Authority 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/ water efficiency (WE)			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

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 section 10.3.

The following table summarises how we evaluated third party and trading options.

Table 42 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
CRT option: 15 Ml/d from the Wolverhampton levels with abstraction from the Trent and Mersey Canal near Blithfield reservoir	Major concerns regarding raw water quality. Has potential to increase yield but quantity unclear.	Need certainty that discharge of canal water into Blithfield would not cause WFD deterioration or INNS transfers.	The use of canal provides social and environmental benefits. Also likely to meet expectations of several stakeholders to use water more collaboratively.	Deliverability is unclear but has potential to increase resilience.	Not in preferred plan but it was in our constrained list of options.	Water quality and associated environmental concerns.
CRT option: release from Chasewater reservoir via Wryley & Essington Canal to augment Crane Brook, thereby allowing further catchment utilisation for South Staffs Water	Yes, it could potentially give both. We consider the water quality in Chasewater to be good.	We are not aware of any.	Yes	Deliverability depends on negotiations with the Canal and River Trust and the Environment Agency but could give resilience benefits.	Not in preferred plan but it was in our constrained list of options.	Our preferred plan selected more deliverable options and/or options with greater customer preference.

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
Others including numerous Coal Authority dewatering options	No, there was not enough information available to be confident in either respect.	n/a	n/a	Not deliverable – resilience benefit uncertain	No, these did not make our constrained list.	Insufficient detail and confidence in deliverability – essentially these are R&D options more than credible supply schemes.
Environment Agency Shropshire Ground water	Yes, if available, it could potentially give both.	Need certainty that any increase in abstraction would not cause WFD deterioration	Likely to meet expectations of several stakeholders to use water more collaboratively.	We don't think this is deliverable as it is not available. If it was available it has possible resilience benefits.	Not in preferred plan but it was in our constrained list of options.	Insufficient detail and confidence in deliverability – essentially this is not an available 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
United Utilities import	Quality not a concern but unclear if this would give an additional quantity.	We are not aware of any.	Likely to meet expectations of several stakeholders to use water more collaboratively.	Deliverability depends on negotiations with United Utilities, the Environment Agency and other stakeholders. Could give resilience benefits.	Not in preferred plan but it was in our constrained list of options.	To deliver a benefit this option requires an upsizing of our River Severn Works and the distribution network linked to this treatment works.
Perry Barr from Severn Trent Water	Yes, it could potentially give both. Potable transfer so no raw water concerns.	We are not aware of any.	Likely to meet expectations of several stakeholders to use water more collaboratively.	Deliverability depends on negotiations with Severn Trent Water but would give resilience benefits.	Not in preferred plan for supply/demand balance but we have included this as a resilience option.	Resilience scheme but no supply demand benefit.

We will continue to pursue options involving third parties at any stage within the five-yearly WRMP cycle. Should any third party know of an opportunity of this sort we encourage them to contact us. We note that 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.

The following sections describe the screening of unconstrained options to the feasible list. Annex 1 to **appendix S** sets out our unconstrained list of options.

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. For some sources there are multiple options identifying where new treatment may be needed in the future. By having treatment as a separate option this enables the DMF model to appraise whether to select the treatment option to continue with that source or whether to select an alternative lower cost option from the point where treatment is required. In most cases where treatment is required if it is selected then other capital maintenance costs must also be included.

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 continuation of output from existing sources is not viewed as being 'free'.

When considering capital maintenance schemes potential impacts on DO as a result of WFD 'no deterioration' have been factored into the expected yield. All expected AMP6 sustainability changes have been included and those sites at risk of causing deterioration if abstraction increases above the recent actual abstraction over the period 2000 to 2015 have been capped at recent actual. We further clarify how our plan ensures that none of our capital maintenance schemes (which involve installing new water treatment) will cause deterioration against WFD objectives in section 11. We will:

- agree and share with the Environment Agency data that forms our recent actual baseline and peak historic abstraction for each source and group; and
- where appropriate, consider the individual elements of the Ground Water Body test.

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

HAPW and HUPW are licensed sources which are not currently operational and are not included in baseline DO. There are no options to reintroduce them.

SSPW, SAPW, SHPW and SOPW are also not currently operational and not included in baseline DO. Options to reintroduce these sources are included in the 'new groundwater sources' options.

10.5.2 Maintenance of existing surface water treatment works

There were multiple options considered regarding the future treatment capacity at our River Severn Works and our Central Works. The range of options included replacement with current capacity, smaller works and larger works and options to split the works into smaller components and carry out treatment at multiple locations to enhance levels of resilience. For all these options the baseline NYAA and DYAA DO remained the same as currently assessed in our DO modelling.

While undertaking this work, we will carry out the major improvements to our largest works by planning the work so that it is an 'off-line' build. This means the capital work will not reduce output from either of these treatment works for any significant period. This means the impact on outage is minimal. During these short periods we will use resilience options, such as the Perry Barr transfer, if required to preserve treated water storage. When we have completed the work and implemented dual streaming of flows, it will reduce any single points of failure, which will enhance our operational resilience. We will also plan the work so that any brief reductions in output coincide with periods of low demand. We will ensure we have the flexibility to ramp up other (resilience) sources if we require them.

The upgrades at our two surface water works will have a minimal impact on outage over the 2020/25 period but, once complete, they will reduce the risk of unplanned outages at either works. For example, by including the dual streaming, we are effectively creating two works at each site. This means that if we ever identify an issue with one stream, we can continue to supply customers using the other stream. It also means that when we carry out maintenance in one stream, the other stream can run without any outage or interruptions.

10.5.3 New sources

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

Table 43 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 as a result of external events – climate change, licence reduction, etc.

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

The technical note in **appendix V** describes the screening process in more detail.

Appendix W contains a report detailing the approach to costing new sources of water.

10.5.3.1 New groundwater sources

Options to provide additional groundwater at existing groundwater sources have been included alongside reinstatement of sites currently unused because of treatment requirements. New locations providing additional resource have also been considered.

Table 44 New groundwater sources options

New groundwater sources				
Option	NYAA yield Ml/d	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
KIPW1	0	0	9	New borehole for peak output and improved blend main
HIPW	0	0	5	New borehole for peak output and improved blend main Or New borehole for peak output plus nitrate treatment
SSPW	4.9	4.9	4.9	New boreholes, abandonment of well and nitrate treatment
Warton Unit	2	2	2.5	New borehole in Warton groundwater unit and new treatment works
SAPW (linked with augmentation water from Chase Water)	4.9	4.9	4.9	Reinstate SAPW borehole
SOPW	1.5	1.5	1.5	Headworks, remediation of boreholes, treatment for SOPW boreholes
SOPW/SHPW	6.4	6.4	7	Re-drill boreholes at SHPW, treatment for SHPW and SOPW
Coven	1.9	1.9	2.8	New groundwater source in Coven unit south of SOPW

The selection of some of these options (KIPW1 and HIPW) is dependent on the selection of associated capital maintenance schemes to secure the current output from existing groundwater sources.

When considering these schemes potential impacts on DO as a result of WFD ‘no deterioration’ have been factored into the expected yield. All expected AMP6 sustainability changes have been included and those sites at risk of causing deterioration if abstraction increases above the recent actual abstraction over the period 2000 to 2015 have been capped at recent actual.

