Cambridge Water

Cambridge Water

Draft Water Resources Management Plan 2024

Securing your water future

Contents

List of appendices

Appendix J	ValueStream 1 Workbook for Supply Options
Appendix K	Artesia Demand Management Optimisation Report
Appendix L	SEA for Demand Options
Appendix M	Demand Management Activities detail report
Appendix N	Supply options
Appendix N1	WRMP24 Supply options Reporting V2
Appendix N2	All preferred Supply Options Details
Appendix N3	WRMP24 unconstrained options list v12
Appendix P	SEA and other environmental reports
Appendix P1	INNS Assessment
Appendix P2	HRA Assessment
Appendix P3	BNG and NCA Assessment
Appendix P4	SEA Assessment
Appendix P5	WFD Assessment
Appendix Q	Board Assurance Statement

Executive summary

1. Introduction to our water resources management plan

Summary

Every water company in England and Wales must produce a Water Resources Management Plan every 5 years. This plan looks at the predictions for water demand over the next 25 years, and what water supply is available to meet this demand. It then details how it will ensure it meets this demand through a potential range of demand management options and new supply options.

Our last plan was produced in 2019 and a lot has changed since then. Much of this relates to climate change and its impact on future water availability, both for public water supply and for environmental needs. In 2021, Cambridge Water was declared as an area of serious water stress by the Environment Agency. This means that either currently or in the future, the household demand for water is a high proportion of the current effective rainfall.

Even as we have been developing this plan, in 2022 our region is currently classified as being in drought, and the need to ensure our supplies are resilient to future periods of long dry weather is apparent. This WRMP looks to ensure a step change in drought resilience as we have undertaken studies to identify the actions required to make our system resilient to a 1 in 500 year drought, where the previous requirement was a 1 in 200 year drought In reality, this means that the chance of an extreme drought reduces from 0.5% to 0.2% in any given year.

A key focus of this plan is to ensure that we meet not only the water needs of our customers, but also that of our environment. Our plan will ensure that abstraction reductions are delivered over the next 25 years from our existing sources in order to counteract the impacts of climate change and ensure the environment has the water it needs. This will also ensure delivery of the Water Framework Directive (WFD) targets.

In addition, our population is growing. The Covid-19 pandemic saw customer use over 20 litres per person per day more than they did prior. This is due to people working from home more and increased hygiene practices. Even now, we are seeing this increase has not returned to pre-pandemic levels, nor has it been offset by a reduction in non-household usage. This means that demand for water has increased since WRMP19 and is set to increase across the lifetime of our plan.

Whilst the threat of climate change is not a new challenge, our understanding of it and the risk it poses to public water supply and the environment has evolved since our last WRMP in 2019. It is clear that our old method of developing WRMPs, where individual water companies prepare their own and focus only on their own requirements, will not alone solve the wider water issue in England.

This has led to the development of regional water resources planning groups across England. There are five groups, and Cambridge Water is part of Water Resources East. This regional group comprises of Cambridge Water, Anglian Water, Affinity Water and Essex & Suffolk Water, and has combined the supply and demand needs from each of these companies, and non-public water supply sectors, to create a regional water resources plan. The five regional plans have been overlaid to create a national picture, which ensures that the best value plan, for both customers and the environment, to meet the water needs of the country has been developed.

The WRMP has strong links to a number of other plans. It is a key building block of the PR24 business plan which we will submit to Ofwat in October 2023.

1.1 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 2025 to 2050 and beyond, and takes into account factors such as population growth, climate change, water availability and the environment. The plan is subject to annual review and companies need to write a new plan where circumstances change or the Secretary of State (SoS) at the Department for Environment, Food and Rural Affairs (Defra) requires them to. A new plan must be prepared at least 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 and beyond. While South Staffordshire Water now incorporates the supply area of Cambridge Water, this WRMP applies only to the Cambridge Water operating area.

1.2 The process of developing a water resources management plan

The Water Act 2003 made WRMPs statutory documents which must be submitted to the SoS 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 2019 WRMP and have integrated it more with the wider regulatory business plan (PR24) 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, and invited them to webinars explaining the process.
- We held regular meetings with Environment Agency staff during the development of the draft WRMP.
- We appointed independent research consultants to carry out 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 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 to gain customer views of service levels, our plans and where we should invest to meet demand for water. This was facilitated by independent research specialists.
- Consultants have also facilitated online surveys, face to face Q & A sessions with different customer demographics, both household and non-household.
- We have been part of regional engagement, customer research and workshops facilitated through Water resources East (WRE)

  A detailed discussion of our customer engagement is included in Section 9.

1.3 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 also consult with wider key stakeholders, 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 organisations, and invitations were sent out to attend a pre consultation webinar that took place in March 2022

- CCW, the water consumer watchdog.
- Ofwat.
- The Environment Agency.
- Defra.
- Natural England.
- The Independent Customer Panel.
- Anglian Water.
- Affinity Water.
- Local councils and councillors
- Local interest groups.

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

We received a number of responses to the pre consultation, and a number of organisations attended our webinar, and engaged in Q&A. We received formal responses from:

- the Environment Agency;
- Ofwat;
- Wilbraham River Protection Society;
- CCWater.

These responses and our response on how our plan will represent these views are in Appendix A.

1.4 Public consultation on our draft water resources management plan

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 will publish our draft plan on our website as soon as possible after receiving notification from Defra. We will notify key stakeholders (as specified in the WRPG) of the consultation period, directing them to the website and advising that a paper copy of the plan is 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;

- Icosa Water;
- Severn Trent Water; and
- CCW.

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

1.5 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 our 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.

1.6 Timetable

The timetable for adopting the final WRMP is as follows:

- 24th February 2023: the start of a 10-week consultation period which closes on 19th May 2023.
- 28th August 2023: we will publish on our website our response to any representations we receive on our WRMP consultation.

We will publish our final WRMP on our website once the Secretary of State has authorised us to do so. Copies will also be made available at our head office.

1.7 Links to other plans and context

1.7.1 Water Resources East – Regional Plan

The regional planning process and requirement for a regional water resource plan was initiated by the National Framework for Water Resources in 2020. Before this time we have been working regionally with other companies, and this was then formalised into a consistent planning approach in multiple regions. Our WRMP is closely aligned with the Water Resources East (WRE) draft plan which will be published in November 2023, following the emerging plan consulted on in January 2022. The draft regional plan can be found here www.wre.org.uk

Figure 1 The WRE Vision

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

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

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

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

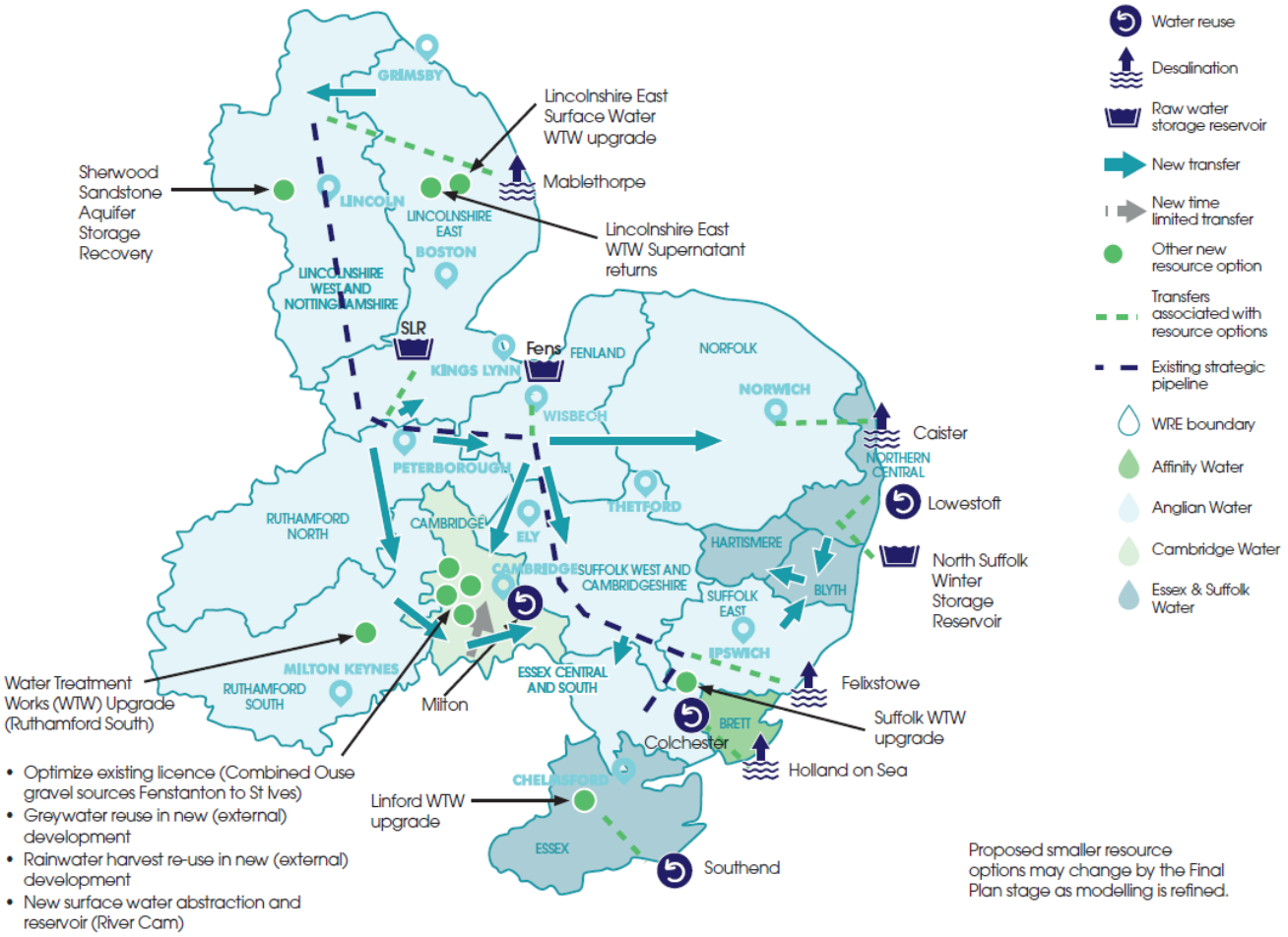
· Develop a strategy that supports the policy objectives of Government described in the water white paper "Water for Life"; in particular**, supporting economic growth** while simultaneously protecting the environment.

The WRE draft plan identifies the best value supply and demand options to meet the expected regional deficits for public water supply, whilst maximising benefits for other water using sectors such as power and agriculture. The regional plan supports companies WRMPs by developing a portfolio of solutions to meet the future needs of the water sector from environmental needs, growth, ensuring resilient supplies and climate change impact. It includes supply and demand options from all 4 water companies and determines options required under various uncertain futures which will also ensure the environment is restored and enhanced.

A common approach to use of data, modelling of regional problems and alignment of proposed solutions for companies ensures consistency between our WRMP, the regional plan and other water company plans. A number of regional low/no regret options that are consistently selected in portfolios are being progressed in WRMPs alongside individual company's options that are selected both in the regional plans and WRMPs.

In our WRMP, the Strategic Resource Option (SRO) Fens Reservoir features as a regional option that is selected in our plan to meet the licence reductions resulting from and the environmental need to achieve good ecological status and enhance designated sites and chalk rivers.

Figure 2 Water Resources East Best Value Plan



1.7.2 Strategic environmental assessment

In accordance with the strategic environmental assessment (SEA) directive[1] 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. We undertook consultation with the environmental regulators on our approach to scoping the SEA. Our SEA and environmental assessment report and post-adoption statement are included as Appendix P and the associated annex. A summary of the SEA process and the results of the SEA are included in section 10.

[1] 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.

1.7.3 PR24 business plan

Our WRMP has been integrated into the process of developing our business plan for the five years from 2025 to 2030, which we will submit to Ofwat in October 2023. Our plan will also contribute to the LTDS and has been progressed as a key workstream of the development of this.

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

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

1.7.4 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 summer 2021 and was finalised for publication in April 2022.

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

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

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

The River Rhee scheme supports tributaries including sites of special scientific interest (SSSIs), all of which have been investigated in the National Environment Programme (NEP), and are complete.

Our population and property forecasts are based on the latest local authority development plans taking account of their projections for new housing needs. This is discussed in detail in section 5.

1.7.5 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 abstraction volumes to be reduced and or capped. We have considered the potential impact of the uncertainty that this means 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 included the expected reductions in our baseline supply forecasts. This is in accordance with current Environment Agency advice and expectations.

1.7.6 Flood management plans

- Our operating area covers the river catchment of the Cam and Ely Ouse and we have considered flood management measures identified by the Environment Agency and the other statutory partners such as the county council for the Anglian Cam and Ouse Catchment (including South Level) area as appropriate

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.

1.7.7 25 Year Environment Plan

In 2018 the Government published its 25 Year Environment Plan. This plans sets out government action to help the natural world regain and retain good health. The clear goals that the adoption of the plan are set to achieve are:

1. Clean air
2. Clean and plentiful water
3. Thriving plants and wildlife
4. A reduced risk of harm from environmental hazards such as flooding and drought
5. Using resources from nature more sustainably and efficiently
6. Enhanced beauty, heritage and engagement with the natural environment

Cambridge Water are committed to playing their part in the delivery of these objectives, and we have ensured these goals are supported through the options developed in this plan.

1.7.8 The Environment Act

November 2021 saw the Environment Act be passed as legislation. This Act sets clear statutory targets for the recovery of the natural world in four priority areas: air quality, biodiversity, water and waste. It builds on the 25 Year Environment Plan by providing deliverables in these key areas to ensure pace of delivery.

We have included the proposed target from the Environment Act of a reduction of 9% in non-household water consumption by 2037 in our plan. More detail on this is included in section 10.

2. Scope of our plan

Summary

We are facing a number of challenges.

- We forecast an increase in demand driven by growing population and properties and need to make sure we have enough water to meet this demand.
- Some of our abstractions present a risk of deterioration to the environment and we need to address this through reducing and capping licences, which will drive the need for replacement resources
- We need to further reduce existing licences in order to improve the environment and meet good ecological status, protect designated sites and chalk rivers
- We need to become more resilient to future droughts and the impact of climate change.
- We want to go further on demand management, our regulators and customers expect and support this.

We have reviewed the challenges we face and the scale and complexity of them and our plan identifies the required measures, both supply and demand side to address the challenges. We have identified the best value programme to deliver these measures over the planning period.

There is always uncertainty when developing long term plans, as these are built on assumptions of the scenarios which may come to pass in the future e.g. climate change, population growth. As such, we look to stress test our plan for a range of scenarios to ensure it is robust to changing situations. If there are larger areas of uncertainty, or the plan needs to be adapted in certain circumstances, we may need to consider an adaptive plan. We have reviewed our need for an adaptive plan, which would provide an alternative pathway if a future assumption were to change.

We have agreed common processes for developing our plans with the other companies in Water Resources East to ensure consistency in approach. In addition, we have sought assurance from Jacobs to ensure we have met our obligations in the Water Resource Planning Guidelines.

2.1 Challenges facing Cambridge Water

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

- substantial growth in population and properties driving demand upwards;
- environmental pressures to ensure that our abstractions do not cause deterioration to the environment, and measures to further improve the status of the environment; and
- Customer expectations regarding our approach to demand management.

We have reviewed the challenges we face and the scale and complexity of them through an exercise of problem characterisation and have explored least cost and best value planning solutions. We have identified the most appropriate mix of supply and demand options going forwards.

The remainder of this WRMP is structured as follows.

- Our forecasts for baseline demand are described in chapter 8.
- Customer views are described in detail in chapter 4.

- The environmental assessment of our plan is described in chapter 10.
- Our problem characterisation exercise and multi-criteria approach to decision-making is described in detail in chapter 9.

2.1.1 Water stress

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

The Environment Agency published an initial consultation on identifying areas of water stress in 2007 and followed this with a response in August the same year. It later updated its classifications in 2013, and again in 2021[2] following public consultation.

Each water company is classified as being not water stressed, in moderate water stress or in serious water stress. The assessments are carried out by the Environment Agency and are based on a Water Exploitation Index (WEI) linked to the status of water bodies within the area. Water stress is defined where 'the current household demand for water is a high proportion of the current effective rainfall which is available to meet that demand; or, the future household demand for water is likely to be a high proportion of the effective rainfall which is likely to be available to meet that demand' For the previous Cambridge WRMP published in 2019, our area of supply was not classified as water stressed, however following the revised approach in 2021 the determination indicates that there may be environmental impacts caused by public water supplies, or need for further resources, which may be reduced by improved water efficiency through metering.

Water stress status can help to show where there is, or is likely to be, benefit from increased metering. It does not indicate that there will not be enough water for supplies or reflect water company performance.

Accordingly our plan has explored metering programmes, including universal metering as part of our demand management options. We have also explored customer views of universal metering in light of the challenges faces in the region. Together with water stress status, customer support for metering, and the demand management benefits that can be realised with smart meters, there is a strong case for universal metering.

2.1.2 Improving the environment

The National Framework for Water Resources review of public water supply in the WRE region has projected a deficit by 2050 of 580Ml/d, largely as a result of the need to abstract less water and leave more for the environment. This is to support achieving good ecological status, and provide extra protection for designated sites and chalk rivers. The need for new supplies also takes account of climate change impacts and ensuring resilience to future droughts, The framework acknowledges this is a generational challenge with considerable cost pressures.

These changes will be delivered by capping abstraction licences to prevent deterioration of the environment, and further licence reductions to meet future environmental destination scenarios, alongside increased demand management such as leakage reduction and metering programmes. It is estimated for the WRE region that licence caps for public water supply could be 136Ml/d, and environmental destination 338 Ml/d by 2050.

[2] https://www.gov.uk/government/publications/water-stressed-areas-2021-classification

2.2 Planning period

This plan covers the period 2025/26 to 2049/50. The year 2019/20 is the base year for the WRMP, with demand side reductions based from 2017. Actual data for the base year as reported in the 2020 Annual Review[3] has been normalised to remove the impact of year-on-year climatic variation.

2.3 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 is supplied by 26 groundwater sources which are linked by a highly integrated pipe network. Storage reservoirs are linked with large diameter mains, booster stations and remotely controlled valves to allow the transfer of water throughout our supply area. A map of the area of supply is shown in Figure 3 below.

Figure 3 Cambridge Water supply area and water resource zone

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

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

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

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

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

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

2.4 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 2019/20 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 where there is a deficit in the supply demand balance to be resolved.

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 6.

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.

2.5 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.

2.6 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 a number of inset appointments in our area of supply held by Anglian Water, and Integrated Networks Ltd for developments at Northstowe and Marleigh. We provide bulk supplies for these.

2.7 Anglian Water and Affinity Water

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

For example, we have discussed the optimal use of sources in other undertaker's area of supply, and close to borders, as well as licence trading in the catchments that we operate. We will continue to explore the feasibility of trading or exchanging source ownership to enhance our operational resilience and efficiency, many of these are explicitly evaluated through WRE and the options assessment for WRMPs.

2.8 Bulk supplies

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

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

2.9 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 to explore opportunities for water trading in terms of being a recipient of a trade. Where we have considered options for trading of resources or licences, these are included in our unconstrained options and if appropriate the feasible list of options, as described in in chapter 9.

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

To further assist third party trading 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, the bid assessment framework (BAF) that we have produced as part of our PR24 business plan submission provides useful information on how we assess proposals from third parties.

2.10 Retailers

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

While we did not receive responses from all the retailers we contacted, those that did respond suggested that 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.

We continue 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 and engagement work carried out in preparing this plan, and 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 2022 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.

2.11 Sensitivity analysis

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

- The sensitivity of the supply/demand balance to data uncertainty is accounted for within the assessment of headroom, which is described in section 7.
- The sensitivity of the proposed actions in the plan to assumptions or changes in the supply/demand balance is accounted for in our best value modelling approach described in section 9.

2.12 Adaptive Planning

For WRMP24, there is the need to look at adaptive planning.

An adaptive plan is a framework which allows you to consider multiple preferred programmes or options. The adaptive plan should set out how you will make decisions within this framework.

You can consider an adaptive plan if you have:

- Significant uncertainty, particularly in the first 5 years of your plan;
- A strategic decision in the plan's medium term, which has a long lead-in time;
- Large long-term uncertainty which might lead you to consider different preferred options.

We have considered the need for an adaptive plan and we describe this in more detail in section 10.

2.13 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 Director level 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 September 2022 meetings.