The Environment Agency's view of options which abstract water only for peak periods is not clear at this stage. The intention of peak DO schemes is to provide additional water at times of peak demand, usually in the summer and for a maximum of 6 to 12 weeks each year. The storage capacity of the sandstone aquifer in this region is such that it is likely that short-term peak abstraction will have no additional impact on the environment providing the long-term abstraction does not increase above recent actual where a risk of deterioration has been identified. To account for this uncertainty around acceptability of these peak options, it was decided to test alternative solutions if options providing peak DO were selected in the modelling as part of the preferred options portfolio.

10.5.3.2 New surface water sources

These options include both additional raw water input to be treated at our existing Central Works or our River Severn Works and new sources with their own associated treatment.

Table 45 New surface water sources options

New surface water sources				
Option	**NYAA yield Ml/d**	**DYAA yield Ml/d**	**CP yield Ml/d**	**Major investment requirements**
Raw water from the River Trent to support Blithfield levels	3	3	0	For treatment at Central Works
Increase the storage in Blithfield by raising the dam by 1m	5	8.5	0	For treatment at Central Works
Increase the storage in Blithfield by raising the dam by 2m	10	18	0	For treatment at Central Works
River Trent 40	40	20	40	40Ml/d intake on River Trent with treatment works and six-month bankside storage. Possible location between Rugeley and Yoxall
River Trent 70	70	49	70	70Ml/d intake on River Trent with treatment works and six-month bankside storage. Possible location between Alrewas and Burton

We have been part of the River Trent Working Group liaising with other water companies and third parties regarding current use of and future options for use of the River Trent resource. It is evident that a number of water companies have options for using the River

Trent and that there is insufficient flow at times of need for all of these options to proceed. The allocation of the River Trent resource will be subject to Environment Agency agreement over greatest justification of need. On this basis, it is possible that other water companies with fewer alternative options would be successful in securing rights to abstract water from the River Trent in preference to us. To account for this uncertainty around River Trent options, it was decided to test alternative solutions if these options were selected in the modelling as part of the preferred options portfolio.

10.5.3.3 New trades/third party inputs

We have explored the opportunity for third parties to provide water to us. This includes treated water transfers and raw water transfers. There were a number of options explored with the Coal Authority and the Canal and River Trust, which were screened out because of design feasibility or uncertainty of yield. The feasible options which were included in the DMF are as follows.

Table 46 New trades/third party inputs options

Trades				
Option	**NYAA yield Ml/d**	**DYAA yield Ml/d**	**CP yield Ml/d**	**Major investment requirements**
Severn Trent Water – reversal of Perry Barr trade	20	20	20	Treated water bulk supply for resilience and planned maintenance use only.
United Utilities – water into the River Severn	30	30	0	Release of raw water from United Utilities to River Severn for treatment at River Severn Works
CRT – Chase Water (2Ml/d) in conjunction with an option to reinstate an existing source at SAPW (5Ml/d)	2	2	2	Release of compensation flow from Chase Water to augment Crane Brook would offset need to use PWS water for this purpose
CRT – from canals to Blithfield	0	5	0	Raw water option to transfer water from the canal network to support Blithfield levels
Shropshire Groundwater Scheme (SGS)	20 50 80	20 50 80	0 0 0	Three raw water options relating to commissioning phases 6, 7 and 8 of Shropshire Groundwater Scheme.

Severn Trent Water has confirmed that the 20Ml/d trade via Perry Barr is available for resilience and planned maintenance use only. The option has been modelled using assumed costs which have not been subject to commercial negotiation and would likely be subject to change.

The Environment Agency's view on the viability of the options based on the Shropshire Groundwater Scheme (SGS) was uncertain at the time of preparing our draft WRMP. To account for this uncertainty around SGS options, we decided to test alternative solutions if these options were selected in the modelling as part of the preferred options portfolio. As the SGS was not selected in our preferred plan, its viability is only of academic interest. If the Environment Agency confirms that it is a viable option, we will include it in our 2024 WRMP options appraisal.

10.5.4 Demand management

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

Table 47 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 40 options of which some represented only very small savings. Bundles of options which delivered different volumes of saving were then created. Bundles were created for leakage activities, and water efficiency and metering were bundled together. Some metering options were also kept as separate options.

Savings for all options are based on annual averages. For metering there may be some additional peak benefits but there is limited evidence to support this and therefore this has not been included.

Metering options were based on automatic meter reading (AMR) meters unless otherwise stated as advanced meter infrastructure (AMI) smart meters. Options are based 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 T**.

Figure 34 Phase 1 leakage reduction options

Bundles	Sub-option code	Sub-option name	Yield profile: Year first delivery	Yield profile: Year maximum yield	Yield profile: Maximum yield
Leakage Bundle 1.0	129a	Pressure Management Ph.1	1	1	0.21
Leakage Bundle 1.0	129b	Pressure Management Ph.2	1	1	0.22
Leakage Bundle 1.0	129c	Pressure Management Ph.3	1	1	0.28
Leakage Bundle 1.0	059_60	Improve allowances	2	3	0.40
Leakage Bundle 1.1	073a	ALC Ph.1	1	2	1.96
Leakage Bundle 1.1	129d	Pressure Management Ph.4	1	1	0.19
Leakage Bundle 1.1	073b	ALC Ph.2	3	5	2.82
Leakage Bundle 1.2	088	DMA sub-metering	1	2	2.19
Leakage Bundle 1.2	073c	ALC Ph.3	6	10	4.30
Leakage Bundle 1.3	073d	ALC Ph.4	11	15	3.95
Leakage Bundle 1.3	057	TMSR monitoring	1	5	4.40
Leakage Bundle 1.4	183	Reduce CSPL	1	25	2.77
Leakage Bundle 1.4	073e	ALC Ph.5	16	20	3.35
Leakage Bundle 1.4	052	Accelerate Meter Optants	1	25	0.97
Leakage Bundle 1.4	180a	LDAR Ph. 1	1	10	0.62
Leakage Bundle 1.4	180b	LDAR Ph. 2	1	10	0.60
Leakage Bundle 1.4	104	Reduce repair times	1	1	0.10
Leakage Bundle 1.4	177	Reduce backlog	1	1	0.51

Bundle	Year first delivery	Year maximum yield	Maximum yield
SST Leakage Bundle 1.0	1	3	1.11
SST Leakage Bundle 1.1	1	5	6.07
SST Leakage Bundle 1.2	1	10	12.56
SST Leakage Bundle 1.3	1	15	20.91
SST Leakage Bundle 1.4	1	25	29.82

sub-option code	sub-option name	Yield profile: year first delivery	Yield profile: Year maximum yield	Yield profile: max yield
500	Live Network	1	3	6.51