3. Our WRMP in the wider context

Overview

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 which is considered by the Environment Agency to present a risk of deterioration to the environment. Restricting our licences to address this risk will introduce an immediate deficit. There are significant challenges to meet the needs of the environment and growth in our area, which will drive large deficits in the supply demand balance We have addressed these in our plan with supply side options and an extensive demand management programme

Demand management

Government and regulators' policy is clear that water companies must be more ambitious with demand management. Customers echo this view. Ambitious demand management is at the core of our plans to meet the growth needs in our area and reduce the impact on the environment.

Our proposed programme includes:

- a 50% reduction in leakage by 2050, and triple the of the rate of leakage reduction in AMP8;
- Per capita consumption (PCC) of 110 litres per person by 2050
- Reductions in non-household consumption of 9% by 2037
- Rollout of universal SMART metering between 2025-2035

Supply side options

We have evaluated a comprehensive number of supply side options, and propose a number of significant investments to meet the deficits in supply due to environmental need. These include:

- Imports from Anglian Water
- Optimising our sustainable licences
- Re-use and storage from water recycling works
- A partnership with Anglian Water to develop Fens Reservoir, a regional winter storage reservoir

Drought resilience

Our proposals will assist with our resilience to more extreme drought events in the long-term. Once all of our planned options are in place and before 2040, we will be resilient to a 1 in 500 drought event.

Options

We have considered all available options to balance supply and demand, both those at a regional scale and those that can be provided by third parties.

Innovation & partnership working

We continue to explore new and innovative approaches to water resources planning, such as working with developers to re-use and recycle water and make new dwellings highly water efficient. We have invested in satellite technology for detecting leaks and continue to work collaboratively to identify multi-sector and cross-border solutions and catchment approaches to improve raw water quality. As a key member of Water resources East, we work with other companies and sectors to identify long term solutions, and are developing a strategic

resource option through RAPID[4] with Anglian Water. Working closely with local councils and other local stakeholders is also a key part of informing our plans.

3.1 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 1 Context for the WRMP

Statement or document	Owner	Key points of relevance for WRMP	Publication date
Water Industry Strategic Environmental Requirements (WISER) setting out statutory and on-statutory expectations for PR24	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.	May 2022
Final water resources planning guidelines specifying approach to WRMPs	Environment Agency	What to include in WRMPs and approach to take? Changes since the 2019 water resources management plan (WRMP19) include environmental destination, classification as water stressed area, increasing drought resilience to 1 in 500, and regional planning requirement.	February 2022
PR24 methodology	Ofwat	Specific water resources guidance: • Use of common reference scenarios to test plans • Adaptive planning should be applied if meets required criteria • 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); • Costs in the WRMP should be reflected directly in PR24 submission.	Draft July 20122
25 Year Environment Plan and Environment Act targets	Government	Both provide direction and targets relating to water resources and biodiversity. Specific target: • 9% non-household consumption reduction by 2037	2018 and 2021
Other plans and dependencies	Public Interest Commitments	**Water Industry:** commitments have been made across the industry relating to demand management. These are; 50% reduction in leakage levels from 17/18 baseline by 2050, and achieving 110 l/h/d PCC by 2050.	Ongoing

[4] RAPID is the Regulatory Alliance for the Progression of Infrastructure Development, and is made up of our main regulators to support the funding and development of large regional resource schemes

	WRE	**Water Resources East (WRE):** collaborative project looking at strategic regional multi-sector solutions for water resources in the long-term.	Ongoing
	Customers	**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.	Ongoing

3.2 Customer expectations

We have carried out extensive customer research as part of our preparations for the PR24 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 chapter 4 of this plan and the associated appendices. We have developed our WRMP to take account of customer views.

3.3 How we have incorporated these policies and programmes

3.3.1 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 50% reduction in leakage by 2049/50;
- a commitment to reduce PCC to 110l/p/d by the end of 2049/50;
- a reduction in non-household consumption by 9% by 2037;
- installation of universal smart metering by 2035.

We expect these reductions 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.

Smart metering underpins our ability deliver ambitious demand management savings. The information that frequent meter reads provides to us and our customers can help provide targeted support and actions. It will improve our ability to identify customer supply side leakage, as well as on our network, and we will then develop a programme to support customers with repairs. Metering also enables innovative options, such as the introduction of green tariffs, to encourage customers to reduce their usage. These are options we will continue to work with our regulators and customers on to further develop in AMP8.

We will be building on our AMP7 engagement with developers to incentivise them to build more water efficient homes and estates. We have seen strong take up of our scheme by Developers in AMP7 and we propose to continue to develop this scheme to ensure we can increase our reach in this area, and drive further reductions through support to schemes such as water neutrality and grey/rain water reuse systems.

3.3.2 Environmental protection

We have considered the impact of our operations on the environment, and discussed in detail abstraction reductions with the Environment Agency related to the Water Framework Directive, and no deterioration, as well as further environmental improvements to bring water bodies to good status. 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, and additional reductions for a future Environmental Destination to improve all water bodies. These are included over different timescales in the planning period, as we refine the certainty around the scale of reductions. The potential reductions to licences and abstractions are significant, and this has reduced our baseline DO. The need to replace this reduction is driving the need for resource options.

We have applied least cost economic balancing of Supply and Demand (EBSD) and Best Value (ValueStream) of options to review our whole portfolio of options 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 raw water transfers that present a risk and have assessed these in our AMP7 WINEP investigations. We have also assessed the risk associated with the spread of INNS for all new options within the plan and ensured that risks are fully mitigated when considering scheme details and costs.

3.3.3 Options

We have considered a wide range of options to balance supply and demand, including those that can be provided by third parties. Our unconstrained list and preferred options are detailed in the WRMP tables and in Appendices M and N.

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

3.3.4 Resilience and droughts

The national water resources planning framework reviewed the 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, 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 shows our supplies are resilient for a range of droughts across the 25-year planning period – including those more severe, or less frequent than our design droughts. We have revised our drought assessments since WRMP19 to make use of revised datasets, and gone beyond assessment of 1 in 200 droughts to 1 in 500 for increased future resilience.

3.3.5 Innovation

Our ambitious demand management plans are based on developing new and innovative approaches. Through AMP7 and 8, we are delivering our “smart network” programme which will provide more live data cross our network to enable more efficient and timely delivery of our leakage and water efficiency programmes, as well as our day to day service offering to customers.

3.3.6 Partnerships and collaboration

On a local scale we are actively engaging with the agricultural sector, working with farmers and landowners to educate and encourage appropriate use of chemicals in catchments that provide public water supplies. We started this work in 2015, focusing on priority catchments where we had identified the most potential benefit. We are rolling this out to more of our groundwater catchments over the next few years, and widening the remit to include Chalk Rivers and further measures in our PR24 WINEP for river restoration.

We continue to work with local groups to deliver on the ground water environment improvements as well as with catchment groups in the Cam Ely Ouse, and other water users and the environmental sector through water resources east. 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.

4. Customer engagement

Summary

To ensure our customers' and stakeholders' preferences sit at the heart of our plans, we have undertaken a robust engagement programme. This programme commenced in 2020 following the conclusion of the WRMP19 and PR19 business planning process.

Between WRMP14 and WMRP19 we delivered a cultural shift in our approach to engagement that was driven from our executive team's view that the customer voice should drive all the key decisions we make, now and in the future. Our engagement at WRMP24 goes further to allow us to gain a more robust set of preferences from a wider number of customers and other key stakeholders, than at WRMP19. We have also used new techniques to engage with customers to ensure we have detailed evidence to support our plans given the importance of the plan, with a marked shift towards on-going deliberative conversations over an extended period. This shift in approach has proved valuable and timely, particularly given the impacts caused by the COVID pandemic when conducting research. A comparison of the step change undertaken from WRMP14 to WRMP24 is detailed below.

Given the wide number of strategic water resource challenges the East of England region faces, we have also pro-actively engaged with other water companies to undertake a range of collaborative research studies to share resources, research costs and expertise and to ensure a consistent approach to the research. This engagement has complemented, without duplicating, our local engagement to deliver the most comprehensive programme we have ever undertaken to support our WRMP.

Our plans are based on a wide range of engagement activities that we have carried out in preparation to support our business plan submission. Below we have provided a summary of our engagement journey that has helped to significantly improve our understanding of our customer and stakeholder preferences. This is broken down into 3 key stages. Appendix B1 contains supporting material for each of these stages.

4.1 Laying the foundations and designing the engagement programme

During 2020 and into 2021, we ran a series of online activities on our H2Online Community to engage our 300+ members in discussing WRMP priority areas. The aim was to draw out key preferences and uncover themes to help shape our WRMP24 customer engagement programme. Although the Community feedback is mainly from a set of more engaged, informed group of household customers who are not fully representative of the wider customer base, our Community also has a group of less engaged and informed members who also take part less frequently in activities over time. As such, the feedback provides a robust cross-section of views across key demographics, including metering status, which is valuable for helping to inform wider research programmes and to understand the reasons behind customers' preferences. The activities covered a wider range of topics, including:

- leakage performance expectations
- metering preferences and reactions to trials to increase meter up-take
- views on messaging approaches and initiatives to encourage water saving behaviours given the impacts of COVID pandemic and more recently increases in the cost of living (including taking part in water dairy videos)
- reactions to support mechanisms to protect financially and PSR vulnerable customers in the context of changes to policies, such as universal metering
- Preferences for water recycling options and views on regional water resources planning approach.

The insights gained from these activities during 2020 were then taken into a comprehensive, independent desk research review undertaken by one of our preferred supply chain partnerships, Accent and PJM Economics. This review was conducted between November 2020 and February 2021, following several workshops to scope a brief for the review. The core objective for the WRMP24 customer research programme is to be able to demonstrably and transparently obtain and utilise customer insight to produce a WRMP that genuinely reflects customer and wider stakeholder preferences. Given this, the main objective of this study was to conduct a detailed review of customer engagement in the water industry in the context of water resources management planning, and the latest guidance, expectations, and regional method statements, with the aim of drawing out recommendations for SSC's WRMP24 customer engagement programme. The review materials were grouped thematically as follows:

- Our own customer engagement research (past and on-going)
- Research conducted by other UK water companies for WRMP19. The review focused on those companies that received for their research a rating of A or B by Ofwat
- Reviews of wider industry PR19 customer engagement by Ofwat and CCWater
- Key industry publications pertinent to PR24/WRMP24 requirements. These included publications by CCWater, the EA, UKWIR and Ofwat, including the Water Resources Planning Guidance.
- Relevant available publications on engagement strategies used by Water Resources West (WRW), Water Resources East (WRE) and Water Resources South East (WRSE) to engage with customers and stakeholders around resilience, environment, demand-side levers and supply-side solutions.

The outputs of the desk review report recommended that we implement a customer research programme organised around four main themes, corresponding to key customer input points during the WRMP development. These are illustrated in the figure below. See Appendix B2 for the full report.

Figure 4 Customer research reported themes

In addition to the four themes of the programme, we have also commissioned Impact Research to undertake a thematic review of all the insights to provide a robust evidence base to support our key policy decisions. See Appendix B3.

4.2 Implementing the engagement programme

To ensure consistency when implementing the WRMP24 engagement programme, we have also considered our wider PR24 approach. From our review of WRMP19/PR19 of the desk research we developed a series of high-level principles to guide our WRMP24 engagement programme. These principles have been applied consistently throughout our engagement programme to ensure we achieved robust, high-quality research outputs which can be used to support the decisions made in our WRMP24.

- Targeted and meaningful
- Robust but proportions
- Inclusive
- Adaptive/flexible
- Customer friendly
- Transparent
- Collaborative
- Ethical.

Central to the design of our programme was recognition that there is value in applying both qualitative and quantitative methodologies to exploring customer views in key areas. Qualitative research gives depth to the understanding of preferences and motivations behind these and enables richer discussions of topics, while quantitative research can help extract insights based on representative, but less informed samples. To maximise the value of the programme, we elected, where appropriate, to use the same key questions in both the qualitative and the quantitative research. This has allowed us to review the findings from both methods used to be interpreted jointly rather than separately. We explain the qualitative and quantitative in more detail below.

4.2.1 Qualitative customer engagement

The core of our local customer engagement programme is our WRAP Forum. This was carefully recruited in July 2021 to ensure it represented as many consumer voices as possible on an online Forum. At its heart, the WRAP is a group of household and business customers (and future customers) who are convened (multiple times) to feed into an organisation's thinking on their priorities, business plans, service or policy developments or strategic direction. This allows for a continuous, ongoing two-way dialogue with gradually more informed customers. This engenders trust on both sides and allows consumers to input into complex issues and ongoing debates within organisations.

This approach has given us a clear steer on consumers' views and priorities as well as offering a compelling narrative about the journey that participants went on throughout the WRAP process, both individually and collectively. It also allowed us to check back in with the Forum through the programme to ask them follow up questions and also share with them what other members of the Forum had said so that preferences could be further discussed.

When evaluating the insights from the Forum we have taken into account that those who participated in the Forum 'opted in' to the process, so it could be that those who did are different in some way than other customers / citizens. We have also considered that they become progressively more informed about the challenges we face and the detail of the demand and supply options available. This is a key reason why alongside the Forum we have run large scale, representative quantitative studies so that we can compare differences in responses and the potential reasons for these.

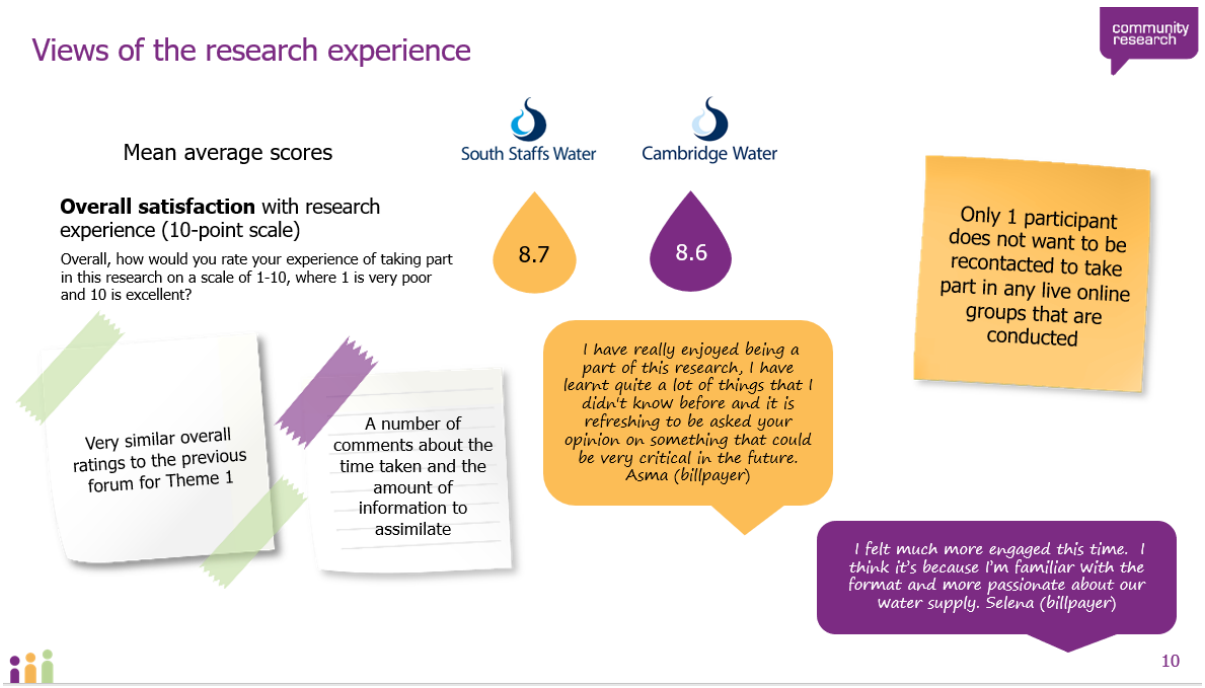
The engagement points in the WRAP Forum are detailed in Table 2 with references to supporting appendices, which detail all the insights gained. The project methodology statements are also provided as evidence of the approach taken.

Table 2 Engagement points with our WRAP Forum

WRAP Forum engagement	Supporting evidence
Theme 1: strategic choices, facilitated 2 week online Forum, July 2021	Appendix B4 (final report) Appendix B5 (methodology statement)
Theme 3: deep dives, facilitated 1 week online Forum, October 2021	Appendix B6 (final report)
Theme 3: deep dives follow ups, facilitated Zoom discussion group, February 2022	Appendix B7 (final report)
Theme 4: acceptability / affordability testing	We are planning to engage with our Forum again to discuss their thoughts on our final WRMP24 in 2023.

By taking a broadly representative group of consumers along a deliberative engagement path over an extended period, it increases their understanding and allows them to have a voice within our business. Views from the WRAP Forum members who took part in the engagement activity in October 2021 is shown below and highlights the positive feedback received in the end of Forum survey undertaken on their experiences of taking part.

Figure 5 Customer research reported themes



Source: Community Research Deep Dives final report, October 2021

In addition to the WRAP Forum, we have also engaged extensively with our H2Online Community members since 2020 to help shape our plan. Our Community is independently managed by Explain Research and all members are household bill payers. We will engage our Community again to show them our WRMP24 final plan in 2023 to close the loop through our "You Said, We Did" feedback approach, which will also explain the reasons for any changes made between draft and final plans that will impact them as customers.

4.2.1 Quantitative customer engagement

Our quantitative studies were carefully designed to follow the first two WRAP Forums and Accent, with input from Community Research, designed the stimulus materials for the studies and delivered the fieldwork and reporting. This enabled us to develop materials that would work in a 20 minute online survey which, where appropriate and feasible, would allow us to inform customers and ask them the same questions to compare the insights to those gained from the WRAP.

The two quantitative studies are detailed in Table 3 with references to supporting appendices, which detail all the insights gained and the methodology statement, which covers both studies.

Both studies achieved a robust sample across demographics which was then weighted to the 2011 Census data. Additional care was taken to conduct on-street-interviews and/or depth interviews with digitally disadvantaged and other customer segments who would not engage with the online survey. In both studies, 40% of customers were identified as being in a vulnerable situation which is consistent with other quantitative studies that we have run over the last two years. This provides evidence that we captured the preferences of customers who are more likely to be impacted by the decisions in our WRMP24, particularly those who are struggling to pay their water bills and/or those who have a medical condition that means they have a reliance on a reliable and safe water supply. As in all our major quantitative studies a sample of future customers (non-bill payers, aged 18-25) was also included.

Table 3 Engagement points with our WRAP Forum

WRAP Forum engagement – run by Accent	Supporting evidence
Theme 1 and 3: strategic choices and deep dives Quantitative online and face-to-face survey, Feb-Mar 2022.	Appendix B9 (final report)
Theme 2: wights and metrics Quantitative online and face-to-face survey, Dec 2021 to Mar 2022	Appendix B10 (final report)
Methodology statement – covering both studies	Appendix B11

There are two main quantitative studies that will be completed to inform our final WRMP24 submission in 2023. These involve:

- Working with our partners Turquoise to run a representative quantitative study in early 2023 to robustly acceptability and affordability test the final WRMP24 investments and associated bill impacts
- Delivering our PR24 Willingness to Pay Study is due to complete in November 2022 and will provide us with normalised WTP figures (per year) among our Cambridge Water customers (HH and NHH). Within this study there are service attributes directly applicable to WRMP investment decision making, including:
    - TUBS/NEUBs service levels
    - Leakage levels
    - Environmental protection – area of land managed
    - Number of properties with AMR meters.

4.2.2 Thematic reviews of insights

Impact's PR24 Thematic analysis report summarises the combined insights from a review of almost 40 pieces of evidence including research reports, literature reviews and white papers from local engagement programme and collaborative studies, other water companies and relevant third parties. See Appendix B3.

We have committed to the over-arching recommendations of the triangulation framework put forward by SIA/CCWater's extensive review of water companies' PR19 triangulation approaches and we have worked closely with Impact to develop a best practice approach we strongly believe is suitable for a thematic analysis to support our plan development. The analysis and report are structured under the following headings shown in Table 4.

Table 4 WRMP24 thematic review areas

WRMP24 key areas – thematic reviews	Specific areas of focus
Best Value Planning and investment priorities	
Environmental destination	
Service level and resilience to drought	
Balancing demand and supply side options	
Demand side options	• Leakage • Water recycling • Behaviour change and PCC • Metering – including smart technology • Supporting low-income and priority households
Source preferences, reservoirs and water transfers	Including associated water quality impacts
Acceptability and affordability of WRMP24 plan	

Alongside the Thematic report, an Excel Spreadsheet serves as the key data collation tool. The tool has one sheet per topic area and common columns to each, comprised of critical information about the data source including date of data collection, contextual environment, sample size, objectives of study, applicable region and method of data collection. See Appendix B12.

We are using the report to inform and guide the development of our final WRMP24 plans. The report will be updated in 2023 in light of further evidence from our customer engagement programme, including final plan acceptability and affordability testing, business as usual engagement, PR24 willingness to pay study, and feedback from wider stakeholders such as Ofwat over the next year.

Table 5 highlights how we have drawn on the expertise of our research supply chain to deliver our engagement programme.

Table 5 SSC's preferred supply chain partners

Workstream	Supply chain partner
WRAP Forum - qualitative research	Community Research
Theme 2 quantitative study	Accent (research elements) in partnership with PJM Economics (economic modelling)
Themes 1 and 3 quantitative study	Accent
Theme 4 – acceptability / affordability, quantitative testing	Turquoise – to deliver this element ahead of final plan submission

Theme 4 – acceptability / affordability, qualitative testing on H2Online Community	Explain Research
Thematic reviews – triangulation	Impact Research

4.3 Assuring the engagement programme

We have taken robust steps to ensure our customers, stakeholders and regulators can have confidence that our engagement is high-quality and so can be relied upon when making policy and investment decisions in our WRMP24. The steps we have taken are outlined in Table 6.

Table 6 SSC's preferred supply chain partners

Assurance review	Evidence
We have engaged with our customer panel, which formed a champions group of experts in 2021 to challenge and input into all stages of our WRMP24 engagement programme. This covered activities such as reviewing discussion guides, questionnaires, attending presentation de-briefs and commenting on research reports. A log detailing all the specific challenges raised and our response to these was kept and we have provided this as evidence of the level of challenge undertaken by our panel on behalf of our customers. A statement from the Chair of the WRMP24 champions group is found below.	Appendix B13
We have commissioned the consultancy Jacobs to undertake a review of the outputs of our engagement programme. The objective was to provide assurance in how we have demonstrated the evidence from stakeholder and customer engagement in its WRMP24 in the Cambridge Water supply region. This includes any justifications of why we may have chosen not to use customer or stakeholder engagement feedback in the WRMP24. Jacobs's independent report is provided as evidence of this assurance and that we have accurately reflected our customer and stakeholder preferences in our draft plan. We have taken on board their recommendations in our draft plan.	Appendix B14
We have engaged our executive team and our board with the insights from our engagement programme.	Board Assurance Statement

4.3.1 Customer Panel Statement

The statement for customer assurance can be found in Appendix B16.

4.4 Overview of customer and stakeholder engagement findings

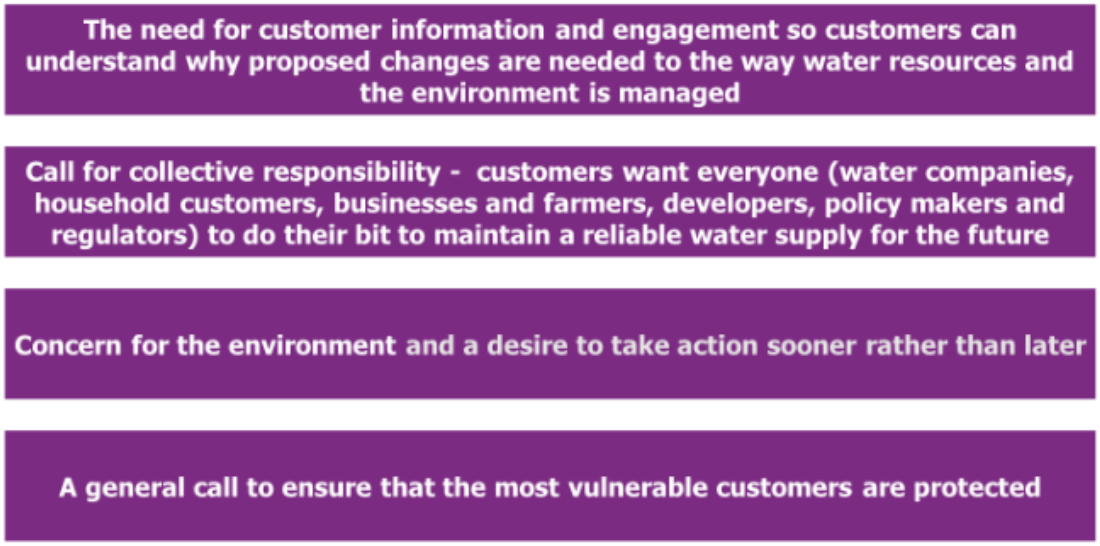
Our engagement programme has identified four 'golden threads' that are driving our customers' and stakeholders' preferences. Whilst customer segments and stakeholders may attach different levels of importance to these four threads in their individual responses, these are commonly observed across all customer household and business demographics and stakeholder representatives.

The threads were first uncovered from the Theme 1 strategic decisions WRAP Forum (July 2021) through the detailed comments that the participants left as they engaged with activities over the 2-week Forum. However, it is important to note that:

- The calls for collective responsibility and fairness in decision making and the need for customer engagement to inform people of why decisions have been made, what they need to and what support is available to help them play their part have remained consistent throughout the last 15 months, no matter what the external context.
- Protection for the vulnerable has remained an important thread that customers and stakeholders expect us to deliver on, but since 2022 increasing numbers of customers have started to turn their gaze more towards the impacts that the cost of living increases are having on their own household's financial situation.
- The qualitative evidence suggests that "concern for the environment" started to move for a notable number of customers from being an urgent short-term priority to address quickly in 2021, towards a longer-term priority to deliver on in 2022. This was driven by the rises in the cost of living increases impacting on a proportion of peoples' preferences and their willingness to support the company to go further and faster to protect the water environment in the short-term.

These 'golden threads' have underpinned the policy and investment decisions that we have made in our WRMP24. These threads are outlined in the diagram below.

Figure 6 Key customer engagement points



Our engagement since February 2022 has highlighted that the "increases in the cost of living" is now becoming an established 'golden thread' that must be considered further in our final plan and through the results of our on-going acceptability and affordability research studies of how our plan is being received by customers. We will also use our H2Online Communities and the Customer Priorities Tracker, detailed in Impact's Thematic Analysis, to monitor the impact of the increases in the cost of living on customers' preferences and priorities.

Impact's WRMP24 Thematic analysis report provides a detailed review of all the relevant insights we have drawn on (see Appendix B3). We have summarised the key points in the table below and our responses in our plan to these.

Table 7 Customer and stakeholder priorities and our subsequent plans

WRMP theme	What customers and other stakeholders told us	Our plans to meet expectations
Investment priorities	The top priorities have remained consistent across WRMP and broader customer priorities research studies since those identified for WRMP19: • high-quality and reliable water supply • fair, accurate and affordable bills • reducing leakage on pipes • protecting natural environment – habitats, water sources • great customer service • helping those customers who may need extra support – both through financial and other targeted support Future top priorities that customers expect us to deliver, include: • giving consumers more control of their water usage (e.g. smart metering) and providing education on how to use water responsibly, particularly true for younger generations (16-25) • planning for population growth and managing the impact of climate change • ensuring affordability of bills vs ensuring long-term resilience of assets to meet future demand • meeting the challenge of rising energy costs by lowering our carbon footprint; and • investing in innovation to drive improvements in operational and customer services offered. Our qualitative research with our WRAP Forum in July 2021 found that customers are generally happy to pay for investments that will benefit future generations. They recognised that they already benefit from contributions paid for by previous generations for the benefit of all. Making sure the environment is fit for future generations is the responsible thing to do, not least because current customers have contributed to the problems. In our 2022 quantitative studies, customers overall had an even balance between keeping bills as low as possible for customers and making investments in long-term infrastructure and looking after the water environment. When tested qualitatively, the majority of customers continue to express a preference to have a smooth increase in their water bills over time, rather than being front or back loaded so that it can vary over time.	We believe our plan delivers on these core priorities and provides the best balance between investments to protect water supplies and the environment and ensure water bills are affordable for customers We will test the acceptability and affordability of our final plan robustly in 2023 to validate our plans with customers and take appropriate action to protect those customer segments who do not find their bills affordable.
Best value planning	Across all our engagement, the top three priorities for best value planning identified are; affordable water bills over the long term, making 'the most from what we have' (reducing leakage, encouraging customers to use less) and a plan that is adaptable in case of new/emerging conditions'.	Our plan offers a demand side set of options which aligns to customers preferences and help keep bills affordable in the context of the challenges we face. We are making use of adaptive planning to meet future challenges.

	Options selected should meet, at minimum, three criteria to be considered "best value"; financially viable, low carbon; and effective in the long term. Options that appear short term stop gaps and/or poor environmentally, were largely rejected (including use of drought permits and water transfers).	

Environmental Destination	• As seen in the drivers of best value, environmental concerns are high on the agenda for most customers, having come to the forefront since engagement conducted for PR19 and WRMP19, usually featuring within the top five priorities for customers. Yet, despite being a priority, many customers were not willing to pay much towards achieving environmental goals through their water bill and therefore, since 2020 when the pandemic initiated a rise in the cost-of-living, environmental concerns have slipped down the priority list for some, particularly during 2022, replaced by areas that serve personal interests more and protect the financial impacts on them as customers.
	• In our themes 1 and 3 quantitative study, 53% of customers wanted us to achieve the middle level of environmental destination level 2 (BAU+) compared with 29% wanting us to achieve the top level of destination. Customers who supported level 2 thought it was the best balance between protecting the environment and the cost to deliver. Only 19% wanted us to achieve level 1.
	• Amongst our more informed WRAP Forum, there was widespread concern when customers were informed about the current and future risks to the chalk streams and aquifers across the region when led to calls for greater environmental protection and restoration, with 18 out of 25 opting for us achieving level 3. It makes sense to customers that water companies should protect the water environment, in order to ensure water supply and to protect nature. The customers provided some useful advice to help validate our plans:
	  ○ Work with others to protect the water environment – water companies are just one of the many stakeholders with a role to play.
	  ○ When setting targets and timetables, weigh up what is practical (in terms of cost, timetable, disruption etc.) against what is ideal for the environment
	  ○ If opting for ambitious targets, ensure the cost is acceptable to customers, and involvement of stakeholders is not onerous/overly time-consuming.
	  ○ When communicating with customers about the water environmental problems, recognise that awareness and concern varies.
	• There were mixed views over speed of implementation. In our themes 1 and 3 quantitative study, 42% of customers said that 2050 was the right timescale to deliver their preferred level of environmental destination, but 38% said this was too late. Environmental stakeholders want us to deliver the highest level of environmental protection as quickly as possible. Our more informed WRAP members mainly wanted to see their preferred ambition delivered between 10-20 years. Faster than 10 years was seen as unachievable given what would be required.
	• In our 2021/22 brand tracking study 31% of customers agree that we are "a company that does a good job at protecting the environment
		We propose to implement "environmental destination scenario BAU+" by 2050
		
		We will work closely with the Environment Agency to understand the impact of our abstractions on key water courses and water bodies and have committed to investigations in AMP8 to understand the exact needs of catchments.

	in the areas we abstract water from". With over 1 in 3 customers not able to answer the question, this highlights how important education campaigns are to raise awareness of our plans to protect and restore the water environment and what the challenges are that these plans seek to address. • In our Theme 2 quantitative study, abstracting more water from underground aquifers was the least supported of any demand or supply side option tested, attracting only 2 points on a 0-100 priority preference scale.	
Service level and resilience to drought	**Severe drought restrictions** • Customers and wider stakeholders remain universally opposed to severe drought restrictions (stand pipes/rota cuts) being implemented. • In our Themes 1 and 3 quantitative study, 54% of our customers support the proposed move from 1:200 to 1:500 risk of drought restrictions being used, with 32% neither supporting nor opposing it. • Highest selected option (by 41% of customers) was to achieve the 1:500 resilience target by 2040. 30% wanted us to achieve the target sooner. **Service levels (TUBs/NEUBs)** • TUBs/NEUBs are not popular as a way of managing water resources when compared to other demand and supply options. In our Theme 2 quantitative study, they attracted only 2 points on a 0-100 priority preference scale when customers were asked to rank their preferences. • However, in terms of TUBs and NEUBs; multiple studies show customers would be willing to accept lower service levels than they experience at present. Business customers seemed more mixed in their views than household customers, partly because they see their usage as "essential" where others might define it as non-essential. • In our Themes 1 and 3 quantitative study, after reading about the challenges we face in meeting future demand and protecting the water environment, 57% of HH and 55% of NHH customers would support us bringing in temporary restrictions every time there is a long period of dry weather. Only 1% of customers wanted the current service levels to be improved. • There was also strong support (54%) for bringing in higher charges for high levels of non-essential use during periods of drought to help reduce demand. • The main caveat to these insights is that as so few customers have actually experienced a TUB/NUEB that their preferences when asked may not truly reflect their reaction if a ban we to be imposed on them (as evidenced by critical comments on social media over the summer of 2022 when customers in some areas of the country were subjected to a TUB, particularly in the context of the ongoing negative perceptions over leakage performance). • Qualitative support in a wider regional research study for harmonising levels of service across regional water resource areas – seen as the fairest way to manage the situation for all.	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.

Balancing demand and supply side options	• Across all qualitative and quantitative engagement customers from all demographics have and continue to consistently prefer demand side options, rather than increasing supply side options. This is because customers say they are:
	  • Cost effective
	  • Common sense
	  • Environmentally sound
	• In particular, leakage gained the highest level of support of any demand or supply side option, attracting 40 points out of a 0-100 priority preference scale when customers were asked to rank 9 options in our Theme 2 quantitative study. Given the next highest option, "introducing universal water metering", only attracted 12 points and the highest supply side option "building a new regional storage reservoir", attracted only 11 points, this clearly highlights the significant preference for a leakage led plan.
	• However, in our WRAP Forum, as customers become more informed about the challenges we face and the options available and what they can deliver to address future water demand and supply balance, calls grow for a well-balanced use of demand management and supply strategies. There was a recognition that that demand side options might not be sufficient, on their own, to allow for the needs of an increasing population and that there is a limit to how far these can solve the problem.
	• Of supply side options, increased water abstraction from underground aquifers was the least popular, and at times unacceptable to some customers.
	• Whilst the principle of sharing a vital resource between regions was well supported, water transfers were mainly viewed by less informed customers as a short-term gap stop solution only, as most do not want to become over reliant on transfers and some strongly disliked the negative environmental aspects these solutions can bring - such as increased carbon emissions and the transfer of invasive species.
	• In our WRAP Forum focus group in February 2022, a summary of possible water transfer options was sent to participants in advance of the session. This outlined options and gave some information on cost, control of environmental impact and resilience. At the discussion group the most popular of the four options presented was the shared new surface water reservoir and treatment works with a pipeline transfer into the Cambridge Water supply region. It was viewed as providing sufficient security and control for the company, whilst being lower cost than some of the other options.
	• If water transfers are to be used, customer cconcerns relating to the environment, quality of water and cost will need to be clearly addressed and the context for transfers clearly explained for them to be acceptable.
	• **The overall message is clear that, to be acceptable, our plan must make the best possible use of current water resources before investing in any large scale supply side options.**
		We are committed to a demand led set of options, supported with medium and long-term supply side investments to meet the forecast Supply Balance Deficit.
		
		We will develop an engagement plan to communicate the key demand and supply side options that are needed, drawing on the insights to help ensure customer concerns are addressed. We will do this through our public consultation upon publication of the draft plan.

Demand options - leakage	• Reducing our leakage levels further emerges as a clear and consistent priority among most customers. • Among a less informed, representative sample of customers in our themes 1 and 3 quantitative study 47% want to see leakage reduced to as close as zero as possible.	We are committed to delivering the 2050 national leakage target.

	• As customers become more informed around the challenges associated with reducing the volume of water lost, 79% support the national target for reducing leakage – just 3% oppose.
	• Customers who are more engaged with protecting the
	• environment are significantly more likely to have a higher level of support for the national target for reducing leakage. Key reasons for supporting the national target are:
	  • Wasting water doesn't make sense – 'we'll leave more water for future (if leaks are fixed)'
	  • Educate customers to be more aware of water usage/ shortages
	  • The right thing to do
	  • Impossible to reduce leakages to 0%.
	• Customers also flagged in discussions that they want to see interim targets set in the context of the 2050 national target, to hold the company to account on progress.
	• Leakage also remains an emotive issue for customers, and some feel that levels must be reduced if people are to be motivated to play their part with water conservation.
	• However, despite this strong sentiment from customers, a notable proportion are reluctant to pay for this on bills and expect this to be funded by us in other ways. This situation has been exacerbated by financial hardship since Covid-19.
	• In addition, leaks on customer properties are unlikely to be effectively addressed without an education programme to inform customers of the scale of this problem, how to detect leaks and how to reduce them.
		We will continue to explore the benefits of new technologies and approaches to identify if further leakage reductions can be gained.

Demand options – universal metering	• On balance, the majority of customers continue to support the principle that metering is the fairest approach to charging, although this is backed more strongly by customers who already have meters installed, and future customers. • Universal metering gained majority support among a less informed, representative sample of customers in our Themes 1 and 3 quantitative study. 59% supported the policy when uniformed about the benefits, with this rising to 66% once informed. Levels of support were significantly higher among metered customers (76%) vs unmetered (41%). • However, it is important to note that among unmetered customers 22% had a neutral view, with 22% against. The most commonly cited reasons for being against the policy was the fairness of taking away the choice of being or an unmetered charge and the fact that water is a basic human right and if it becomes too expensive it might impact on peoples' health as they have to cut back on usage. This highlights potential through engagement to shift views, particularly those who are neutral, to being supportive of universal metering. • In addition, universal metering attracted 12 points out of a 0-100 priority preference scale when customers were asked to rank the options in our Theme 2 quantitative survey, the second highest of any option, behind leakage. It was also the highest ranked option on our WRAP Forum, with 17 of 25 selecting it in their top 3 options. • Household customers in deliberative discussions on our H2Online Community often call strongly for universal metering, as do those representing environmental stakeholders. • Support from customers for universal metering is driven by 5 key reasons: • Greater equitability	Given the challenges we face we are committed to delivering universal smart metering by 2035. We will work with customers, stakeholders and other interested parties to put in place a communications plan and targeted support to customers who are struggling to pay their bills or who would be adversely impacted from having a meter due to a medical condition.

	• Control and awareness • Incentive to reduce consumption • Protecting the environment • Potential to save money • However, customers and stakeholders have some concerns about how to move unmeasured customers to universal metering, including concerns for vulnerable customers who might struggle to afford their charges and/or have a medical condition that means higher water usage is needed. • In our WRAP Forum in the summer 2021 the majority of customers wanted us to target areas of higher consumption first if rolling out universal metering. In our quantitative testing in 2022, minimising the cost of rolling out universal metering was the preferred option given by 39% of customers, with 32% wanting to target areas to reduce the demand for water the quickest – the drive towards lowest cost is linked to the rise in the cost of living • 62% of customers in our Themes 1 and 3 quantitative survey said that they would pay at least £2.50 or more a year more to have smart metering rolled out by 2050. 27% said they would pay £4 more a year to deliver it by 2035. However, 1 in 3 customers in our quantitative study had no appetite to pay more to roll our universal metering any faster. In our WRAP deep dive Forum in October 2021, 19 of 20 said they would pay an extra £2.50 a year to have universal metering completed by 2050, with 14 of 20 saying they would pay an extra £4.00 a year to have this completed by 2035. • Metering is strongly believed to encourage behaviour change and is considered the fairest way of paying for water, so getting all customers on a new meter is therefore seen as more of a priority than updating older meters. However, when engaged in detail on the topic many of the WRAP Forum mainly supported a combined approach of fitting new meters for unmeasured customers and retrofit of older meters should happen at the same time from a fairness perspective. • Across all our wider research there is a consistent preference expressed by household customers for receiving water meter readings monthly or quarterly. There was also broad agreement across all our deliberative research that the current meter read frequency of twice a year is not fit for purpose for accurate billing and engaging consumers with water conservation. • However, in our Themes 1 and 3 quantitative study, 53% of customers said they were not prepared to pay more to have a more regular frequency of meter reads, a response significantly more likely to be given by those from lower social economic backgrounds. 30% said they would pay £2.50 a year more to have a monthly/bi-monthly meter read. • With regards to preferences for smart meter technology if rolling out universal metering, once educated, a small and informed group of customers from our WRAP Forum had a preference for AMI over AMR metering technology and some willingness to pay for the programme, due to a perceived small price difference between the two technologies and that it made sense to future proof the investment. • However, there were concerns raised over the use of AMI technology, such as how data security would be handled and how reliable the technology is to work in all locations.	