Figure 35 Phase 2 leakage reduction options

Bundles	Sub-option code	Sub-option name	Yield profile: Year first delivery	Yield profile: Year maximum yield	Yield profile: Maximum yield
SST Leakage Bundle 1.5, SST Leakage Bundle 1.6, SST Leakage Bundle 1.7, SST Leakage Bundle 1.8, SST Leakage Bundle 1.9	057	TMSR monitoring	1	5	4.40
SST Leakage Bundle 1.6, SST Leakage Bundle 1.7, SST Leakage Bundle 1.8, SST Leakage Bundle 1.9	073d	ALC Ph.4	11	15	3.95
SST Leakage Bundle 1.7, SST Leakage Bundle 1.8, SST Leakage Bundle 1.9	183	Reduce CSPL	1	25	2.77
SST Leakage Bundle 1.8, SST Leakage Bundle 1.9	073e	ALC Ph.5	16	20	3.35
SST Leakage Bundle 1.9	052	Accelerate Meter Optants	1	25	0.97
SST Leakage Bundle 1.9	180a	LDAR Ph. 1	1	10	0.62
SST Leakage Bundle 1.9	180b	LDAR Ph. 2	1	10	0.60
SST Leakage Bundle 1.9	104	Reduce repair times	1	1	0.10
SST Leakage Bundle 1.9	177	Reduce backlog	1	1	0.51

Bundle	Year first delivery	Year maximum yield	Maximum yield
SST Leakage Bundle 1.5	1	5	4.4
SST Leakage Bundle 1.6	1	15	8.35
SST Leakage Bundle 1.7	1	25	11.12
SST Leakage Bundle 1.8	1	25	14.47
SST Leakage Bundle 1.9	1	25	17.26

Figure 36 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		0.6	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.5	
157a	Dual flush toilets social housing	N	1	5	14		0.4	
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		0.7	
207A	Compulsory Metering AMR	N	1	25	none		12.3	
	SST - WEM 1.0		1	10	none		14.2	12.3
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.6	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.5	
157a	Dual flush toilets social housing	N	1	5	14		0.4	
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		0.7	
206A	206 FMO AMR	N	1	25	none		2.4	
	SST - WEM 1.1		1	10	none		4.2	2.4
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.8	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.6	
157a	Dual flush toilets social housing	N	1	5	14		0.4	
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		0.7	
111A	111 Change of Occupier AMR	N	1	25	none		4.1	
	SST - WEM 1.2		1	10	none		6.9	4.1
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.6	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.5	
157a	Dual flush toilets social housing	N	1	5	14		0.4	
023a	Non HH water efficiency programme - company led site visit with installation	N	1	10	14		0.7	
207S	Compulsory Metering AMI	N	1	25	none		14.9	
	SST - WEM 1.3		1	10	none		16.0	14.9
021	Household WEFF programme company led plumber install (2 runs)	Y	1	10	14		0.6	
200.00	Partnership with retailers for more efficient white goods (2 runs)	Y	1	10	14		0.6	
157a	Dual flush toilets social housing	N	1	5	14		0.4	
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		0.7	
	SST - WEM 1.4		1	10	14		2.6	
207S	Compulsory Metering AMI	N	1	25	none		14.9	14.9
207A	Compulsory Metering AMR	N	1	25	none		12.3	12.3

SST Final Committed WEM

Option Code	Option	modified	year first delivery	Year maximum yield	year stop delivery	yield profile	Max Yield (Ml/d)	2079/2080 Yield
	SST - WEM 1.5	Y	1	5	none		1.8	1.8
206A - Committed	206 FMO AMR	N	1	25	none		2.8	2.8

10.5.5 Resilience options

A number of options have been considered specifically for resilience purposes only. These include:

- enhanced levels of rebuild or refurbishment of existing assets to ensure that all processes are dual streamed and provide a level of resilience;
- diversifying the asset base by considering options whereby we split surface works into smaller independent sites; and
- increasing the transfer capacity of the strategic spine main, therefore enabling potentially larger surface works to be considered.

These options have been appraised within the DMF in the same way as all the other supply- and demand-side options, and all options have been scored for how they affect operational resilience. Where included in the preferred portfolio customer support can be demonstrated.

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, a series of scenarios were appraised 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 Shropshire Groundwater Scheme and the River Trent). In addition to this, we optimised across a range of the other objectives included within the MCA to understand how bringing in, for example, a greater level of resilience, or a portfolio that better delivered 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 supply-side scenarios.

- **Scenario 1:** utilisation by Severn Trent Water of a higher than current proportion of the treated capacity at our shared surface water works on the River Severn. (Severn Trent Water would transfer additional licence to be used at the works to enable them to use up to 68Ml/d. We based our DO modelling on current arrangements of 40.6Ml/d average and 48Ml/d peak use by Severn Trent Water.)
- **Scenario 2:** reduced DO as a result of a more extreme view of the impact of WINEP (additional 11Ml/d reduction on DYAA DO).
- **Scenario 3:** Exclusion of options where there was some particular uncertainty:
  - Perry Barr trade with Severn Trent;
  - Shropshire Groundwater Scheme – because of uncertainty in availability;
  - a new surface works on the River Trent – because of uncertainty in availability; and
  - 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.

The outputs of the DMF for each of these scenarios were then considered 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

Our least cost programme was derived 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

- Central Works – 90Ml/d capacity (smaller than current).
- River Severn Works – 210Ml/d (as current).
- Groundwater – 158Ml/d DO for DYAA (maintain all sites except MAPW1 and reduced output at KIPW1 – no nitrate treatment).
- Leakage – 12Ml/d reduction over AMP7 and 8.
- Compulsory metering – from year 27.
- Live network – earliest introduced in year 20 (6.5Ml/d).
- Trades – Perry Barr considered much later (year 54).

There were no demand management (metering or water efficiency) options selected in the least cost runs inside the first 25years.

10.7.1.2 Sensitivity testing

Scenario 1 – Increase take at River Severn Works by Severn Trent

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 12Ml/d leakage reduction was an embedded option in all cases.

Over the last 12 months we have been in dialogue with Severn Trent Water about their plans and options for utilisation of our shared River Severn treatment works. Over the course of developing our WRMPs we have considered a range of options. However, for the final sensitivity testing we have modelled a 20Ml/d increase in use of the works by Severn Trent Water. They would need to relocate existing River Severn abstraction licences to the works to enable them to access the capacity which they are entitled to.

Results

- Central Works – 110Ml/d capacity as current.
- River Severn Works – 210Ml/d as current.
- Groundwater – 158 Ml/d DO on DYAA (maintain all sites except MAPW1 and reduced output at KIPW1 –no nitrate treatment).
- Leakage – 12Ml/d reduction (included by reducing demand).
- Live network – earliest introduced in year 17 (6.5Ml/d).
- Compulsory metering – post-year 27.
- Additional leakage – post-year 27.
- Trades – Perry Barr considered much later (year 56).
- No demand management.

On reviewing these results to check the modelled behaviour, we could see that because of our existing license constraints on the River Severn, our Works has the required additional capacity during both NYAA and DYAA to meet the additional Severn Trent Water demand. The DYCP was the trigger to increase the Central Works by 20Ml/d, as the River Severn Works is already fully utilised in the base run for this planning period – that is, requiring the full 210Ml/d.

Scenario 2 – More extreme reduction in yields because of WINEP

We also considered a more extreme application of the impact on DO of WINEP. This produced the same optimised portfolio as above for the early years without the need for some of the later options as the impact was less (11Ml/d WINEP impact compared with 20Ml/d impact of greater Severn Trent Water use of the River Severn works).