Demand options – water efficiency and behaviour change	• A wide range of research studies, including our local engagement, continues to indicate that a gap remains for many customers between considering the impact on the water environment when they turn on the taps. Many customers are not aware of rainfall levels, the true scale of population growth and the low proportion of water habitats which are rated as in good health. A proportion are also unaware that they live in a water stressed area. All these remain barriers to engagement with water conservation behaviours.
	• However, there has also been a significant drop in the number of customers in CCWater's Water Matters survey agreeing that they are "confident in the long-term supply of water" in their region – 62% in 201/22 down from 82% in 2017/18. This highlights the growing concern among the population around long-term resilience of supply.
	• All our deliberative engagement has shown that many customers go onto express real concerns about the potential shortfall in water supply and all agreed in our WRAP Forum that water companies must play a central to play in the solutions, but that we can't solve it all on our own and will require Government, consumers and other stakeholders to play their part.
	• On our WRAP Forum the national target for reducing customer demand for water (PCC) was largely acceptable to customers, although the stretch targets to 80 l/h/d seemed too difficult to achieve at this point. However, environmental stakeholders would prefer to see a stretched level of ambition achieved as quickly as possible to help protect the water environment.
	• The 110 l/h/d target is achievable as long as:
	  • Customers are educated and incentivised to change behaviours
	  • There is investment in changing infrastructure (water recycling, water efficient appliances) and developers are encouraged to build houses which help consumers use less water.
	  • Businesses are also set targets to reduce consumption.
	  • The impacts of the pandemic in terms of increasing PCC are not long term.
	• Many of our WRAP Forum say that the aspiration should be for the PCC target to be 'the sooner the better' – there is a need for action; 30 years is too long to wait we should be ambitious. However, some are more cautious and mentioned that behaviours can be slow to change.
	• There is appetite from stakeholders in the building sector and wider sectors (e.g. environmental) and customers for building in water recycling into new builds. Customers remain keen to have education on water efficiency strategies, whether via schools, directly to their homes or information on water saving strategies for large businesses.
	• Behaviour change is an area that overlaps with other demand and supply side options, but in general customers say they need to have a full understanding or any particular issue before any change is likely e.g. the amount of leakage that takes place on customer properties, or the benefits of smart metering versus the costs of installation. For the most part, customers agree they could save more water than they do at present (but need motivation to do so and barriers removed). Education and advice were the fourth most popular option when customers were asked to rank 9 options in our Theme 2 quantitative survey, attracting 10 points on a 0-100 priority preference scale.
	• All our NHH local engagement, including the NHH club project undertaken in 2022 indicates that the biggest barriers to the market engaging in water efficiency are:
		We are committing to the national target of reducing PCC to 110 l/h/d by 2050.
		We will continue to encourage developers to build water efficient home through incentives. Policy approach will be agreed in our PR24 plan.
		We forecast that the Government Water labelling scheme from 2025 will deliver water savings through purchase of efficient white goods and other appliances.
		In the non-household market we are committing to universal smart metering - this programme will replace our existing meter stock with Enhanced Meter Technology (EMT) that will provide intelligent consumption information for use by businesses and Retailers to drive water efficiency savings.
		We are committed to delivering the proposed National Environment Act target of 9% reduction in consumption by 2037.
		We will continue to engage with customers about new ways of charring fore water as we develop options to trial.

	• The lack of accurate and accessible meter data • A lack of skills and knowledge to understand how to be more water efficient • The lack of return on investment of becoming more water efficient and/or when they should become more water efficient • There was also an overall lack of knowledge around water scarcity and the fact that at this time water restrictions are not seen as a business threat. • There were no obvious incentives to drive them to save water and no consequences in place for not becoming more water efficient. • NHH customer engagement has also shown that: • In-person audits and carefully designed leakage allowance policies can engage them effectively in water efficiency • Larger water users also fed back that more partnership working between energy and water around data and developing solutions to help the NHH customer meet sustainability targets is key and they expressed a greater interest in being engaged with water recycling initiatives through targeted support from wholesalers to help them with business cases and case studies. • Our H2Online community members have been vocal in telling us that we need a multi-channel approach to educating customers to encourage water conservation – from TV, radio, digital, print and face-to-face engagement. • Water recycling is a popular option across a number of our engagement studies, with both household and non-household customers, however the reality of installing a retrofit system provides challenges which would require education up front on the benefits and likely costs, potential subsidies to help customers accommodate the costs of retrofitting a system and information on how to maintain it. These would all need to be in place before large scale adoption is likely to take place. • From the start of our WRAP Forum there were spontaneous calls from some for water companies to bring in new tariffs to encourage water saving behaviours, particularly for use in periods of drought. Our early engagement around new tariff options suggests that tariffs which benefit the individual household are preferred over community based ones. We will continue to engage customers on this area to develop our plans.	
Supporting low-income and priority households	• We have engaged extensively with our customers on how to manage the transition for customers from unmeasured to measured charges. There was no overall majority on the best way to approach this, but there was common agreement that is it fairest to give customers at least a year after their meter is fitted, to allow the opportunity to change their behaviours, before being switched to measured charges. • The use of guaranteed price caps during a transition period was also popular among some on our WRAP Forum and H2Online Community members to help protect against bill shock. • There was universal agreement that we must provide clear communication and a range of measures to help ensure customers are not adversely impacted by any of our investment and policy decisions, particularly those who are already struggling with paying	We are continuing to engage with customers and other parties to review options for supporting customers during the introduction of universal metering We are also reviewing options with our customers and stakeholders for the use of “ghost metering” as part of our universal metering to allow customers a two year period to get ready for being on metered charges

	their bills, or who have a medical condition that requires higher levels of water use. • Offering a price guarantee that ensures that medically vulnerable customers would not pay more than their current annual fixed rateable value charges was also seen as important for us to consider in our plan. • It was also important to customers that any new tariffs developed in the future which are linked to water consumption do not adversely impact on vulnerable customers groups. Fairness was a key consideration throughout the engagement.	following installing a meter at their property.

Source preferences, reservoirs and water transfers	• When asked to rank a range of demand and supply side options in our Theme 2 quantitative survey, building a new surface water reservoir was ranked second of the 9, attracting 15 points on the 0-100 preference scale and therefore was seen as a higher priority option to help meet the future supply and demand balance.
	• Looking wider, we have undertaken extensive and wide-ranging research studies into customers' preferences for supply and demand options for water resource planning. These qualitative and quantitative research studies, undertaken at both a local and regional level, highlight that reservoirs are the preferred supply side option of the options tested. This view on why reservoirs are preferred as a supply side option is predominately driven by:
	  • Feeling they are a familiar, tried and tested option
	  • Ability to hold large volumes of water in an efficient way to meet future demand challenges
	  • Being seen as environmentally friendly, including helping reduce the amount taken from rivers, streams and underground aquifers
	  • They can help reduce flood risks if planned correctly
	  • Delivering an attractive community asset.
	• Water transfers received less support compared to reservoirs. When asked to rank a range of demand and supply side options in our Theme 2 quantitative survey, they were the second highest ranked supply option (6 of 9) attracting 15 points on the 0-100 preference scale.
	• Transfers are viewed by uninformed customers mainly as a short-term solution, only to be used if needed to meet future demand. Customers are often concerned about how reliant we could become on other water companies and some think water transfers should be a last resort, as this could affect other suppliers' resilience.
	• The more informed customers on our WRAP Forum generally supported water transfers as an option alongside others (such as demand options) but immediately questioned and were concerned about the effects this might have on the environment. The CO2 emissions associated with moving large volumes of water over a long distance especially provoked a strong reaction among some.
	• For any major supply side option, customers want to be informed about when they may happen and if there will be any effect on the quality of the water they receive.
		We are committed to the Fens Reservoir and Grafham water transfer to deliver our resilience and environmental ambitions.
		We will continue to test the acceptability and affordability of our plan with customers ahead of final submission.
		We will use the insights to help communicate these schemes effectively to customers and will continue to engage over time to ensure customers are fully aware of why these investments are needed and the impacts they will have on them and their local communities.

Acceptability and affordability of WRMP24 plan	• We will provide detailed feedback on our customers' views on our final plan in 2023 and the actions we have taken based on their feedback.	

4.5 Stakeholder Engagement

Throughout the development of the plan, we have also undertaken a corresponding stakeholder engagement plan. For our non-statutory stakeholders, such as retailers, eNGOs and other interested parties, we held a webinar during pre-consultation to share our thoughts or our draft plan and gain feedback In addition, we held several roundtable events in October 2021 where we gained views from local businesses, councillors and community groups on their views on what our priorities should be and the potential elements within the plan.

We have also undertaken focused engagement sessions with the Environment Agency, Ofwat and CCWater during 2022 to provide updated on the progress of the plan, and gain feedback on our proposals.

All of the comments and feedback received from these sessions is included in Appendix A.

5. Baseline demand for water

Summary

Our baseline demand forecast incorporates a multitude of factors and assumptions. Through support from Artesia, we have produced population forecasts and both household and non-household consumption forecasts. We have reviewed the number of people we believe will be living in each household, which has a bearing on the average consumption of each individual.

It is also important to understand what makes up this household usage, and we do this through defining the micro-components, and we worked with Artesia to develop a new micro-component forecasting model for this WRMP. The balance between the values of these micro-components often varies with occupancy and it is an important area for us to understand if we are to target our water efficiency work appropriately.

One of the most significant changes for our WRMP compared to WRMP19 relates to our assumptions regarding metering penetration. In 2021 the Environment Agency designated our region an area of serious water stress, and as such we have looked at the option to deliver universal metering across our entire population. We have undertaken extensive customer engagement on this topic to understand the level of support and the concerns, and this is covered in chapter 4 above. This universal metering underpins some of our proposed demand management programme, and this is covered in more detail in sections 9 and 10.

Our forecasts show that without intervention, demand continues to increase throughout the planning period as Planning Authority and Government led growth plans (Cambridge expansion and OxCam Arc) take effect.

5.1 Overview of the baseline demand forecast

The WRMP tables present only the Dry Year Annual Average (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 Chapter 10.

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 10Ml/d. Household water demand is forecast to rise by around 7.5Ml/d and non-household consumption by around 3.5Ml/d.

Over the 25-year period the total household population is forecast to rise by approximately 75,500 people and it is forecast there will be an additional 41,250 homes by 2045. If a view was to be taken beyond the 25 year planning period Household Population and Households can be seen to continue to rise significantly.

Under our proposed metering strategies an additional 145,000 meters would be installed increasing the meter penetration level of 77% to around 100% by 2034/35.

The baseline household demand forecasts include assumed savings as a result of water efficiency activity. Our demand forecasts estimate that average PCC under normal year conditions will fall across the planning period from 136l/p/d in the base year to 126l/p/d by 2049/50.

Under the dry year annual average (DYAA) scenario, we forecast a base year average household PCC of 143l/p/d reducing to 132l/p/d by 2044/45 in the baseline forecasts.

We forecast that non-household demand will rise over the planning period which reflects the rise in bio-tech, Service Sectors and Technology across the supply area.

We included total leakage in the baseline demand forecast at the current performance commitment of 13.5Ml/d in the base year reducing to 11Ml/d by 2049/50.

We converted normal year demand to dry year demand by applying a dry year factor of 4.9% to household demand. We derived this factor from a review of climatic factors and per household consumption. We applied the adjustment to both the measured and unmeasured household demand in a normal year.

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

5.2 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 Edge as part of the joint ‘Water Resources East’ Regional Planning group 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 Edge.
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 2019/20.

The detailed methodology for population forecasts is included in Appendix H. This covers our Cambridge Water region and our other region in South Staffs as the work was carried out by Artesia to cover both regions. Base year household population and property figures taken from our customer database and consistent with those reported in the '2020 Annual Review' were used to reconcile the base year data.

The forecasts show that household population is expected to increase by 75.500 people by 2050 and that there are approximately 41.250 new homes forecast to be built. This is an increase of 28% in connected household properties.

5.2.1 Non-household population and properties

We assume growth in new non-household properties to rise reflecting the growth in bio-tech, Service Sectors and technology round the emerging growth plans for the county. This includes where unmeasured non-household supplies are refurbished and supplies are split. Unmeasured non-household properties will continue to reduce because of commercial meter optant switchers and as a result of site developments.

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.

5.3 Metered household property projections

The Final Plan Metering strategies will result in a significant increase in metered households by the end of the planning period.

By 2049/50 there will be 83,410 more measured households arising from new connections and our targeted universal metering programme. This is described in more detail in chapter 9. This will effectively proactively switch our customer base to meters and drive the reduction in consumption in order to achieve the 'Per Capita Consumption' (110 PCC) target by 2050.

The number of unmeasured households fall directly related to the meter option and meter switching promotions as households opt to have meters installed. The metering strategy is aimed at switching all unmetered households to meters.

5.3.1 Free Meter optants

We have reviewed the actual number of meter optants required to achieve the reduction in the Base Line PCC to the ODI target of 110l/h/d by 2050 with the support of Artesia Consulting Ltd who ran a series of scenarios to optimise Demand Management Options (section 9).

We have based our forecasts on an average number of optants and switchers over the planning period in order to achieve 100% metering by 2035 and 110 l/h/d with the support of a Smart meter network and water efficiency initiatives (section 9).

5.4 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. Household occupancy rates

5.5 Household occupancy rates

Artesia Consulting Ltd were commissioned to develop the Company's Household and Non-Household consumption forecasts (Appendix C). Embedded in the forecasts are modelled household occupancies derived from Artesia's experience from working across the industry. The purpose of modelling occupancies across the customer household types is 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.

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 2.45 people/property in 2024/25 to 2.31 people/property in 2049/50.

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

The underlying occupancy rate for unmeasured households is forecast to rise reflecting larger family units (growing families) over the planning period as the metering strategy takes effect and we approach 100% meter penetration.

The underlying average occupancy rate for all measured households is a mixture of lower occupancy optants and lower occupancy, small, newly-built houses until a point when the larger unmeasured household occupancies become metered.

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.

5.6 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.

The results of the micro-component forecast based on a Base Line NYAA. Average household PCC (mean of all household types) reduces from 135l/p/d to 126l/p/d over the period 2024/25 to 2049/50.

Details of the Water efficiency strategy are contained in section 10. .

5.7 Baseline non-household demand

Since the Water Market opened on 1st April 2017 non-household customers have been able to choose their retail service supplier. Those not eligible have remained with the incumbent water supply and form the retail market.

Following the separation of the Retail/Wholesale markets water companies have been unable to directly communicate with the retail markets and as a result water efficiency has been the responsibility of the billing company. This has led to some loss of knowledge of non-household customer consumptions.

However, WRMP24 will give water companies the opportunity to engage directly with the Retail market with a view to introduce consumption and waste reduction strategies. As a result we have submitted plans to reduce non-household consumption by 9% by 2050. See section 10 for more details.

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.

Results indicate a general increase in consumption over the plan 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 C2.

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.

5.8 Baseline leakage forecast

For the baseline demand forecast we have included total leakage across the period from 2024/25 of 11.96Ml/d to 10.99 Ml/d in 2049/50.

5.9 Baseline leakage forecast

We have committed to reduce leakage by 50% by 2050 in the Final Plan incorporating a number of innovative leakage management technologies and processes. The FP leakage commitment follows a glide path that will achieve 5.5Ml/d by the end of the plan period. See section 10 for more details.

5.10 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); 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.

5.11 Dry year demand

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

We applied the resulting dry year factor (4.9%) to the normal year household consumption forecast uplifting it to the dry year scenario. We applied the adjustment to both the measured and unmeasured household demand in a normal year.

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

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

5.12 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.

We have commented on the impact of Covid, particularly in the year 2020/21 when prolonged lockdown coincided with historic peak daily demand and periods of long, hot dry weather bringing about high demand from higher than usual garden water use.

The Artesia per household micro-component model produces a Critical peak week forecast. The derivation of the factor for peak week is described in Appendix C. The peak week factor is 27.8%, which is applied to the components of use which are affected by summer weather. This ratio is applied across the period to convert normal year household demand to peak week household demand. This is an alternative forecasting methodology recognised by UKWIR 2006.

DI rose to 83.21Ml/d in 2020/21 compared to a typical annual DI of 81Ml/d. Household consumption rose from typically 43.5Ml/d to 49.5Ml/d. We are now seeing some return to pre-epidemic consumption although there is now a hybrid work/home culture whereby the ratio of home/office is typically 2 or 3 times a week.

A small reducing allowance has be applied to household consumption to account for the continued change to home working reducing to 0.25% by the end of AMP8.

5.10.1 UKWIR 2006 peak week demand forecasting methodology

Artesia has previously assessed peak week household demand (PWHH) for us using UKWIR's 2006 methodology. 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 C.

The Artesia 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.

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 previous models. 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.

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.

For WRMP24 the new model indicated a Critical Peak Week Household (PWHH) demand in the base year (2024/25) of 61Ml/d and predicted that it would rise to 71Ml/d by 2049/50.

5.10.2 Peak week household demand model

Artesia's per household micro-component model produces a Critical period 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 Artesia's predicted base year PWHH demand against the Artesia modelled base year normal year household demand. This gave a ratio of 1.278. 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. Baseline supply forecast

Overview

Reductions to deployable output

There has been a significant reduction in the assessed dry year annual average (DYAA) deployable output (DO) of our sources since WRMP19, once sustainability reductions are applied to abstraction licences. Our declared baseline licence and deployable output shows a modest increase, due to WRMP19 supply options to address growth and resilience.

Sustainability reductions to DO for WFD No deterioration are included as abstraction reductions, and for meeting Environmental Destination. The need to address the risk of causing deterioration to the environment is driving an immediate deficit in our baseline supply demand balance even within existing authorised licence limits. We have been investigating the impact of our abstractions on the environment to determine licence reductions, and the Environment Agency have provided an assessment of impacts and advised they view the likelihood of the risk to be high and therefore the reductions should be considered as a reduction to our DO assessment. The approach to determining reductions has developed since sustainability changes for no deterioration were considered for WRMP19, and this has significantly increased the amount of reductions required.

Baseline licenced DO has increased from 99.12Ml/d in the 2019 plan to 102.74Ml/d for DYAA conditions, and from 118.31Ml/d to 138.10Ml/d for peak week conditions.

The following changes forecast DYAA DO have been applied to the baseline;
- 6.46Ml/d of sustainability changes from AMP7 No Deterioration risk from 2025
- 20.37Ml/d of additional sustainability changes from AMP8 No Deterioration risk from 2030
- 35Ml/d of additional reductions for Environmental Destination from 2040.

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

Drought resilience

We have evaluated our resilience to drought based on our current resources in the base year. We have considered drought scenarios with a severity up to a 1 in 500-year event. There is marginal difference between historic design droughts and more severe modelled events, and with existing licences and baseline deployable output we can meet demand in a 1in500 event without the need for restrictions.

We have also tested our drought resilience over the whole planning period with our forecast changes in demand and supply. Our analysis shows our supplies are resilient for a range of droughts across the 25 year planning period – including those more severe, or less frequent than our design droughts. Accordingly, we are not putting forward any new drought management options in addition to those currently in our existing drought plan.
One exception to drought resilience to 1in 500 before 2040 is the timing of licence capping through sustainability changes and the impact of this loss to supply, as this would for the baseline put the SDB into deficit, and therefore not provide 1in500 resilience

Climate change impacts on supply

The assessment of climate change impact has been reviewed since the previous WRMP, to align with the current Environment Agency guidance, latest supplementary information and to align with revised datasets also used for

WRE companies, as this will ensure alignment in the assessments regionally. Our assessment of climate change impact has increased as a result of the revised methods – by the 2080's. We have undertaken a drought vulnerability assessment as the risk of drought is 10% of DO. The Annual impact of climate change on DO has been included in our baseline and final plans.

Treatment works operational use (TWOU)

We have made no changes to the approach used for WTMP19 which was an improvement to the data collected for this component and approach used. A total TWOU allowance of 0.16Ml/d has been included in the supply forecast.