When both the WINEP reductions and the greater use of the River Severn Works were modelled together the results were as follows.

- Leakage – 12Ml/d reduction (included by reducing demand).
- Central Works – 110Ml/d capacity (as current).
- River Severn Works – 210Ml/d (as current).
- Existing groundwater – 153Ml/d DO for DYAA maintained at all sites and nitrate treatment required at KPW1 to increase DO from 9Ml/d to 14Ml/d.
- Live network – earliest introduced in year 6 (6.5Ml/d).
- Compulsory metering – year 13.
- Additional leakage reduction – year 28.
- Trades – Perry Barr considered much later (year 54).

Supply-side options become more diverse by including MAPW1 and treatment at KIPW1 to increase DO. The demand-side options showed no difference, they are just selected earlier than previously required.

Scenario 3 – Excluding uncertain options

We then tested what removing some potentially uncertain schemes would do to the feasible portfolios. Those schemes were either uncertain because of contractual agreements not yet being in place, such as trades with neighbours or those which require significant construction and planning consents which are yet to be gained.

As the modelling results for scenarios 1 and 2 did not select the Shropshire Groundwater Scheme or the River Trent options we did not need to exclude them from the modelling to identify alternative more certain options. However, the Perry Barr trade appears in all scenarios, albeit towards the end of the 80-year modelling period in some cases. Therefore, we need to identify what the alternative option would be if this were not available.

The outputs were in line with the above portfolios. However, instead of Perry Barr trade being utilised in the later years Coven was selected in year 36.

Planning horizons

The model also allowed us to understand the impact of changing the planning horizons. The model has the capability to optimise over an 80-year time horizon, but we can also constrain to a shorter period, based on greater certainty on demand, water quality and costs of solutions. We ran the scenarios over a number of alternative planning horizons; this had no impact on the portfolios that were selected.

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 fundamentally different within our asset portfolio.

We had included a number of feasible options that delivered the same DO, but because of asset enhancements, such as dual streaming, or even splitting the asset in to smaller distinct standalone assets, 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 our supply/demand balance is met. We wanted to ensure that our preferred portfolio not only met our supply/demand balance in a cost-effective way, but also was shaped by what our customers had told us was important. In essence this meant looking to promote demand-side opportunities and balancing resilience benefits against cost for supply-side options.

Table 48 The preferred portfolio

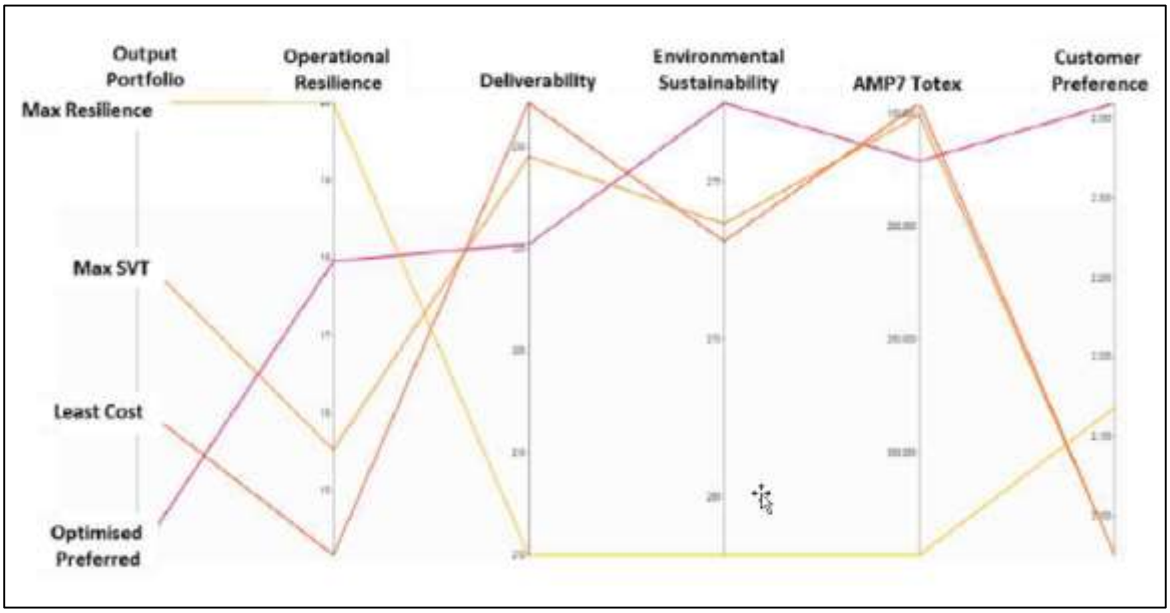
	Portfolio results						
	Baseline	WINEP applied (leakage reduction applied)	Increased take by Severn Trent Water at River Severn Works (with WINEP and leakage reduction)	Extreme application of WINEP (leakage reduction applied)	Increased operational resilience (with WINEP and leakage reduction)	Reflecting customer preferences (with WINEP and leakage reduction)	Preferred
Existing surface works	River Severn works – same size Central works – smaller (90Ml/d CP)	River Severn works – same size Central works– smaller (90Ml/d CP)	River Severn works – same size Central works – same size	River Severn works – same size Central works – same size	River Severn works – same size Central works – same size	River Severn works – same size Central works – same size	River Severn works – same size Central works – same size
Existing groundwater	All groundwater – excluding MAPW1	All groundwater – excluding MAPW1	All groundwater – excluding MAPW1	All groundwater – including MAPW1 and treatment at KIPW1	All groundwater – including MAPW1 and treatment at KIPW1	All groundwater – including MAPW1 and treatment at KIPW1	All groundwater – including MAPW1 and treatment at KIPW1

Portfolio results							
	Baseline	**WINEP applied (leakage reduction applied)**	**Increased take by Severn Trent Water at River Severn Works (with WINEP and leakage reduction)**	**Extreme application of WINEP (leakage reduction applied)**	**Increased operational resilience (with WINEP and leakage reduction)**	**Reflecting customer preferences (with WINEP and leakage reduction)**	**Preferred**
Leakage	12.5Ml/d reduction – by yr10 6.5Ml/d – live network (yr20)	6.5Ml/d – live network (yr17) (Additional leakage option selected in yr26 reaching a further 11Ml/d by yr51)	6.5Ml/d – live network (yr22) (Additional leakage option selected in yr26 reaching a further 11Ml/d by yr51)	6.5Ml/d – live network (yr6) (Additional leakage option selected in yr26 reaching a further 14Ml/d by yr51)	Additional leakage	6.5Ml/d – live network	12Ml/d reduction Explore live network. Note that we have increased our leakage ambition, as described in section 11, so that we will reduce leakage by 17.5 Ml/d in AMP7.
Demand management	Compulsory metering (yr27 – reaching 14.89Ml/d by yr51)	Compulsory metering (yr27 – reaching 14.89Ml/d by yr51)	Compulsory metering (yr27 – reaching 14.89Ml/d by yr51)	Compulsory metering (yr13 – reaching 14.89Ml/d by yr51)	Compulsory metering (yr27 – reaching 14.89Ml/d by yr51)	Increased metering and water efficiency – (2.75Ml/d at the end of 25 years and 1.82Ml/d by	Increased metering and water efficiency – (2.75Ml/d at the end of 25 years and 1.82Ml/d by end of 5 years)