Planning allowance for outage

The DYAA allowance in our plan for outage has increased marginally from 4.8Ml/d in WRMP19 to 4.9Ml/d in our draft baseline forecast, for the 70th percentile for this and we describe our updated outage modelling in Appendix E.

6.1 Overview of the Cambridge Water operating area

Cambridge Water is responsible for public water supply across one of the fastest growing areas in the east of England. Our area of supply stretches from Ramsey in the north to Royston and Haverhill in the south, and from Gamlingay in the west to the east of Cambridge city.

6.1.1 Planning area – the water resource zone

For our WRMP19, 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 equivalent to our area of supply boundary. A map of the area of supply is shown in Figure 7 below. This assessment has been reviewed[5] against latest supplementary guidance from the EA and there have been no changes to our water resources zone boundary.

Figure 7 Cambridge Water supply area and water resource zone

[5] 2021 03 16 WRMP24 SG - Resource zone integrity

6.1.2 Supply sources

Our water resources are supplied wholly by groundwater, mainly abstracted from the chalk aquifer in the southern and eastern part of the supply area, with a small percentage of greensand aquifer sources. All these sources are linked by an integrated supply and transfer system. Less than 1% of supplies are currently derived from bulk imports from neighbouring companies. Our supply side proposals in this plan include options that will change some of our sources over time, by introducing further transfers from neighbouring companies and new resources, derived from surface water sources.

6.1.3 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 and drought triggers are based on a range of droughts observed in the historic record, specifically those of a severity or longevity where we required additional measures to manage supplies and demands, and the likelihood of restrictions being necessary. On this basis, we would not expect to need to restrict domestic customers use with a temporary use ban (TUB) more frequently than once in every 20 years. The calculated DO for this level of service models the available yields in drought conditions to ensure this level of service can be met with the available resource.

We have not had to resort to a non-essential use ban or ordinary drought order in previous droughts experienced, and would not expect to for reference droughts in our drought plan more frequently than once in every 50 years.

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

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

Table 8 Annual average percentage risk of restrictions – planned levels of service

Restriction	Company proposed levels of service	Average Annual risk	Reference level of service
Temporary use bans (formerly hosepipe ban)	1 in 20 years	5%	1 in 10 years
Non-essential use (Ordinary Drought Order)	1 in 50 years	2%	1 in 40 years
Rota cuts or standpipes	1 in 100 years	1%	Not applicable

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 in our PR24 business plan.
- We do not change our levels of service between now and 2050.
- We continue to meet, or exceed, these levels of service with a view to moving towards 1 in 200 drought resilience.
- Should any of these risks change during the 25-year planning horizon – for example, as a result of a changing climate – we will bring in timely demand- or supply-side options that mean that we can still maintain our levels of service for customers.

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.

To derive the annual risks shown above we converted our levels of service from a 1 in X return period to a percentage risk. We calculated levels of service and the annual probability by using our historic design drought. Our design drought is based on historically observed data, but we have also modelled more extreme/severe events as described in our drought plan[6].

We published our most recent drought plan in April 2022, and this is reviewed regularly against any material change, and fully updated at least every 5 years.

6.2 Deployable output

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

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

6.2.1 Method selection

The DO total used in the plan is an aggregate to the WRZ level of the DOs derived from our source reliable output (SRO) study, which has been carried out in accordance with best practice techniques in the UKWIR handbook of source yield methodologies[7]. First carried out in 1997 and periodically updated to reflect changes to sources, the SROs for all sources were updated during 2012, and have been comprehensively reviewed again during 2017 with reference to the Environment Agency's 'Water resources planning tools', WR27[8].

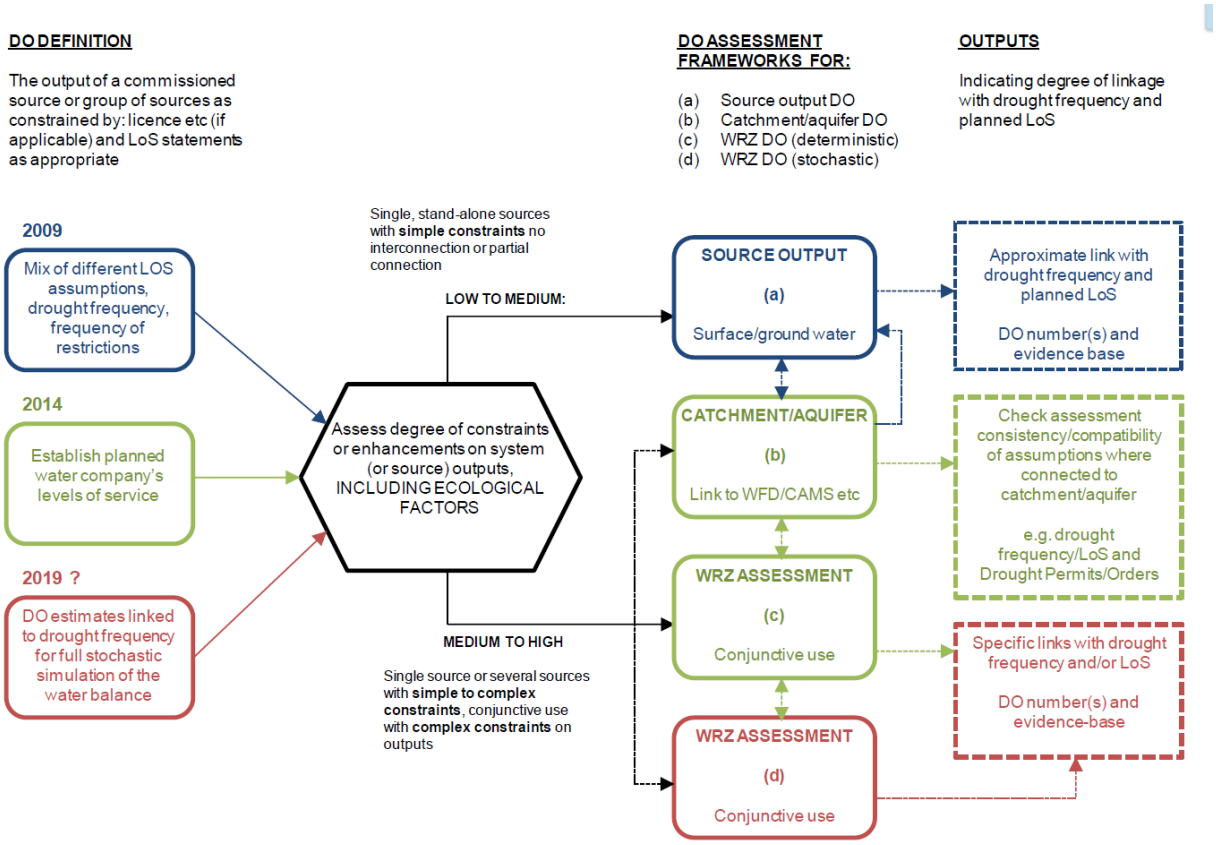
The SRO studies determine the quantity of water available from each of our sources to satisfy average and peak demands, under drought conditions. The DO from our sources has been assessed on a source output basis with reference to the appropriate UKWIR guidelines, and is proportionate to the nature of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

[6] https://www.cambridge-water.co.uk/media/3638/cambridge-water-final-drought-plan-2022.pdf

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

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

Figure 8 UKWIR framework for groundwater source assessment



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

- Licence conditions, or other regulatory constraints – for example, the abstraction incentive mechanism (AIM). The AIM is an Ofwat mechanism to incentivise companies to reduce abstractions at environmentally sensitive sites, where no other mitigation is yet in place[9];
- physical limitations, such as aquifer properties;
- operational constraints, such as transfer ability, pumping plant, etc; and
- Water quality or treatment constraints.

We regularly carry out a comprehensive review of reliable source capability and constraints which is reflected in our reported DO, in annual reviews and for the Peak Week Production Capacity value for our Outage performance commitment.

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

6.2.2 Baseline deployable output results

The estimated DOs are shown in the following tables, together with those from the previous WRMP. Baseline licenced DO has increased from 99.12Ml/d in the 2019 plan to 102.74Ml/d for DYAA conditions, and from 118.31Ml/d to 138.10Ml/d for peak week conditions.

The changes to baseline licenced DO are due to WRMP19 options being completed and the deployable output available, capital investment at source works and treatment works to increase outputs, and as a result of our regular re-assessment of achievable outputs at sources. DOs for each of the individual sources within our WRZ are also listed in the Environmental Agency data table – '1. Base Year Licences'.

In addition, the following changes to our forecast DYAA DO have been applied to the baseline;

- 6.46Ml/d of sustainability changes from AMP7 No Deterioration risk from 2025
- 20.37Ml/d of additional sustainability changes from AMP8 No Deterioration risk from 2030
- 35Ml/d of additional reductions for Environmental Destination from 2040.

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

Table 9 Deployable output – dry year annual average conditions

Source name	WRMP19 Ml/d	WRMP24 Ml/d	Constraint	Deployable output following No Deterioration cap
APPW	1.00	1.00	Annual licence	0.60
BAPW	7.17	7.17	Annual licence/ compensation flow conditions	4.45
BRPW	8.25	8.25	Annual licence (from 2018)	8.44
DUPW	3.6	3.6	DAPWL	1.65
DGPW	2.88	2.88	BH performance DAPWL/drawdown	3.09
DAPW	4.56	4.56	Annual licence	2.25
EUPW	8.00	8.00	Annual licence	4.17
FOPW	3.27	3.27	Annual licence	3.25
GCPW	1.06	1.06	DAPWL	1.06
GWPW	5.67	5.67	Annual licence	4.08
HEPW	1.13	1.13	DAPWL	0.97
HOPW2	1.80	1.7	DAPWL peak yield (as licence)	0.87
LIPW	0.00	0	Licence HOF conditions	0.00
LOPW	3.40	3.4	Annual licence	3.09
MEPW	7.20	7.2	DAWPL	6.11
MGPW2	1.20	1.2	WFD no deterioration cap	0.95

Source name	WRMP19 Ml/d	WRMP24 Ml/d	Constraint	Deployable output following No Deterioration cap
RIPW	1.00	0.00	Licence HOF conditions	1.00
SAPW	1.49	1.49	Annual licence	0.98
WEPW	10.60	10.6	Pump/network configuration	7.31
SIPW	0	1.5	Yield	1.5
CRPW2	0	1.3	WFD no deterioration cap	1.01
KIPW2	0	0.92	WFD no deterioration cap	0.92
FUPW	1.49	1.49	Annual licence	3.28
WCPW	2.92	2.92	DAPWL	
HGPW	5.77	5.77	Annual licence	5.23
FD36PW	12.3	12.3	DAPWL	9.74
FD12PW	3.27	3.27	Annual licence	
TOTAL	**99.12**	**102.74**		**76.0**

Table 10 Deployable output – critical period (peak weak)

Source name	WRMP19 Ml/d	WRMP24 Ml/d	Constraint
APPW	4.0	4.0	Licence
BAPW	7.17	7.17	compensation flow conditions
BRPW	15.0	15.0	Licence
DUPW	3.6	3.6	DAPWL
DGPW	3.95	3.95	BH performance DAPWL/drawdown
DAPW	5.68	5.68	Licence
EUPW	10.0	10.0	Licence
FOPW	5.40	5.40	Licence
GCPW	1.06	1.06	DAPWL
GWPW	9.09	9.09	Licence
HEPW	2.13	2.13	DAPWL
HOPW2	2.8	2.8	Licence
LIPW	0.00	0	Licence HOF conditions

Source name	WRMP19 Ml/d	WRMP24 Ml/d	Constraint
LOPW	4.27	4.27	Annual licence
MEPW	7.20	7.20	Annual licence
MGPW2	1.50	1.5	DAPWL
RIPW	1.00	0.00	Licence HOF conditions
SAPW	1.49	2.16	Licence
WEPW	10.60	11.39	Licence
SIPW	0	4.5	Licence
CRPW2	0	1.99	Licence
KIPW2	0	1.18	Licence
FUPW	1.8	1.8	Licence
WCPW	2.92	2.92	DAPWL
HGPW	5.77	5.77	Licence
FD36PW	12.7	12.7	Licence
FD12PW	3.27	3.27	Licence
TOTAL	**118.31**	**138.10**	

6.3 Time-limited licences

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

Table 11 Time-limited licences

Licence	Expiry	Details	Risk
BRPW	March 2024	Reduction in temporary element of licence comprising 7.34Ml/d Annual average and 10Ml/d at daily peak	Previously the time-limited elements were expected to be renewed until 2027, following agreement with the environment agency, at the reduced volumes stated in our WRMP19 DO assessment, which included an annual total aggregate volume with EUPW which represented a net reduction in annual licence. This was based on a WFD no deterioration licence cap advised by the EA at the time. Subsequent changes to the licence cap approach would not further reduce the

Licence	Expiry	Details	Risk
			temporary time limited element of this individual licence, but would be included as future sustainability reductions for licence cap needs.
EUPW	March 2024	Reduction in temporary element of licence comprising 2Ml/d annual average and 2.5Ml/d at daily peak	Previously the time-limited elements were expected to be renewed until 2027, following agreement with the environment agency, at the reduced volumes stated in our WRMP19 DO assessment, which included an annual total aggregate volume with BRPW which represented a net reduction in annual licence. This was based on a WFD no deterioration licence cap advised by the EA at the time. Subsequent changes to the licence cap approach would remove the temporary time limited element of this licence (2Ml/d), as the proposed cap is less than the permanent element (6Ml/d). The reduction of the temporary element has therefore been included, as per EA guidance, for the time limited date in the baseline sustainability reductions to DO. The additional reduction to cap the permanent licence is included as future sustainability reductions for licence cap needs.
FOPW	March 2027	Increase in licence of 5.49Ml/d at annual average	We would need to submit a written environmental assessment of the impact of abstracting at the higher volumes and require written approval to abstraction taking place from the Environment Agency. Current rates of abstraction can continue, and have been agreed with the Environment Agency as sustainable following completed NEP investigations. If the EA chose to cap the licence on renewal for No Deterioration, this would be a reduction of 0.35Ml/d. This has been included as a future sustainability reduction for licence cap needs.

6.4 Links to our drought plan

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

and not hydrological yield, and is therefore unaffected in drought conditions. See section 6 for a full explanation of how we calculated DO.

6.4.1 Measures included within deployable output analysis for WRMP

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

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

Table 12 Drought measures included within the WRMP and drought plan

Drought measure	Supply-/ demand-side	Comments	Savings Ml/d
Extra promotion of water efficiency	Demand	Extra promotion of water efficiency, increased publicity	1
Appeals for restraint	Demand	Further enhanced publicity campaign	3
Increased leakage detection and repair	Demand	Yield dependant on conditions and leakage levels	2
Temporary use (hosepipe) ban	Demand	Yield estimated from UKWIR studies and previous historical experience	5
Non-essential use ban	Demand	Yield estimated from UKWIR studies	5
Rota cuts	Demand	Civil emergency measure only	n/a

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

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

6.4.2 Additional measures within our drought plan

There are no additional measures within the drought plan.

6.4.3 Determination of extreme droughts

The government and regulators have asked water companies to consider how to increase the resilience of public water supplies to future drought conditions. For our WRMP19 we assessed our resilience to 1 in 200 drought return events or 0.5% chance per year without requiring severe restrictions such as rota cuts. For the WRMP24, we are required to reduce the chance of severe restrictions to 1 in 500, or a 0.2% chance per year, by 2040.

This requirement will mean more investment in supply sources in the future. Our planned proposals for developing Fens Reservoir, will include resilience for this resource to 1 in 500, and our existing groundwater resource shave been assessed for 1in 500, alongside our climate change assessment of impact to deployable output at the source level.

Our assessment of the impact of 1 in 500 drought on our baseline supply resource position in included alongside our climate change impact assessment in section 6.6. We have applied the same stochastic approach to determine impact, this also aligns regional planning approaches.

6.4.4 Assessment of resilience in base year

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

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

6.5 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).

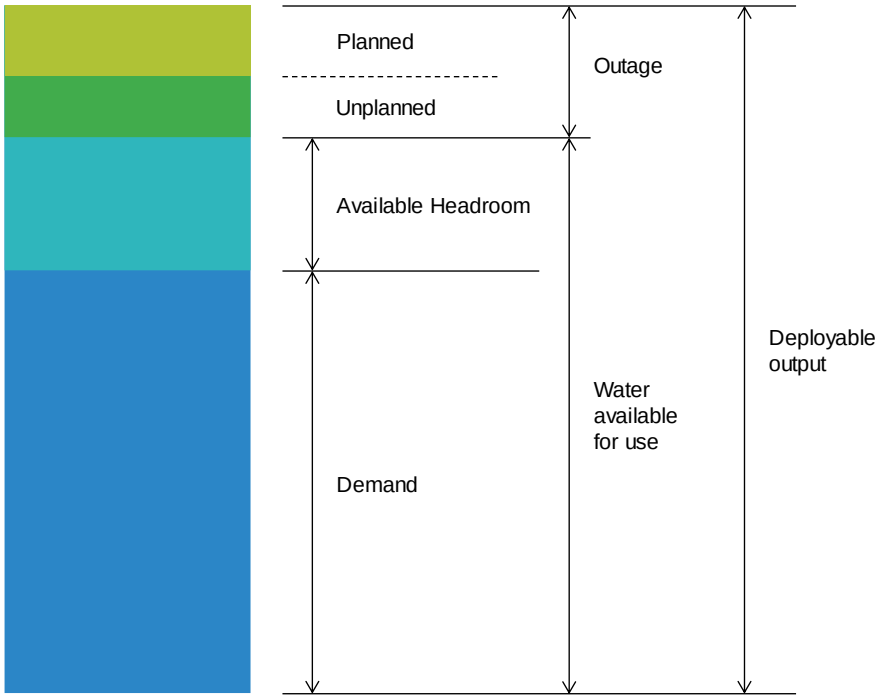
The outage allowance is calculated according to a standard methodology developed and published by UKWIR[10] and in accordance with the expectations of the Environment Agency guidance[11]. We have also reviewed our approach against the latest EA supplementary guidance.[12]

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

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

[12] 2021 03 16 WRMP24 SG - Outage

Figure 9 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 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 2021. The list of events was first reviewed to identify if events were legitimate outages. Non-legitimate events have been excluded from the data. Improvements in the quality of data from 2012 led to events before this time being excluded from the data analysis. 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. Where capital investment has been made to reduce the likelihood of outage, or remove the possibility, these events are also excluded or adjusted as appropriate. Duration distribution was also adjusted to account for likely reductions to planned outages that would occur during a dry year scenario. Sensitivity analysis of the results was undertaken and adjustments made as required. The methodology and results of the outage assessment are in Appendix E.

6.5.1 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 13 Outage assessment results

Percentile	DYAA outage (Ml/d)	DYCP outage (Ml/d
70%	4.9	3.2
80%	6.0	3.5
90%	8.0	4.1
95%	9.6	4.6

For WRMP19, the 70th percentile values for outage at both DYAA and DYCP were considered to be most appropriate for capturing a suitable level of risk to our water supply availability to protect our level of service. For this WRMP, we have continued to use the 70th percentile.

The corresponding Baseline values for DYAA and DYCP outage are 4.9Ml/d and 3.2Ml/d respectively; these have been entered into the WRMP tables.

6.6 Climate change

We have assessed the impact of climate change on our future supplies. Our assessment follows 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 reviewed the methods against the Planning Guidelines supplementary documents on climate change[13] and 1 in 500 droughts.[14]

Of the 28 sources assessed for vulnerability to climate change, seventeen have been identified where climate change may impact the water levels and therefore the potential yield of the source. These sources were taken forward for further climate change assessment. Of these, thirteen sources could be constrained by climate impacts over and above other physical, or licence constraints to deployable output. These sources are also those that demonstrate the most vulnerability during low groundwater level conditions, and have hydrogeological constraints on yields during 1 in 500 drought events. The potentially vulnerable sources are:

- DUP;
- DAPW;
- FD36PW
- FD12PW
- FUGW;
- GCPW;
- HEPW;
- HOPW2
- MEPW;

[13] 210318 WRMP24 SG - Climate Change

[14] 2021 03 22 WRMP24 SG - 1 in 500

- MGPW
- WEPW; and
- WCPW.