Portfolio results							
	Baseline	**WINEP applied (leakage reduction applied)**	**Increased take by Severn Trent Water at River Severn Works (with WINEP and leakage reduction)**	**Extreme application of WINEP (leakage reduction applied)**	**Increased operational resilience (with WINEP and leakage reduction)**	**Reflecting customer preferences (with WINEP and leakage reduction)**	**Preferred**
						end of 5 years)	
New groundwater	No options selected	No options selected	No options selected	6.3 SOPW and SHPW (yr31)	6.3Ml/d SOPW and SHPW 2Ml/d at Coven	6.3Ml/d SOPW and SHPW	6.3Ml/d SOPW and SHPW
New surface works	No options selected	No options selected	No options selected		Trent – 40Ml/d works	No options selected	No options selected
Trades	Perry Barr trade with Severn Trent Water – considered much later in the 80 planning horizon (yr53)	Perry Barr trade with Severn Trent Water – considered much later in the 80 planning horizon (yr56)	Perry Barr trade with Severn Trent Water – considered much later in the 80 planning horizon (yr56)		Perry Barr trade with Severn Trent Water – available from yr1	Trade with Severn Trent Water at Perry Barr	Trade with Severn Trent Water at Perry Barr

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 37 Plot showing our preferred and alternative portfolios



Section 11:

Proposed programme

11. Proposed programme

Proposed programme

Our proposed programme has been informed by our multi-criteria modelling approach to determining 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.

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.

We are currently ranked among the highest on the comparative performance measure of average per capita consumption – that is to say, household customers supplied by us use on average one of the lowest volume of water per person in England and Wales.

That said, we have taken customer preferences for further demand-side options on board and have included ambitious plans in our proposed programme.

Leakage

Our DMF modelling selected a 12Ml/d reduction in leakage between 2020 and 2025. However, we have made changes to this based on customer and stakeholder feedback and we are now targeting a reduction in total leakage of 17.5 Ml/d from the current performance commitment level of 70.5Ml/d by 2024/25. This represents a reduction of 25% from our AMP6 target.

We plan to implement a live network to assist with this further leakage reduction before 2025. We also intend to make continued reductions in leakage from 2025 to 2045.

Metering

We will enhance our engagement with customers to educate them around the benefits of opting for a meter. We will target an additional 2,600 meter optants a year in addition to those included within the baseline demand forecast. We will target 73% meter penetration by 2039/40, which is in line with our last WRMP in 2014.

Water efficiency

We will target a reduction in PCC of 1l/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 greywater 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 had intended to report the findings from our trial of the 'WaterSmart' customer engagement programme in our final WRMP but this review is still ongoing.

Final demand forecast

As a result of our ambitious demand management proposals the final planning demand forecasts are 34Ml/d lower than the baseline forecasts by 2045. Household demand is 3.5Ml/d lower.

Proposed programme continued

Supply options

Our modelling confirms that continuing with our current base of resources is the most efficient and resilient solution. It also identifies that when we invest in our two surface water treatment works we should maintain the current maximum capacities.

Capital maintenance investment is also required to treat water from KIPW1 to restore output to previous DO. Treatment is also required at both COPW and ASPW for nitrate removal to ensure that DO can be maintained.

Investment for capital maintenance will be included in our PR19 business plan which we submitted to Ofwat in September 2018.

Resilience

We have included a number of options which will bring important local resilience.

- SOPW and SHPW provide local resilience for water quality challenges and an additional input to a single feed zone.
- The Perry Barr trade provides important resilience during the delivery of the refurbishments at both our water treatment works.

MAPW1 (our smallest source) provides local resilience, in a rural area.

We take this opportunity to clarify that the capital maintenance options listed above (specifically COPW, MAPW1, KIPW and ASPW) will not result in an increase in abstraction and therefore do not present a risk to deterioration of WFD objectives. The rationale behind this is that schemes ASPW and MAPW1 do not result in any increase in abstraction because water quality does not constrain current site output. Therefore, there is no need to further appraise environmental risk or present alternative options for these schemes. In relation to schemes COPW and KIPW, we are not proposing any abstraction above the rate that occurred during the recent actual period of 2000 to 2015. This time period is the baseline assessment as instructed by local area Environment Agency technical teams.

Because this WRMP does not propose any increased abstraction at these locations and does not cause deterioration risk, we have not presented any alternative options in this version of our WRMP.

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 more ambitious 17.5Ml/d reduction in total leakage to be achieved by the end of 2024/25. This 25% reduction from our 2019/20 target will be delivered 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 with 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 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.
- 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 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.

The DMF modelling also identified the deployment of the live network as a preferred option from 2040. However, we now intend to implement a live network to assist further leakage reduction with a view to realising this before 2025. As mentioned in the summary box at the start of this section, we have made changes to our proposed leakage programme based on customer and stakeholder feedback. In addition to our more ambitious 25% reduction in leakage by 2025, we also plan to reduce leakage in each AMP cycle from 2025 to 2045 and we have included this leakage profile in our WRMP tables.

A more detailed description of a live network is contained within the Artesia report on demand management options in **appendix T**.

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 17.5Ml/d reduction we are proposing. The SELL for PR14 is 70.54Ml/d which is our current Performance Commitment.

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 49 SELL analysis – current and consistency methods

	Current method	Consistency method
SR-SELL (2015/16)	70.5Ml/d	n/a
Performance commitment	70.5Ml/d	n/a
2016/17 reported leakage	69.9Ml/d	70.8Ml/d
SR – SELL (2020/21)	67.2Ml/d	68.2Ml/d
SR – SELL (2024/25)	65.2Ml/d	66.2Ml/d
Leakage included in final demand scenario (2024/25)	53Ml/d	n/a

Our proposed AMP7 25% leakage reduction is significantly more ambitious than the change indicated by the revised SELL calculation.

We have already started preparatory work to achieve this transformational change in leakage by the end of 2024/25, with a view to seeing some benefits before 2020. The extent of such benefit is currently being quantified, which is difficult based upon the significant number of variables within the equation (current performance, gestation of technology based investments, weather, etc). In the WRMP tables we have shown the reduction in leakage to be linear between now and 2024/25. We have a linear AMP7 leakage reduction profile within the PR19 business plan submission and in our final WRMP submission.

We are moving towards reporting leakage on a nationally consistent basis. We will complete this process by 2020. One significant barrier to this at the present time 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 implementing a new household night use monitor in Cambridge 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 annual performance report for 2018 the shadow value was only 0.3Ml/d different to our 'live' value. This suggests that the impact of the reassessment will not be material to our preferred plan.

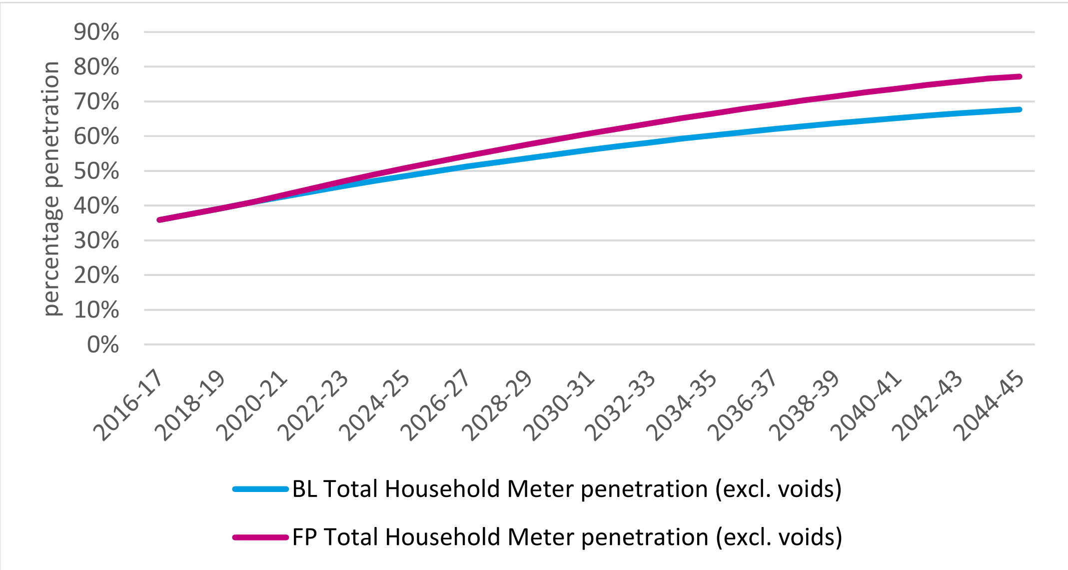
11.1.2 Metering

As evidenced in section 5, customers viewed increased metering as a necessary and important approach for us to undertake. 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 37% and the baseline demand forecast shows this to rise to 67% by 2044/45. Our WRMP14 had a meter penetration target of 73% by 2039/40, which included the implementation of the change of occupier metering policy. As detailed in the baseline forecast, we have not progressed with this metering policy as customers do not support it.

We consider, however, that customer evidence supports a view that we should continue to target a meter penetration level of around 73% by 2039/40. 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 2,600 free meter optants in addition to those included in the baseline forecast each year giving a total of approximately 8,000 optants a year in the early part of the demand forecast. As a result of this, meter penetration will reach 73% by 2039/40 and 77% by 2044/45.

Figure 38 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 50 Cost of our proposed household metering programme

	AMP7	AMP8	AMP9	AMP10	AMP11
New supplies					
Total number in period	27,740	22,600	19,700	19,940	18,560
Operating costs in period	£0.3m	£0.4m	£0.5m	£0.6m	£0.7m
Optants					
Total number in period	40,630	39,630	37,130	32,380	27,380
Operating costs in period	£0.3m	£0.5m	£0.7m	£0.9m	£1.1m
Installation costs (total for period)	£9.4m	£9.2m	£8.6m	£7.5m	£6.3m

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.

11.1.2.2 Water efficiency

The baseline demand forecasts estimate that average PCC under normal year conditions reduces from 126l/p/d to 122l/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.

In addition to 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. As mentioned previously we have trialled 'WaterSmart', a customer portal providing bespoke consumption reports to household customers, is being deployed in our Cambridge Water region. The trial ran from November 2017 for 12 months and we are currently evaluating its benefits in terms of water saving and customer service. This is a product that has been successfully used in the USA and particularly drought-hit California. There are no similar projects with results available for the UK so it is not possible to estimate the savings that might arise from this trial and further roll-out in either region.

We have also embarked on the management of a large rainwater harvesting system on a new development led by the University of Cambridge in our Cambridge Water region. 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 saving of 1l/p/d on average PCC by the end of the AMP7 period.

We have based this target on a range of activities comprised of 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 the following.

- Developer incentives – variable infrastructure charge for varying levels of water efficiency design including rain water harvesting and grey water recycling.
- Working with housing associations and local authorities.
- Providing a self-led water efficiency programme for non-household customers.

- 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.

We estimate there is a cost of around £1 million a year to deliver this and we will use our ongoing willingness to pay research to test whether customers support this. Our approach to implementing future water efficiency will reflect customers' views and any relevant learning from our trials.

11.2 Final planning demand forecast

As a result of our ambitious demand management proposals the final planning demand forecasts are 35Ml/d lower than the baseline forecasts by 2045. Household demand is 4Ml/d lower and leakage reduction accounts for the remainder.

11.3 Supply proposals

Our modelling confirms that continuing with our current base of resources is the most efficient and resilient solution. It also identifies that when we invest in our two surface water treatment works we should maintain the current maximum capacities. Maintenance of our Central Works will result in restoration of deployable output at peak to 110Ml/d by the end of AMP8.

Capital maintenance investment is also required to treat water from KIPW1 to restore output at average and peak by the end of AMP7 to those at PR14. Treatment is also required at both COPW and ASPW for nitrate removal to ensure that DO can be maintained.

Investment for capital maintenance was included in the PR19 business plan we submitted to Ofwat in September 2018.

11.4 Resilience proposals

Our modelling suggests that the reintroduction of SOPW and SHPW will support our operational resilience. This option was selected in our sensitivity analysis together with our resilience runs. In addition to this, 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.

The Perry Barr trade (for resilience and planned maintenance use) was selected in all scenarios, albeit at varying times throughout the 80-year modelling period. We consider that this additional input, especially in this location, would provide valuable resilience during the delivery of the refurbishments at both our water treatment works.

MAPW1 has been included to provide local resilience. While this is our smallest resource, it is located in a rural area and operational experience supports the inclusion of this asset in our preferred portfolio.

As well as carrying out modelling to assess what our future resilience will be, we have assessed our resilience to historic events linked to non-drought 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.

We have also assessed the impacts of past freeze thaw events such as the exceptionally cold weather in March 2018. When Ofwat publicly wrote to all water companies about the 'Beast from the East', it said that: "Our overall analysis is that South Staffs Water performed well and largely met its customers' expectations…"[9].

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 our website on 28 September 2018.