6.6.1 Details of assessment

The Environment Agency methodology[15] includes a tiered approach to estimate the impact of climate change based on the basic vulnerability classification of each resource zone. We have revised and updated the methodology to include the impact of climate change, 1 in200 and 1 in 500 droughts on deployable output at source level, based on a Tier 2 approach. Our approach meets some tier 3 analysis criteria as defined in the guidance. To predict the effect of climate change on groundwater levels, we developed a model to simulate yearly groundwater level minima, depending on the amount of recharge to the groundwater and the change in groundwater levels.

Since WRMP19 we have revised our approach to take account of updated data, and to align with the approach applied for Water Resources East in the regional simulator. Met Office stochastic climate data was used in a British Geological Survey model to generate ground water levels under drought conditions, and the same approach applied to climate change under 4 different future climate scenarios. The generated groundwater levels are then applied to the source reliable output yield diagrams to assess the predicted change in yield as groundwater levels decline.

The BGS AquiMod model simulates a time series of groundwater levels at a location using rainfall, recharge and potential evapotranspiration data, and is calibrated against actual observed groundwater levels. The model also considers rainfall and soil moisture deficit (SMD), which has a direct correlation with temperature. The results take a worst case view of the impact in the 2080s. The approach applied is detailed in **Appendix M**.

6.6.2 Assessment results

The results of our climate change assessment on the most vulnerable sources indicate that of a total impact on DO of 10-16%, this is dominated by 3 individual sources. Note that the impact of long term climate change is less than the shorter term impact of proposed sustainability changes discussed later in section 6.9. We have scaled the impact in the 2080s from climate change using the Environment Agency guidance[16] and applied this to the tables as an annual adjustment to deployable output.

Table 14 Impact of climate change and drought scenarios

DO Loss Ml/d						
	Average (with constraints)			Average (DO from SROs)		
Source (ABH)	1:200	1:500	CC	1:200	1:500	CC
Dullingham	0.2	0.3	0.4	0.2	0.3	0.4
Duxford Airfield	0.0	0.0	1.6	0.0	0.0	1.6
Duxford Grange	0.0	0.0	0.0	0.0	0.0	0.1
Fleam Dyke (12”)	0.4	0.5	0.6	0.2	0.2	0.3
Fleam Dyke (main)	0.6	0.6	0.9	0.6	0.6	0.9
Fowlmere	0.0	0.0	0.0	0.0	0.0	0.0
Fulbourn	0.1	0.2	0.4	0.3	0.4	0.6

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

[16] Environment Agency, ‘Water resources planning guideline: Interim update’, April 2017.

Great Chishill	0.2	0.1	0.2	0.2	0.1	0.2
Great Wilbraham	0.0	0.0	0.0	0.0	0.0	0.0
Heydon	0.0	0.2	0.7	0.0	0.2	0.7
Horseheath	0.0	0.0	0.3	0.0	0.0	0.8
Kingston	0.5	0.5	0.7	0.5	0.5	0.7
Lowerfield	0.0	0.0	0.0	0.0	0.0	0.0
Melbourn	2.0	2.2	2.7	2.0	2.2	2.7
Morden Grange	0.0	0.1	0.3	0.3	0.4	0.6
Westley	3.8	4.2	4.9	4.5	4.9	5.7
Weston Colville	0.9	0.9	1.1	0.9	0.9	1.1
Total DO loss	**10.3**	**11.4**	**16.5**	**11.4**	**12.5**	**18.2**
Baseline DO (Ml/d)	**102.9**	**102.9**	**102.9**	**113.1**	**113.1**	**113.1**
% DO loss	**10.0%**	**11.1%**	**16.1%**	**10.1%**	**11.0%**	**16.1%**

6.7 Water transfers

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

6.7.1 Raw water and non-potable water transfers

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

6.7.2 Potable water transfers

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

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

Our plans propose a number of new transfer options, the details of these are in our options and preferred plan sections.

6.8 Treatment works losses and operational use

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

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

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

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

6.9 Reductions in deployable output

6.9.1 Options to reduce outage

Our approach is to minimise the potential for and impact from unplanned and planned outages at sources through an effective capital maintenance strategy, and mitigation measures, such as dual validation, duty/standby arrangements and standby power generation. A significant programme of investment will be completed during AMP7 involving refurbishment at majority number of source works, re-commissioning of sources out of use and upgrades to new control and monitoring technologies. This will enhance reliability moving forward and improve unplanned outage performance. Planned outages required for major refurbishment works will also reduce overall.

Since publishing our draft WRMP for consultation we have reviewed the work we will complete during AMP7 and more fully incorporated the impact of this on our forecast, future overall outage performance. As a result, we have set our outage risk to the 70%ile to reflect this position in our preferred plan.

We will also continue to manage our forward capital programme to ensure planned works do not present an unacceptable risk to overall supply availability and all capital works aim to ensure robust operating processes going forwards to minimise unplanned outage. Accordingly, we have not included details of specific options to target a reduction in outage in the feasible list of options within this plan. These will be included in our overall PR24 plans for asset maintenance. We review our outage annually against our forecast through the WRMP annual review process and will implement measures to reduce it, if this becomes necessary.

6.9.2 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.

The EA are also reviewing all abstraction licences for the Restoration of Sustainable Abstraction, for the requirements of the environment under the Water Framework Directive, to achieve good ecological status of all waterbodies and to prevent further deterioration from current status.

6.9.3 AMP7 No Deterioration and Implementation

We have included, as per WRMP19, and WINEP investigations, agreed sustainability changes of 6.46Ml/d to be implemented in AMP8 from 2025, based on the previous methodology of determining the no deterioration baseline for WFD. These are included in our baseline deployable output.

Our AMP7 WINEP programme of work includes investigations into all of our existing licences to understand the risk of deterioration of the environment at existing levels of abstraction and for increases to fully licenced volumes, using the EA revised methodology (April 2022). These assess the impact of groundwater abstractions on a source by source basis on both surface water bodies, for flow and ecology and the potential impact on groundwater levels where this may impact on base flows at sensitive sites, such as wetlands and chalk river headwaters.

These investigations will be complete for the revised draft of our WRMP, and we have included sustainability changes to account for the licence reductions associated with these investigations from the end of AMP8, in 2030. The sustainability changes that we have included are in the baseline deployable output, as directed by the Environment Agency, and are based on information provided by the Environment Agency on likely licence caps to historic abstraction levels for the assessments of water body status in the 2015 RBMPs.

6.9.4 Licence capping to avoid environmental deterioration under WFD

The EA have informed water companies that licence will be capped against a historic reference period based on the level of environmental risk, and provided us with their assessment of our licences. Licence capping can be made on a 'max historic peak' value for the historic period or an 'average' for the historic period depending on environmental status, risk and expected growth. The EA expectation is that these changes will be made in AMP8, by 2030, and that they would take the opportunity to change any licences that come up for renewal before that time.

6.9.5 Time limited licence No Deterioration changes

Of the 3 time limited licences that we have for renewal in the planning period, 2 have caps to annual volumes within the time limited element of the licence as assessed by the Environment Agency's revised methodology for licence caps to prevent deterioration. As advised by the Environment Agency, we have included these reductions in the year of time limit expiry as the intention would be to revoke the licence to protect against risk of deterioration. These occur in 2024 and 2027 for EUPW and FOPW respectively and are for 2.0Ml/d and 0.35 Ml/d.

6.9.6 No Deterioration changes – licence caps

We have used the EA assessment of historic baseline to inform the no deterioration licence changes expected in 2030 and have applied these licence cap figures and adjusted for deployable output impacts where applicable. With the earlier reductions to time limited licences, and for WRMP19 caps, this is an additional reduction of 18.02Ml/d. Therefore by 2030 we are forecasting licence capping for deterioration risk to total 26.83Ml/d.

Table 15 Impact of Licence Capping on Deployable Output

Source name	Licence Reduction	Deployable output following No Deterioration cap
APPW	0.40	0.60
BAPW	2.72	4.45
BRPW	2.90	8.44
DUPW	2.85	1.65

Source name	Licence Reduction	Deployable output following No Deterioration cap
DGPW	0.32	3.09
DAPW	2.31	2.25
EUPW	3.83	4.17
FOPW	0.35	3.25
GCPW	-0.15	1.06
GWPW	1.59	4.08
HEPW	0.16	0.97
HOPW2	1.43	0.87
LIPW	0.45	0.00
LOPW	0.32	3.09
MEPW	1.83	6.11
MGPW2	1.32	0.95
RIPW	0.19	1.00
SAPW	0.51	0.98
WEPW	4.08	7.31
SIPW	-00	1.5
CRPW2	0.98	1.01
KIPW2	0.07	0.92
FUPW WCPW	1.44	3.28
HGPW	0.54	5.23
FD36PW FD12PW	6.23	9.74
TOTAL	**35.61**	**76.0**

6.9.7 Other changes to deployable output

We have not included any further changes to DO.

6.10 Environmental Destination

The national framework for water resources sets out the ambitions for a future environmental destination, with different proposed levels of improvement, protection and enhancement of the environment. These scenarios look at measures required to achieve improved flows in water bodies, and good ecological status of all water bodies, designated sites and Chalk Rivers. There is some uncertainty associated with the abstraction reductions required for the various scenarios, and this will be investigated in AMP8 through the WINEP. We have adopted the environmental destination scenarios and calculated likely sustainability changes through a common approach used for WRE, so that all companies in the region plan in a consistent way.

Table 16 Environmental destination scenarios

Scenario	Description
BAU	Support the recovery of degraded rivers and water-dependent environments to meet existing targets and prevent further deterioration ('BAU') Achieve sufficient flows in waterbodies to support 'Good' ecological status under the Water Framework Directive (WFD), apart from waterbodies considered uneconomic to improve within River Basin Management Plans (RBMPs).
BAU+	Secure the resilience of internationally important habitats As 'BAU', with extra protection for European Protected Sites.
ENHANCE	Enhance the region's headwaters, chalk rivers and nationally important habitats ('Enhance') Achieve flows to support 'Good' in all waterbodies including those considered uneconomic within RBMPs. Extra protection for European Protected Sites. Enhanced protection for chalk streams, sensitive headwaters and SSSIs.

Our regulators have expectation is that BAU+ is the minimum improvement for the environment required by 2050, and it is this scenario that we have included in our baseline DO sustainability change adjustment. As this will require significant reductions in abstraction and substantial new investment in alternative water resources, this is driving supply side options at the regional scale such as Fens Reservoir.

Table 17 Environmental Destination - Licence reductions

	BAU	BAU+	ADAPT	ENHANCE
Remaining licence Ml/d	51.88	41.01	40.84	42.85
Reduction %	55.26	64.64	64.79	63.06
Reduction to DO Ml/d	24.12	35.00	35.17	33.16

The methodology for calculating likely reductions has been developed for WRE. We have included the minimum BAU+ reduction of 35.0 Ml/d from 2050 in our planning scenario – this is in addition to the licence capping for no deterioration risk applied by 2030.

6.10.1 Environmental Destination work in AMP8

Further work is required in AMP8 to accurately determine the scale of the abstraction reductions required for delivery in our area. We are proposing to undertake a series of investigations through our WINEP programme which will confirm the scale of the reductions required, and the locations, and a priority and timescale for delivery. We will work with Anglian Water on these investigations where appropriate as we share catchments.

In addition, we are developing ambitious proposals to undertake flagship chalk stream river restoration projects. These will commence in AMP8 and deliver hydromorphological benefits to chalk streams in our area to help improve and enhance them in the short term, as we look to return flows to them in the future.

6.11 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, although we do not expect the need for any additional treatment in AMP8 as the existing treatment and blending with low nitrate water maintains our compliance with DWI standards. We have made a small allowance in headroom for the impact of increased nitrate in groundwater at an increased trend above what is predicted which could have the potential to restrict existing blending capacities.

As discussed in later sections of the plan, future supply options from different sources of supply may present a customer perception challenge when these are implemented. We will be exploring approaches to reduce this, through both treatment and communication plans

6.11.1 Catchment schemes

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

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

7. 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 the standard methodology developed and published by UKWIR and recommended in the water resources planning guidelines. We did not use this approach at the last WRMP and therefore this is an improved approach for us.

Overview of headroom assessment

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

Target headroom has been reassessed using a more detailed stochastic methodology recommended in the guidelines developed and published by UKWIR[17], and has increased slightly from the WRMP19 allowance

All components of target headroom uncertainty have been assessed and reviewed, with time series of uncertainty distributions defined from 2025 to 2100 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 annual profiles aligned with Water Resources East companies for a common regional approach. The risk profile for medium resilience was applied starting at the 90th percentile and reducing each 5 year AMP until 2050 at 65th percentile This reflects a moderately resilient WRZ, with some supply–demand uncertainty.

Target headroom is between 4.4Ml/d and 4.8Ml/d over AMP8, reducing to 2.5Ml/d by the end of the planning period, in 2050.

7.1 Review of headroom components

All components of target headroom uncertainty have been assessed and reviewed, with time series of uncertainty distributions defined out to 2100 for each component, reflective of DYAA and DYCP conditions. These components are listed in the table below.

Table 18 Supply- and demand-side headroom categories

Supply-side headroom categories	Demand-side headroom categories
S1 – Vulnerable surface water licences	D1 – Accuracy of sub-component data
S2 – Vulnerable groundwater licences	D2 – Demand forecast variation
S3 – Time-limited licences	D3 – Uncertainty of climate change on demand
S4 – Bulk transfers	D4 – Uncertainty of demand management solutions
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	

[17] 'An Improved Methodology for Assessing Headroom', UKWIR, 2002.

7.1.1 Supply-side components

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

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

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

S6 comprises uncertainty in the accuracy of supply-side data. For every groundwater source, the 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. Trend uncertainty for water quality parameters is covered under S5.

Uncertainty of climate change on groundwater source yield (S8), is quantified using the results of regional groundwater modelling with monthly climate change perturbation for the 2080s. Wet and dry scenarios are interpolated for 2050 and a time- series of uncertainty input to the headroom model using the standard Environment Agency methodology.

For new supply options planned for completion covered in S9, only options that are included in the WRMP24 deployable output are included where these are new when the plan commences and have some uncertainty on the expected yield declared in the deployable output. These are included in baseline target headroom, but uncertainty from new options that maybe selected in the preferred plan is excluded from headroom as these options would require further development and would not be in place until future WRMP iterations, and yield uncertainty is included in the optimism bias for the option itself.

7.1.2 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 2050, an allowance will be made in final preferred target headroom for D4.

7.2 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 the selection of a glidepath of percentiles has been applied using a WRZ risk based approach common to WRE companies, so that the same profiles will be applied for companies where the WRZ risk is similar.

Table 19 Headroom profile percentiles

Headroom Profile	Percentile glidepath	Typical WRZ Characteristics
LOW RESILIENCE	95% initially (2025), reducing by 5% in each 10-year period to 2045 then remaining at 85%	Low resilience to climate change, significant risks from pollution etc; small, isolated resource zone with little or no raw water storage, small number of sources and/or limited supply flexibility.
MEDIUM RESILIENCE	90% initially, reducing by 5% in each 5-year period to 2050 then remaining at 65%	Moderate resilience to supply-demand balance uncertainty factors. Water supply system has some flexibility to mitigate loss of supply.
HIGH RESILIENCE	80% initially, reducing by 10% in each 5-year period to 2035, then 55% in 2040 and remaining at 55%	Low or no likely impacts from climate change (or significant climate change impacts already built into baseline supply-demand balance), high degree of flexibility / interconnectivity in water supply system.

For the CAM WRZ baseline we have selected the medium resilience scenario, due to future potential supply demand uncertainty related to licence capping, and applied the percentiles from the outage model accordingly. The risk profile starts at the 90th percentile and reduces each 5 year period until 2050, from when it is the 65th percentile until the end of the plan, which reflects a precautionary approach to our plan and uncertainty.

Headroom for DYAA conditions starts at 4.4Ml/d and reduces to 2.5Ml/d by the end of the planning period, in 2050. Further details are presented in the table below

Table 20 Target headroom DYAA and DYCP – 2025 to 2100

Year	DYAA (in Ml/d)	DYAA (%ile)	DYCP/peak (in Ml/d)	DYCP/peak (%ile)
2025	4.43	90%	6.41	90%
2026	4.43	90%	6.33	90%
2027	4.64	90%	6.38	90%
2028	4.75	90%	6.33	90%
2029	4.81	90%	6.46	90%
2030	4.16	85%	5.34	85%
2035	3.82	80%	4.93	80%
2040	3.48	75%	4.07	75%
2045	2.82	70%	3.51	70%
2050	2.59	65%	3.13	65%
2100	2.19	65%	3.51	65%

The breakdown of target headroom by sub component in figure 23 shows that uncertainty is dominated by the accuracy of demand-side data (D1−D4), with household forecasts uncertainty increasing over the plan.

A report detailing the headroom methodology and results is included in Appendix G.

8. Baseline supply/demand balance

Summary

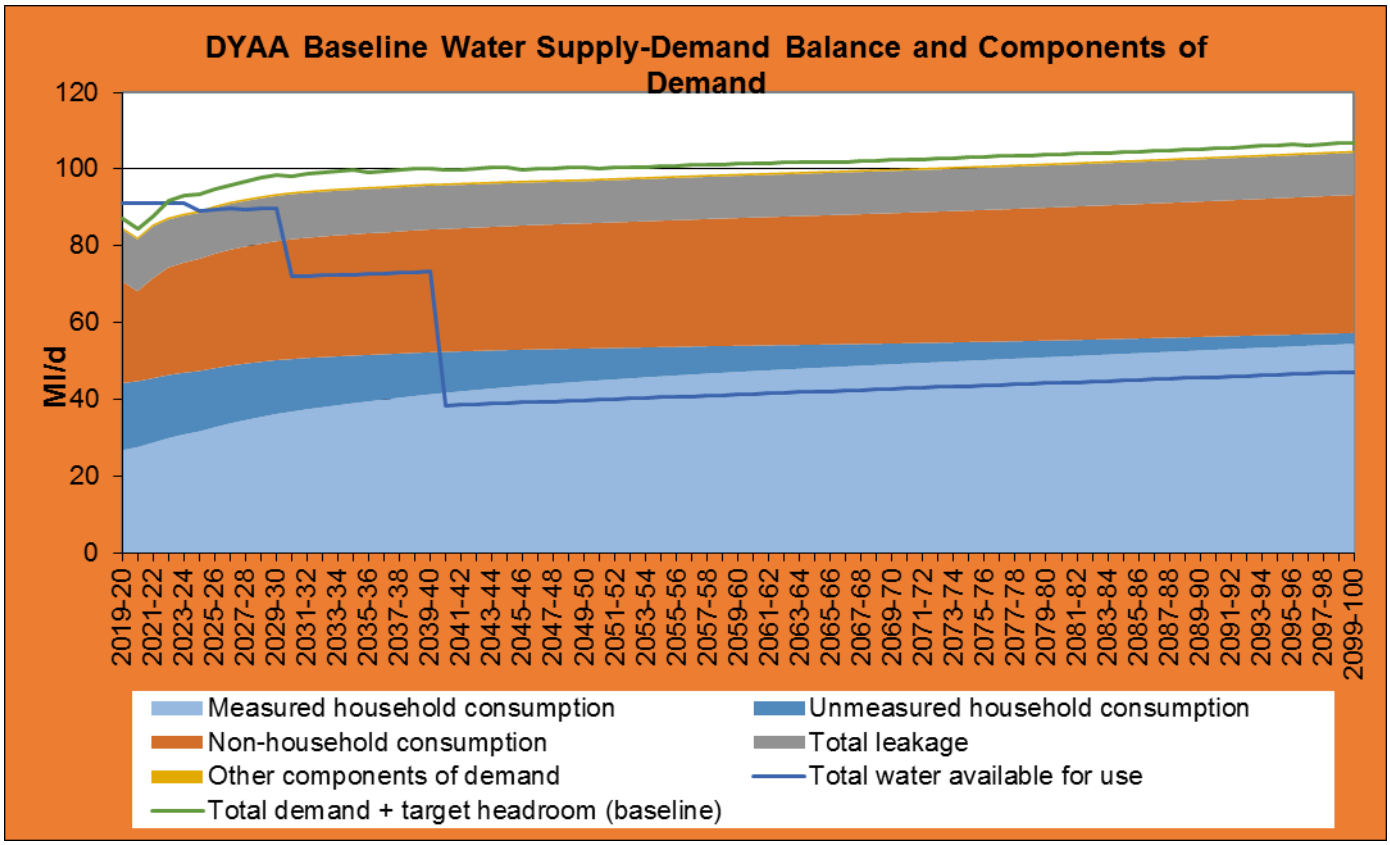
Our baseline supply demand balance is strongly influenced by growth in forecast demand, and by reductions to supply as a result of abstraction reductions to protect the environment against deterioration – as per Water Framework objectives - and future reductions to further improve and enhance the environment for environmental destination.