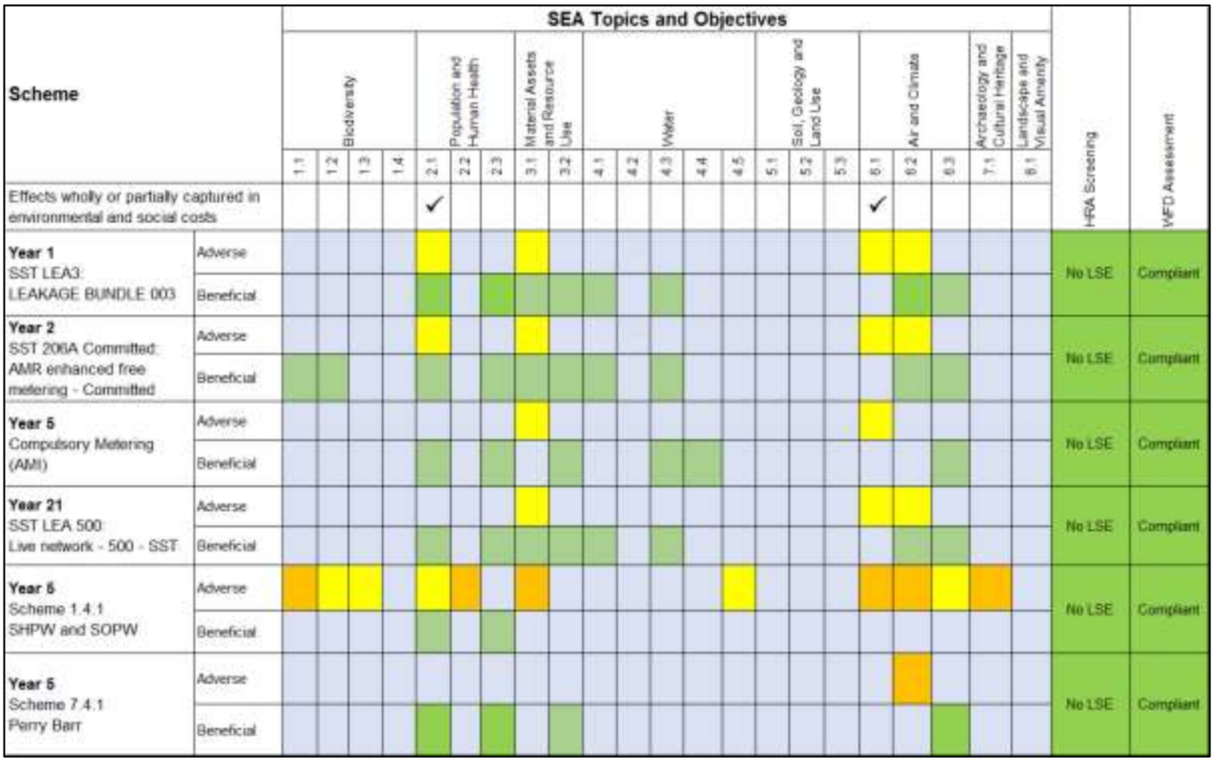
11.5 Strategic environmental assessment of proposed options

Our SEA work has considered the potential adverse and beneficial effects of all feasible options included in table 5 (of the SEA report). The SEA report and post-adoption statement are included as **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.

[9] https://www.ofwat.gov.uk/wp-content/uploads/2018/06/18-06-15-South-Staffs-Water-letter.pdf.

Figure 39 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@south-staffs-water.co.uk

11.6 Summary of proposed programme

Table 51 Summary of our proposed programme

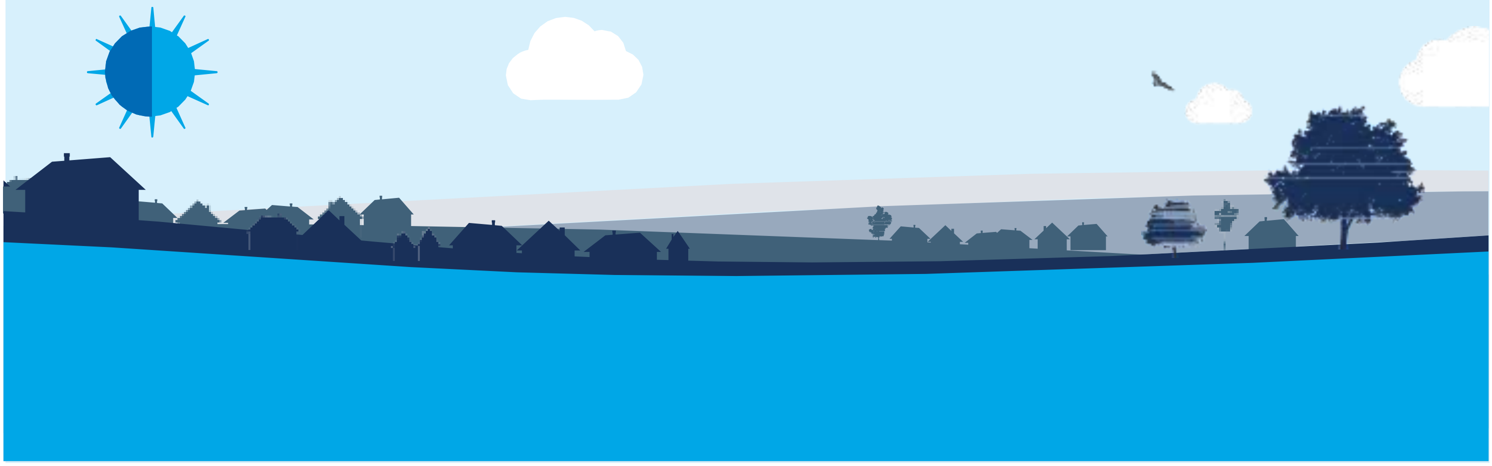
Option	Description
Baseline DO – existing groundwater	All baseline DO except MAPW1
Baseline DO – existing surface water	Central Works as baseline DO River Severn Works as baseline DO
Leakage	17.5 Ml/d reduction by end of AMP7 with further leakage reductions from 2025 to 2045.
Enhanced free meter optants	Additional 2600 free meter options per year throughout 25-year programme
Water efficiency	1l/p/d reduction by end of AMP7

Option	Description
Resilience only	MAPW1 mandated for local network resilience – no supply demand balance benefit
Resilience only	Perry Barr transfer included to provide resilience especially during construction periods of River Severn Works and Central Works – no supply demand balance benefit
Resilience	SHPW/SOPW to provide water quality resilience in the local network – these provide a supply demand balance benefit

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, SHPW and SOPW. All baseline DO sources are not included in table 6.

Section 12:

Final supply/demand balance

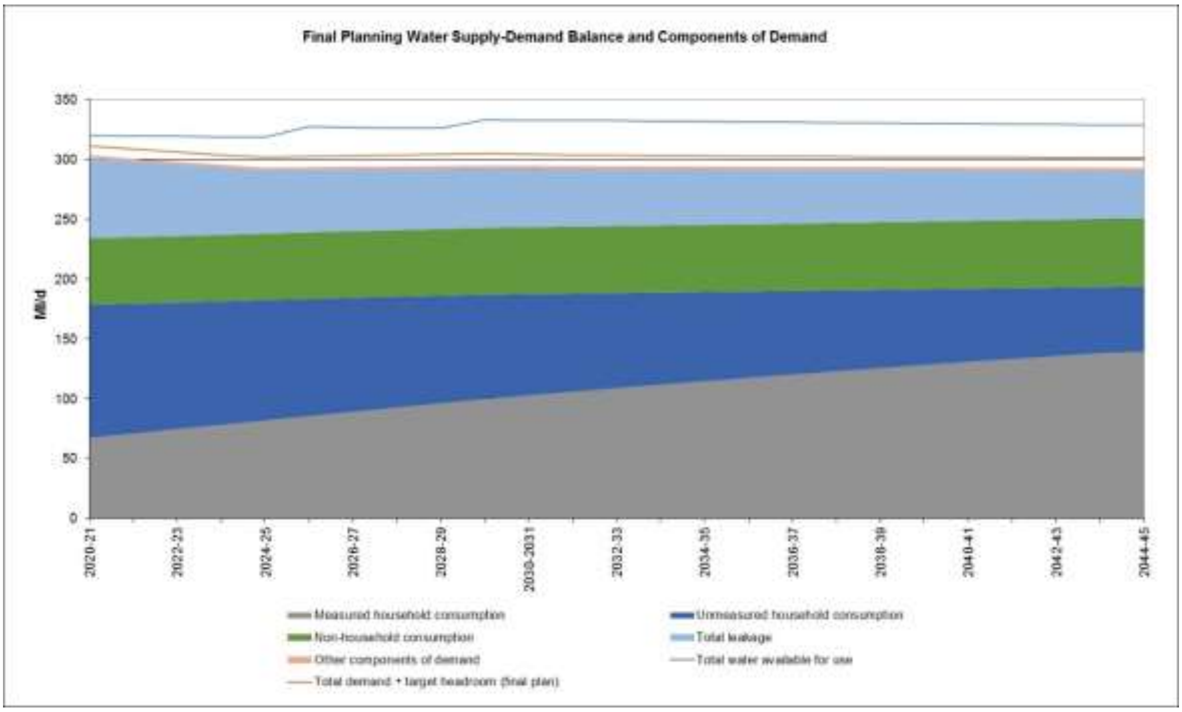


12. Final supply/demand balance

Our proposed programme delivers a 35Ml/d reduction in demand and an increase in supply of 6 Ml/d, together with greater levels of local resilience and overall resilience for the supply/demand balance.

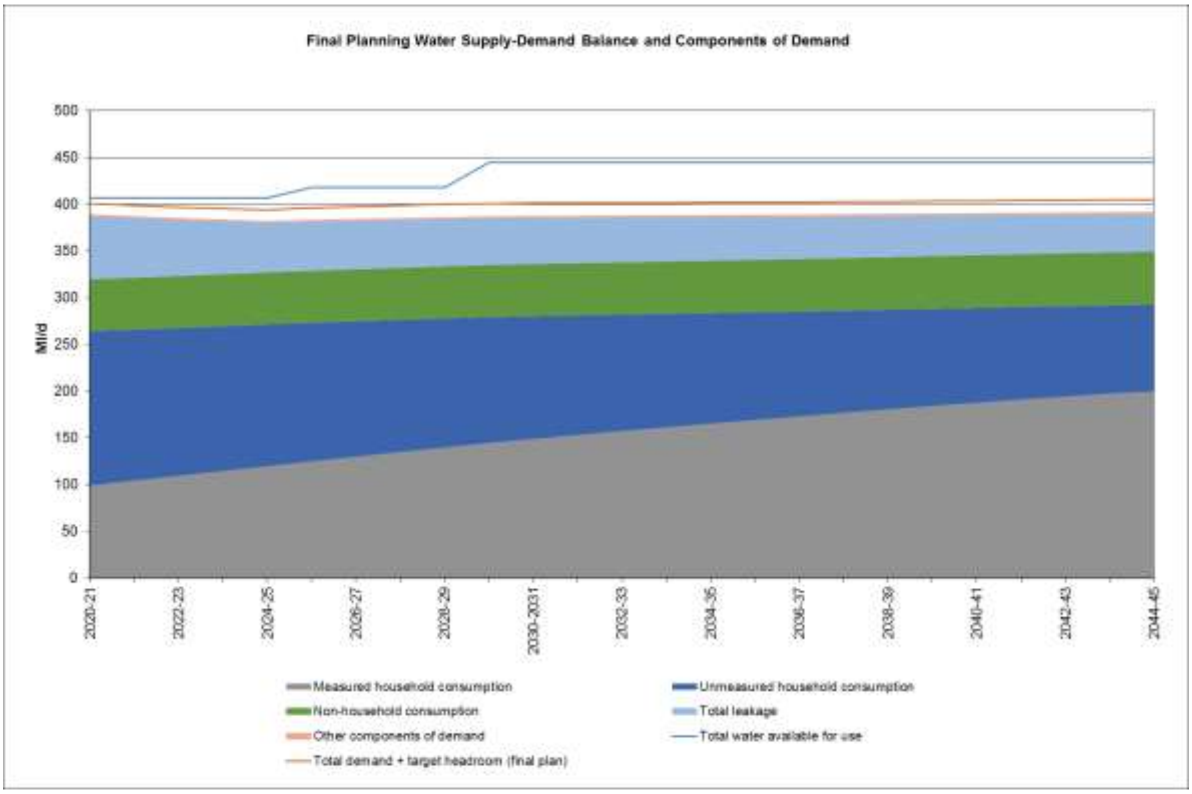
The chart below shows the final planning supply/demand balance for the DYAA scenario. A healthy surplus will be created and maintained.

Figure 40 Final planning DYAA supply/demand balance and components of demand



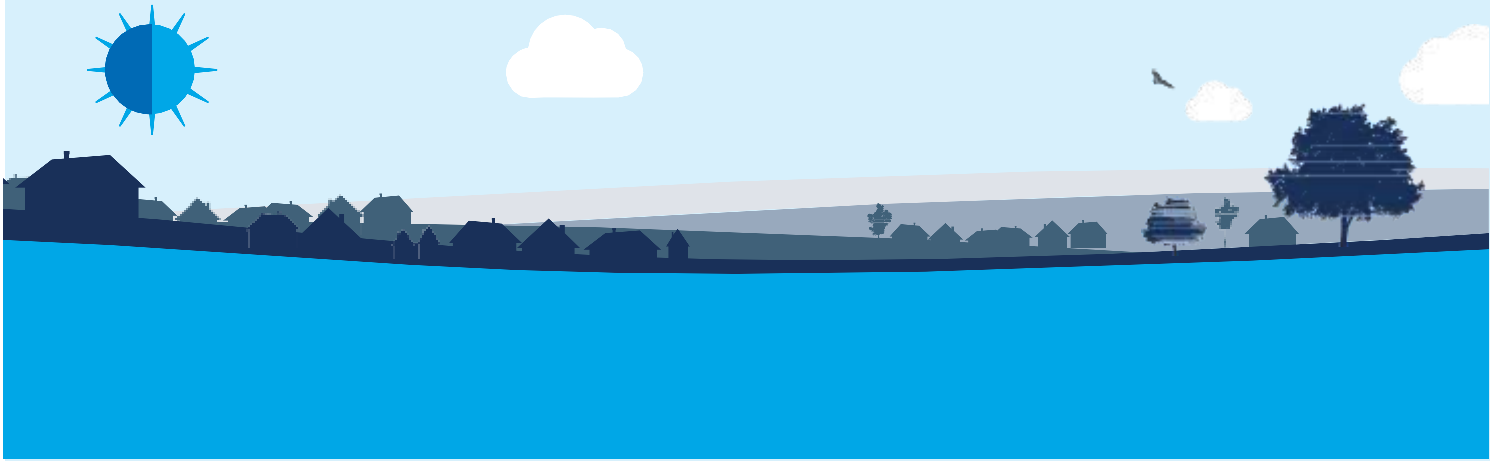
The chart below shows the final planning supply/demand balance for the critical period scenario. A healthy surplus will be created and maintained.

Figure 41 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
- There are AICs and AISCs that do not calculate in the DYCP table. This is because the yield of these schemes, which is used as a denominator, is zero
- 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.