As a result, our baseline supply demand balance shows an immediate deficit.

8.1 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. It shows an immediate deficit from the start of the planning period in 2025.

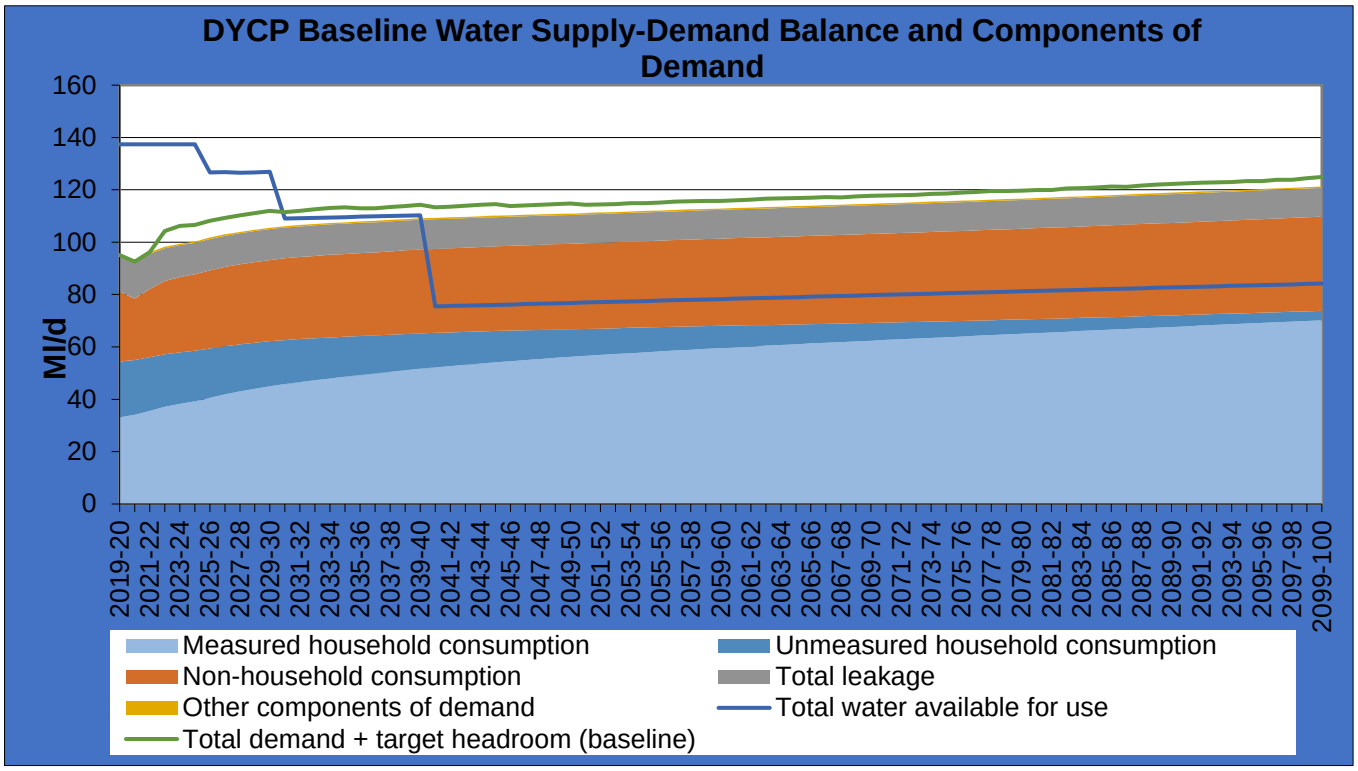
Figure 10 Baseline DYAA supply/demand balance and components of demand



8.2 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 2029/30, and a deficit is shown in 2040, as a result of environmental destination.

Figure 11 Baseline critical period supply/demand balance and components of demand



9. 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. Growth and the needs of the environment are driving increases in expected demands, and decreases in water availability respectively.

We have used a best value planning tool that includes weightings for customer preference, resilience environmental, and carbon impacts to help inform our proposed programme alongside a least cost approach.

We have developed an unconstrained list of options, including:

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

These have been screened and evaluated to define our list of feasible options. An SEA has been carried out on all feasible options to help inform the proposed programme. All options have been modelled in our best value planning 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**.**

As part of the options development process, it is also key to understand any dependencies and enablers to any of the options. The water industry has made several commitments in recent years which must be factored into WRMPs:

- Achieving 50% leakage reduction (from 2017/18 level) by 2050
- Reducing PCC to 100 l/h/d by 2050
- Net zero operational carbon by 2030
- Environment Act target of 9% non-household consumption reduction of 9% by 2037

For demand management in particular, there are two key enablers required for Cambridge Water to meet the first two ambitious demand management reductions. These are:

- Universal smart metering
- Water labelling – a government led initiative to label white goods (in the same way they are currently labelled for energy) in order to drive reductions in water usage in households

9.1 Overview

We have followed the Water Resource Planning Guidelines to develop our options.

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 best value planning approach is described in detail later in this section.

We have also discussed the potential range of options, and the pros and cons of each, with our customers through our engagement work detailed in chapter 4. This has helped to determine priorities and preferences, which has been incorporated into our approach.

Therefore, a full range of demand management options and supply options including all existing sources have been developed for modelling. 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.

Throughout the process we also consider;

- 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, natural capital valuation and the inclusion of carbon costs also allows us to optimise on other objectives for best value planning.

9.2 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.

The National Infrastructure Commission report[18] in 2018 recommends that the water sector will need additional supply and demand reduction of at least 4,000 Ml/day through additional supply infrastructure by the 2030s. This is in response to climate change and ensuring resilience to drought, and to meet the needs of a growing population.

[18] https://nic.org.uk/app/uploads/NIC-Preparing-for-a-Drier-Future-26-April-2018.pdf

Water Resources East has used these findings and determined that this would be the equivalent over 600Ml/d of future water requirements for water companies operating in the East. Regional modelling using a water resources simulator indicated that the abstraction reductions required to meet these needs could be around 60Ml/d or 50% of our existing water supplies. As part of our pre-planning for pre consultation, we have modelled the expected supply demand balance by applying existing supplies, expected unconstrained demand forecasts, and sustainability reductions for environmental need. This work supported the order of magnitude of required future abstraction reductions and supply needs. As a result the revised problem characterisation for the CAM WRZ is of high complexity and significant scale.

Figure 12 Problem characterisation assessment

		Strategic Needs Score ("How big is the problem")			
		0-1 (None)	2-3 (Small)	4-5 (Medium)	6 (Large)
Complexity Factors Score ("How difficult is it to solve")	Low (<7)	PR14			
	Medium (7-11)			PR19 - CAM	
	High (11+)				PR24

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 and the requirement to become resilient to 1in 500 droughts.;
- Cuts to existing abstraction licences, which are leading to sustainability reductions and restrictions on available groundwater resources to meet the needs of WFD No deterioration and future environmental improvements;
- long-term regional growth, which is being encouraged by the UK Government, but with large uncertainty over the amount and timing; and
- limited supply-side options within the Cambridge region, meaning inter-company bulk imports or significant resource development would be required to replace supplies. These carry additional uncertainty in timing, costs and availability.

9.3 Best Value Planning Approach

In the past, we have followed the economics of balancing supply and demand (EBSD) approach to develop our preferred, 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.

At WRMP19 we worked with Arup and Hartley McMaster, our incumbent provider for asset management optimisation, and 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.

For WRMP24, we needed to ensure we take a Best Value Planning (BVP) approach to developing our preferred plan, as laid out in the Water Resource Planning Guidelines. In addition, we need to ensure that our method for assessing best value is aligned with our other operating area, South Staffs Water, to ensure that our assessments are comparable for progression to our business plan for PR24.

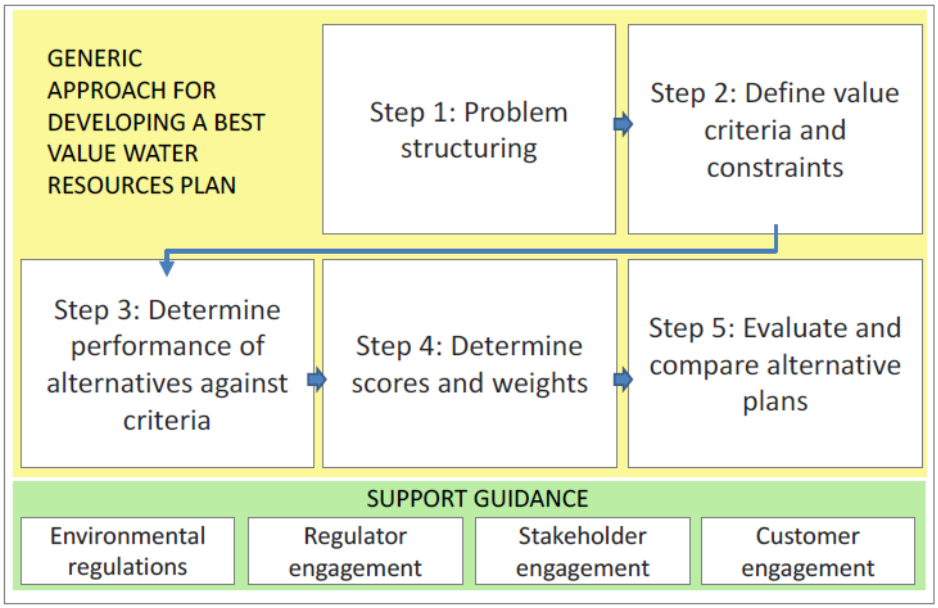
Water Resources West, and the water companies within it (including South Staffs Water), commissioned HR Wallingford and PJM Economics to develop a multi-criteria analysis tool that would allow companies to assess the value of options, as well as then produce the best value plan to resolve the challenges in each company and the region overall. We have chosen to adopt this tool to compliment the least cost modelling, and the regional best value planning undertaken for WRE for our Cambridge Water plan to maintain consistency with the South Staffs Water approach when assessing our plan against customer preferences.

The UKWIR (2020) framework for best value water resources management plans sets out a multi-criteria decision analysis (MCDA) approach for developing a best value plan, and the tool developed follows this approach.

A report detailing the modelling approach is included in appendices I, and a summary of key aspects is included in the following sections.

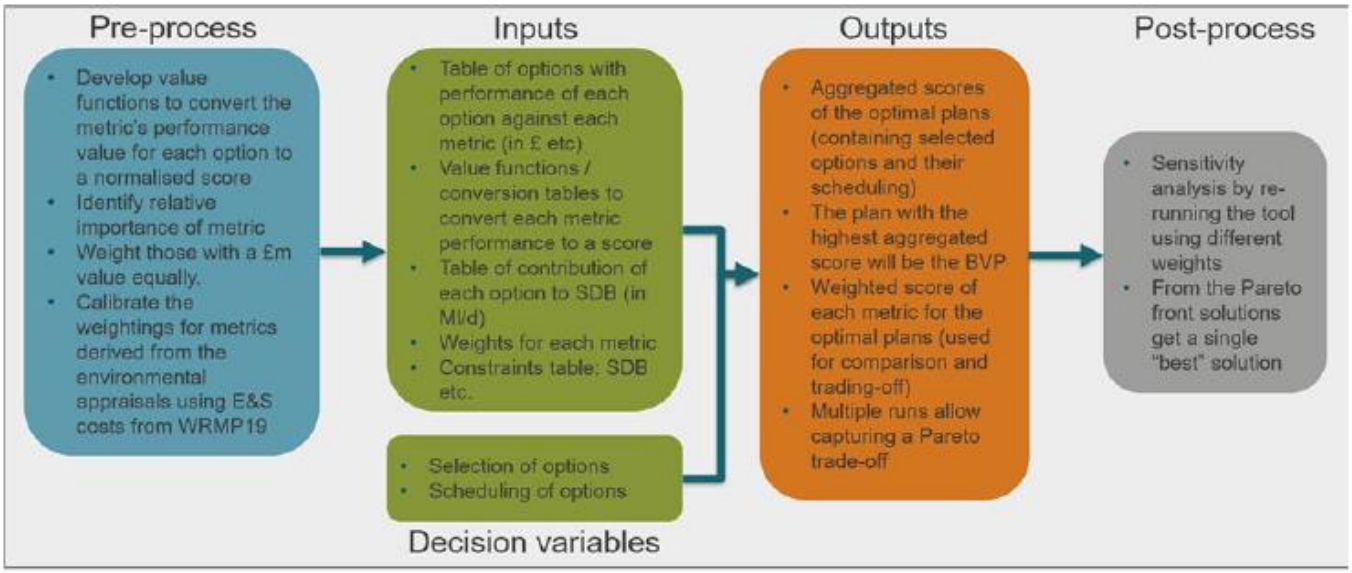
9.3.1 Tool Specification

Figure 13 Overview of the UKWIR (2020) framework for developing a best value water resources plan



The multi-criteria decision tool was designed to facilitate specific tasks within steps 3, 4 and 5. Figure 14 below shows the components of the decision tool (i.e. the inputs and outputs) and the pre and post process steps required for using the tool. The overall approach is a weighed sum optimisation method for plan generation and selection.

Figure 14 Components for the decision tool (inputs and outputs) and pre and post process steps plan.



9.3.2 Value Criteria (metrics)

UKWIR (2020) best value plan framework details the need to define value criteria and constraints. WRW refers to value criteria as metrics, and therefore we will continue to refer to metrics throughout this narrative.

It was a requirement of the multi-criteria decision tool that it enables the consideration of several different types of metrics since this is a fundamental concept in best value planning. WRW carried out a workshop for deciding on the metrics that would be used for the development of the Regional Plan. Cambridge Water have also adopted the same metrics for creating its WRMP. These metrics are listed in the table below:

Table 21 Metrics decided at Water Resources West

Ref.	Metric name	Description
1	Cost	Assessed by water companies. Total net present value (NPV) based on capital expenditure (CAPEX, initial and replacement) and operational expenditure (OPEX, fixed and variable).
2	PWS drought resilience	Assessed by water companies. Supply-demand balance change at 1 in 500 level.
3	Carbon costs	Assessed by water companies. Total NPV of monetised carbon costs.
4	Flood risk	Assessment from Strategic Environmental Assessment (SEA).
5	Human and social wellbeing	Assessment from SEA, covering health, human environment, social and economic wellbeing, cultural heritage, air quality assessments.
6	Sustainable natural resources	Assessment from SEA, Natural Capital Assessment (NCA) and Biodiversity Net Gain (BNG).
7	PWS customer supply resilience	Assessed by water companies. Customer valuations of willingness to pay (WTP) NPV, including supply interruptions, water quality, and water resources from SEA.
8	Multi-abstractor benefits	Assessment from SEA. Water quality and quantity, water resources.

9.3.3 Scores and weights

Given that the MCDA considers different types of metrics, each requiring different types of units, each of these measurements needs to be covert into a common scale for the MCDA process. This scale is typically represented between 0 and 100, representing the worst possible and acceptable outcome/performance and best possible and achievable outcome/performance respectively. Score as used to determine how the different performances are valued.

Subsequently, weights are required to denote the relative value of performance changes on different metrics, or the trade-offs between metrics. HR Wallingford facilitated workshops with Water Resources West members to develop the weights required.

9.3.4 ValueStream Tool

The tool that has been developed is known as “ValueStream”. ValueStream comprises two Excel workbooks:

- ValueStream1: This is the decision tool pre-processing workbook for metric scores and weights.
- ValueStream 2: This is the main decision tool workbook that solves and objective function to find a combination of options that solves the supply demand balance (SDB) taking into account the performance of options against a set of decision metrics (that are scored and weighted in ValueStream1).

9.3.4.1 ValueStream1

Valuestream1 facilitates the input of data from the SEA and NCA assessments, then elicits scores and weights. These outputs are then copied and pasted into ValueStream2.

For Cambridge Water, Ricardo undertook SEA and NCA assessments on feasible supply options. The outputs from these assessments were entered into the ValueStream1 workbook, which provided the scores and weights which were transferred directly into ValueStream2. The ValueStream1 workbook is found in Appendix J.

9.3.4.2 ValueStream2

ValueStream2 comprises several worksheets that enable the selection and scheduling of options to form a plan in order to meet a given SDB profile through the planning horizon.

Inputs are required for the following:

- Supply demand balance profile across the planning period
- Options, including constraints and their performance against each metric from ValueStream1
- SDB contribution of each options
- Metric weights

By changing the SDB profile and the constraints around the options, different planning scenarios can be tested to understand the best plan for different circumstances. It also enables sensitivity testing of a preferred plan to understand the need for any adaptive planning.

9.4 Options development

9.4.1 Demand side options

Demand management options have been developed with the assistance of consultants Artesia. Details of the process of developing options and feasible options considered are included in Appendix K**.** The suite of options was developed by applying a number of key targets and optimisation of the costs and savings for all available demand options

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.

We have adopted the industry public interest commitments, and developed these into 4 key areas of demand management in our proposed preferred plan;

- a 50% reduction in leakage by 2050, and triple the of the rate of leakage reduction in AMP8;
- Per capita consumption (PCC) of 110 litres per person by 2050
- Reductions in non-household consumption of 9% by 2037
- Rollout of universal SMART metering between 2025-2035

Our demand management options complement each other, and are also predicated by the government water labelling scheme for introducing more efficient household appliances.

9.4.2 Supply side options

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 N. 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** – remediation of mothballed sources, and trade or acquisition of sources from third parties;
- **new surface water sources**; and
- **trades with third parties** – neighbouring water companies and other licence holders.

Options development has followed a consistent process from unconstrained through to constrained and we have consulted with third parties and the environment agency for screening of options. All of our constrained options have undergone SEA.

We have evaluated a comprehensive number of supply side options that have been screened from our unconstrained list to feasible options, and propose a number of significant investments to meet the deficits in supply due to environmental need. These include:

- Imports from Anglian Water
- Optimising our sustainable licences
- Re-use and storage from water recycling works
- A partnership with Anglian Water to develop Fens Reservoir, a regional winter storage reservoir

The key stages of options development involve:

- Identification of unconstrained options through brainstorming events including both internal expertise together with leading industry consultants.
- The Environment Agency involved in both demand management options and resources options identification;
- Initial screening using criteria such as technical feasibility, environmental risk, water availability and other factors;
- Further stages of review and screening following more detailed scheme understanding and description;
- Environment Agency views sought on resources options; and
- SEA scoping occurring concurrently, for feasible options.

The process followed, and the options considered are shown below.

Figure 15 Options development process

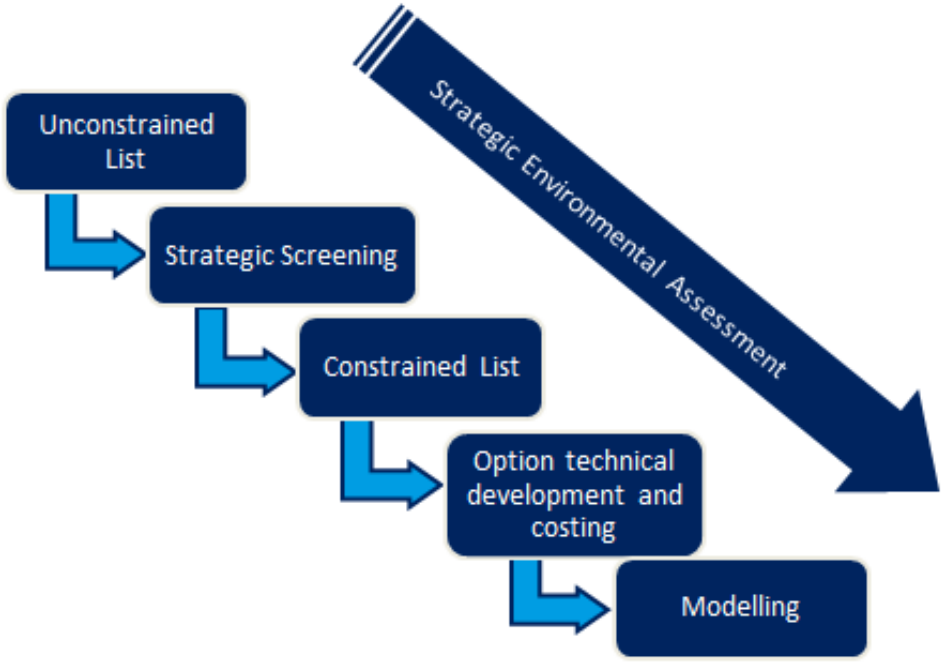


Table 22 WRMP options considered

Option type	Number of unconstrained options	Number of streamlined options	Number of feasible options in DMF	Comments
Maintenance of existing groundwater	24	9	2	Options relate to capital maintenance of existing sources including replacement boreholes and new treatment requirements to maintain existing DO and abstract to full licence
New groundwater	7	2	0	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	27	19	3	Options to develop new surface water sources, reservoirs and new associated treatment plants.
Transfers	23	16	6	Transfers of raw or potable water into existing network or new assets
Third party water and trades	21	7	0	Licence trading, water trades or third party resource options
Other	22	12	4	Options such as sea tinkering, desalination, iceberg import, ASR and re-use/recycling
Total	124	65	15	

Outline scheme design and costs were developed for each of the options included on the feasible list for least cost and best value modelling. The criteria used to evaluate each option in is described in the following section and follows the requirement set out in section 8 of the planning guidelines. An initial unconstrained list of 106 options was increased to c.124 to be reviewed for feasibility. The final list of constrained options was 15, and further sub options were developed as these were progressed to detailed options. These options were also provided to WRE to be included in the regional simulator and modelling.

9.5 Feasible options included in Modelling

All of the options have been reviewed and screened according to the criteria below which summarises how we evaluated options. A rejection log and tracking log of this approach is in Appendix N3

Table 23 Option screening criteria

Criteria	Considerations	Scoring considerations
Location of scheme benefits		
Scale	Yield and consideration of whether option DO is proportional to the estimated supply-demand deficit	Yield (high to low)
		Appropriate in scale to area of demand deficit (high to low)
Location	Option is within, or can serve, the area of estimated supply-demand deficit	Is it in the correct place for distribution network and location of demand deficit?
		Are there constraints in terms of location e.g. difficult to obtain access, likely to be developed on?
Future proofing	Ability to mitigate against future DO losses due to external events - climate change, licence reduction etc	Ability to mitigate future losses
Statutory / Regulatory / Legal Constraints		
Planning and Environmental	Likely to be acceptable in terms of planning and statutory environmental constraints	Likely to be acceptable in terms of planning and statutory environmental constraints
WFD	Scheme does not cause deterioration of a WFD water body	Scheme does not cause deterioration of a WFD water body
HRA	Scheme does not impact on Natura 2000 site.	Scheme does not impact on Natura 2000 site.
Other	Are there any other environmental constraints /showstoppers	Are there any other environmental constraints /showstoppers (likely to cause NE concern)?
Meet customer / stakeholder needs		
Customer	Scheme complies with customer acceptability	Customer acceptability
Internal Stakeholder	Compliments SST business plan, strategy and is in line with corporate objectives	Compliments SST business plan, strategy and is in line with corporate objectives
External Stakeholder	Likely to be acceptable to third party group including local stakeholder groups.	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	Option can be scaled and flexed operationally to meet supply-demand needs

Favourable	Option is favourable in comparison to other options available	Option is favourable when considering potential costs and other options available/other alternatives
Viability	Option is technically feasible	Option is technically feasible and likely to work in this instance/SEW has experience in delivering similar solutions
Known technologies	Option is achievable without significant R&D / trials	Option is achievable without significant R&D / trials, SEW has experience/option considered likely to work in this instance
Licensing	Abstraction licence is likely to be secured	Abstraction licence is likely to be secured and retained in the long term
Delivery risk	Are the risks and uncertainties acceptable	Are the risks and uncertainties acceptable (likelihood of failure/outages, vulnerable to future regulatory/legislation changes etc)

9.5.1 Maintenance of existing groundwater sources

Options relating to existing groundwater sources contributing to baseline DO are included for the baseline in our modelling.

Capital maintenance requirements have been identified separately for PR24 to ensure that decisions regarding new options are considered alongside options to maintain existing sources and that continuation of output from existing sources is included in our costs.

When considering capital maintenance schemes, the potential impacts on DO due to WFD no deterioration have been factored into the expected future yield, in particular for peak outputs. Expected sustainability changes and licence reductions are included in the adjusted baseline DO. Where options to re-instate sources on existing licences are included, then the DO has been reviewed to ensure that the option remains environmentally feasible and sustainable.

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

9.5.2 New sources

9.5.2.1 New groundwater sources

All options identified for new groundwater sources have been screened out from the feasible list. This is due to the Cam and Ely Ouse CAMS status for the groundwater catchments in our area and surrounding area being classified as no water available, or with limited water available that would not provide the required yield throughout a dry year scenario. Options to reinstate sites currently unused because of treatment requirements have also been reviewed in our screening process. Two options relating to an existing source in the shallow gravel aquifer – not assessed in CAMS – have been included in the feasible list.

Table 24 New groundwater sources options

Option	DYAA Yield Ml/d	CP Yield Ml/d	Major investment requirements
CW24-1A: Combined Ouse gravel sources - Fenstanton to St Ives (01A).	0.44	0.55	Existing licence, mothballed source. River gravels/shallow aquifer. Extensive rebuild required.
CW24-1B: Combined Ouse gravel sources - Fenstanton to St Ives (01B).	2.0	2.0	Existing licence plus additional licence volume, at mothballed source. River gravels/shallow aquifer. Extensive rebuild required.

9.5.2.2 New surface water options

There are limited available surface water resources within or close to our area of supply. The majority of chalk rivers typical of the area are unsuitable for large public water supply (PWS) abstractions and already are subject to environmental impacts. A number of surface water options with new reservoirs were considered on the unconstrained list, building on WRMP19 and consistent with WRE regional options. Further screening of these options identified that many utilised the same source of water as Fens Reservoir, a strategic resource option (SRO) being developed and promoted through both WRE and in Anglian waters adaptive WRMP19 plans. Subsequently this SRO has been accepted into the RAPID process and we have joined this process in partnership with Anglian Water to develop this option with 50 of the costs and DO benefit – see Section 10.

We have identified a single additional source of water, with flows supported by water recycling discharges that can be considered a surface source, or an effluent re-use scheme – these are also included in section 9.5.3.

Table 25 New surface water sources options

Option	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
CW24-57: River Cam abstraction & treatment works.	7	7	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
CW24-71: Milton WWTW Effluent re-use post effluent discharge.	7	7	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable
Fens Reservoir	43.5	43.5	New intake and treatment works, associated infrastructure, new reservoir and transfer pipelines, raw and potable

9.5.3 Transfers

We have held detailed discussions with Anglian Water and Affinity Water to consider the opportunities for bulk water trades. The WRE regional water resources strategy group also considers a variety of transfer options, and large resources options from all companies are included in the regional modelling. Some transfer options may be dependent on a larger resource being developed by one of the other companies to increase available resource to facilitate the trade and WRE considers these issues.

The screening process has identified a single transfer location with Anglian Water, with 3 variations on the option for different volumes. This has been developed in conjunction with an Anglian Water transfer option providing a link to provide a time limited surplus and spare capacity in the transfer before larger regional options can be developed. The option would be dependent on Anglian Water developing a new drought permit/curve for Ruthamford South surface water treatment works in AMP8 to support the transfer, and is likely to be time limited for a 6 year duration.

We have also included a transfer option associated with the development of Fens reservoir, this aligns with the potable transfer included in the RAPID scheme for Fens Reservoir, included in the above section.

Table 26 Transfer options

Option	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
CW24-75A: Potable transfer from AWS grid main crossing West to East through CAM area of supply (5Ml).	5	5	Cross-connection from AWS new strategic pipeline and polishing treatment
CW24-75B: Potable transfer from AWS grid main crossing West to East through CAM area of supply (10Ml).	10	10	Cross-connection from AWS new strategic pipeline and polishing treatment
CW24-75C: Potable transfer from AWS grid main crossing West to East through CAM area of supply (15Ml).	15	15	Cross-connection from AWS new strategic pipeline and polishing treatment
CW24-73A: Fens Reservoir potable water transfer	43.5	43.5	New reservoir (SRO scheme), transfer from Fens reservoir to Bluntisham and Madingley, storage reservoir and polishing treatment associated infrastructure

9.5.4 Other options

The only additional options that remain viable as a result of our screening are water re-use and recycling at large new development sites. These are include as supply options and not demand management options as they could include significant infrastructure that we could construct and maintain. These options would however, require support and buy-in from the developers of large sites in our area of supply, a number of these at the required scale are planned.

Table 27 Other options

Option	DYAA yield Ml/d	CP yield Ml/d	Major investment requirements
CW24-37A Site-scale greywater re-use	0.5	0.5	Site-scale greywater reuse scheme incorporated into large scale development (at full build out 10k properties). Dual pipe network, storage and treatment required
CW24-38 Site-scale rainwater harvesting	0.9	0.9	Site-scale rainwater harvesting scheme incorporated into large scale development (at full build out 10k properties). Dual pipe network, storage and treatment required

9.5.5 Fens Reservoir

Our feasible options include transfer(s) from Fens Reservoir to the CAM WRZ. Fens Reservoir is a Strategic resource option (SRO) that is being developed in partnership with Anglian Water, through the RAPID process. The reservoir is selected by regional WRE modelling under most, if not all future scenarios. With a start date on site of 2029 Fens Reservoir could be in supply between 2035 and 2037. Fens Reservoir is an embanked winter storage reservoir, with 55Mm3 of storage providing a useable volume of 50Mm3 with a proposed yield of 87 Ml/d, shared equally between Cambridge and Anglian water. The Fens Reservoir will unlock many multi sector benefits for agriculture, habitat, amenity and recreation, and is an essential option to meet the future environmental needs identified in our plan.

As the Fens Reservoir is being developed as an SRO, through development consent order, and the need is primarily identified through the WRE modelling and water resource simulator, including SEA and environmental assessment we have not explicitly included in our feasible list. We have however included the costs in our tables as these will be shared with Anglian water and are a fundamental part of implementling our WRMP.

9.5.6 Demand management

9.5.6.1 Metering

As part of this work we have considered Smart Network scenarios, which represents an integrated approach to demand management built on the foundation of installing smart meters on all households. This considers the benefit of Cambridge Water implementing smart metering in AMP8, AMP 9 or not at all.

Smart metering on its own does not deliver demand reductions, but it facilitates demand reductions across households, non-households and leakage through behaviour change and targeting savings in specific locations. To facilitate these changes there needs to be a bringing together of all the data, to allow analysis to be carried out to

support behaviour change and efficient and effective targeting of options. This also allows the demand management options to be considered in the context of the whole water balance.

To achieve the public interest commitments for leakage and PCC, we have looked at how to achieve these based universal smart metering being installed by the end of AMP8, AMP9 or not at all. This has then created portfolios of activities to achieve the target in each of these situations; although it should be noted that many situations cannot be achieved without smart metering being in place by the end of AMP9.

We have also tested the option of universal smart metering with our customers, as described in chapter 4.

9.5.6.2 Water labelling

Water labelling is also used as an enabler in the optimisation of demand management activities. When looking at how to achieve the leakage and PCC targets, we have compared the programmes required based on the following water labelling scenarios:

- Water labelling introduced with minimum standards
- Water labelling introduced with no minimum standards
- Water labelling is not introduced

The water savings from water labelling are described in Table 6 of the final report for the WaterUK PCC pathways project. After consultation with Water Resources South East, all companies have agreed to include the 'lower savings estimate' for water labelling without minimum standards as the agreed option.

For the optimiser, these savings are netted off the PCC pathway for household consumption reduction before the optimiser is run.

We make the assumption that government starts to implement water labelling in 2025.

9.5.6.3 Leakage Reduction

Artesia have assessed a range of options in order to achieve the 50% leakage reduction by 2050. They also assessed the following two scenarios:

Table 28 Demand scenarios for reducing leakage

Scenario Reference	Name	Description
LEA_01	Linear to NIC	Linear leakage reduction from 2025 to 50% of the 2018 leakage value by 2050 as per NIC recommendations.
LEA_02	PIC plus NIC	Linear leakage reduction to the PIC target in 2030, then a linear reduction to the NIC target in 2050.

Leakage activities assessed include:

- Proactive trunk mains leakage reduction
- Advanced pressure optimisation

- Customer supply pipe repair or replacement
- Distribution mains/comms pipe replacement
- DMA MOT
- DMA Active Leakage Control (ALC)
- NHH customer supply pipe repair or replacement

9.5.6.4 Household consumption (PCC) reduction

We have considered three PCC pathways which reflect on low, medium and high levels of ambition for PCC reduction by 2050. The medium pathway is based on the national framework for water resources target of 110 litres/person/day. The high and low pathways represent lower / higher ambitions for PCC targets:

Table 29 PCC demand pathways

Scenario Reference	Name	Description
PCC_01	PCC_LOW	120 l/h/d by 2050
PCC_02	PCC_MED	110 l/h/d by 2050
PCC_03	PCC_HIGH	90 l/h/d by 2050

For this optimisation, water labelling is included as an enabler. Three scenarios of water labelling are also tested – no water labelling, water labelling with minimum standards, and water labelling with no minimum standards. This has shown that water labelling is required in order to achieve the 110 l/h/d. In addition, the timing of the smart network and smart meter rollout also has a significant impact on cost and deliverability of this target.

As agreed at Water Resources West, we have agreed to include water labelling with no minimum standards as our option, and have taken the lower savings estimate for this. In this situation, and with a smart network and metering installed by the end of AMP9, the following activities are included in the optimiser:

- Community rainwater harvesting
- Water neutrality
- Household water efficiency programme (partnering approach, home visit)
- Housing associations – targeted programme
- Innovating tariffs
- Home retrofit RWH.GWR
- Increased media campaigns and school education
- New homes standards – voluntary
- Targeting properties for efficiency audits
- Community Water Efficiency Scheme

9.5.6.5 Non-household consumption reduction

The following options have been reviewed in order to deliver the targeted 9% reduction in household consumption by 2037:

- Non-household water efficiency programme (company led, self-install)
- Non-household water efficiency programme (company led, site visit with install)
- Retailer Incentive Mechanism

- NHH Enhanced Meter Technology
- Metering of leftover commercials
- Water audits retail

9.6 Customer support for options

Our approach to customer engagement and the findings from that work are described in detail in Chapter 4.

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.

9.7 Assessment of carbon & GHG emissions

9.7.1 Compliance with WRMP Direction 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. We commissioned Atkins to identify and produce embodied and operational carbon cost data for each of our feasible options (Table 30 below). This data then fed into our ValueStream (section 9.3) modelling to better determine our Best Value Plan.

Table 30 Operational and Embodied carbon (tonnes) used for each feasible option

		Operational	Embodied
Ref	Option name	Total tonnes of operational carbon over lifespan (80 years)	Total tonnes of embodied carbon
CW24-01A	Combined Ouse gravel sources - Fenstanton to St Ives (01A)	51	27
CW24-01B	Combined Ouse gravel sources - Fenstanton to St Ives (01B)	401	274
CW24-37Ai	Site-scale greywater re-use – large storage	347	846
CW24-37Aii	Site-scale greywater re-use – small storage	347	867
CW24-38A	Site-scale rainwater harvesting – large storage	256	207
CW24-38B	Site-scale rainwater harvesting – small storage	256	207
CW24-57	River Cam abstraction & treatment works.	2669	2303
CW24-71	Effluent re-use post effluent discharge	721	2610
CW24-73A	Fens Reservoir potable water transfer Site A	5446	2598
CW24-73B	Fens Reservoir potable water transfer Site B	5247	2911
CW24-73C	Fens Reservoir potable water transfer Site C	6320	3027

CW24-73D	**Fens Reservoir potable water transfer Site D**	6121	3978
CW24-75Ai	**AWS Potable Transfer (5Ml)**	0	33
CW24-75Aii	**AWS Potable Transfer (5Ml)**	0	289
CW24-75Bi	**AWS Potable Transfer (10Ml)**	0	48
CW24-75Bii	**AWS Potable Transfer (10Ml)**	0	560
CW24-75Ci	**AWS Potable Transfer (15Ml)**	0	48
CW24-75Cii	**AWS Potable Transfer (15Ml)**	0	816

The operational carbon costs have been derived from each options' total power (kWh) usage multiplied against a grid carbon factor (tonnes CO2e/kWh) over the 80 year period from 2025. This grid carbon factor has been taken from the government's 'Greenbook supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal', data tables 1 to 19[19]. From this spreadsheet, Table 1's electrical emission factors provide long-run marginal estimates for commercial and public sector consumption base. This was selected as appropriate for Cambridge due to the relatively small change from the overall Cambridge usage, thereby providing a more conservative case for the operational carbon estimation, as well as to align with the operational data produced for South Staffs.

For the embodied carbon costs, WMC's TR61 V14 tool was chosen as an appropriate method to produce each options' embodied carbon. The options' asset data is then fed into TR61 to produce the final embodied carbon costs

Also, to signpost where further information on this can be found outside of our WRMP, we as the South Staffordshire group, report our estimates of greenhouse gas emissions in our annual reports.

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 in the demand forecast section 10.1

We constantly review our total GHG emissions and carbon impacts and have a programme of reducing these for all our operations and investments, and a plan to achieve net zero, separate to this plan

[19] Reference: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

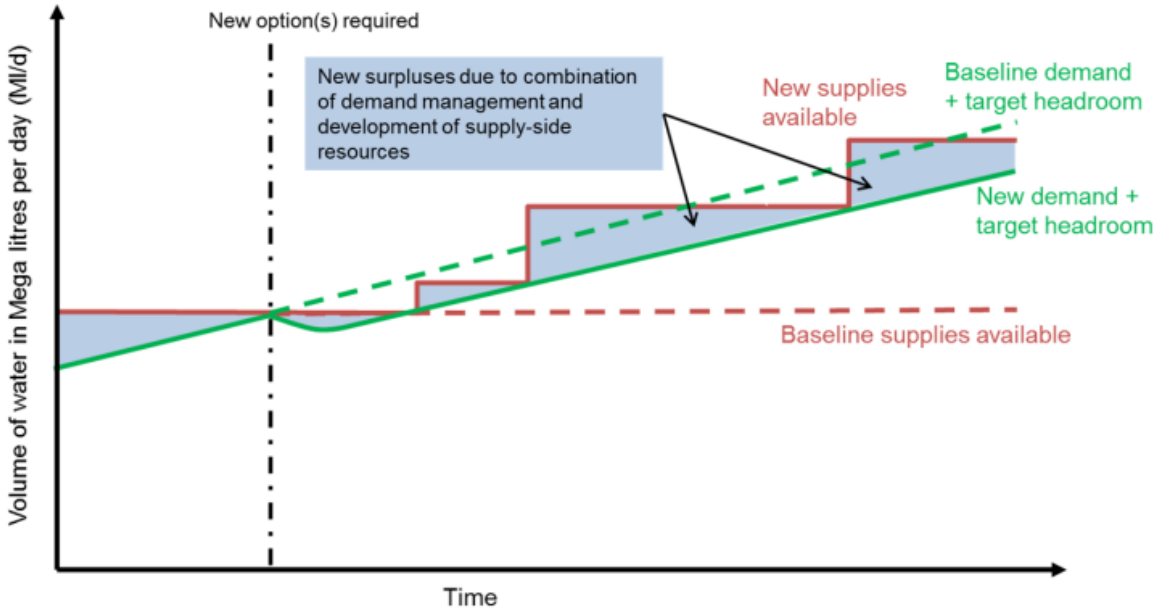
10. Modelling results

10.1.1 EBSD and the Least Cost Plan

As covered to in section 9.3, we have chosen to use the ValueStream model to determine our Best Value Plan. We have also continued to use the Economics of Balancing Supply and Demand (EBSD) model to determine our Least Cost Plan using the same tools and approach developed by Atkins and the University of Manchester for WRE, to ensure consistency. The EBSD model produces a comprehensive long-term supply and demand balance (SDB) that considers a number of different parameters.

For the purposes of producing our Least Cost Plan, EBSD has considered the Capex and Opex costs of each option and balanced this against the WAFU (Water Available For Use) that they provide. As Figure 16 details below, when a deficit in the planning period occurs, EBSD will look for a suitable option that will resolve the supply-demand balance while considering the cost implications and WAFU of the option.

Figure 16 EBSD's approach to investment modelling to solving supply-demand balance deficits



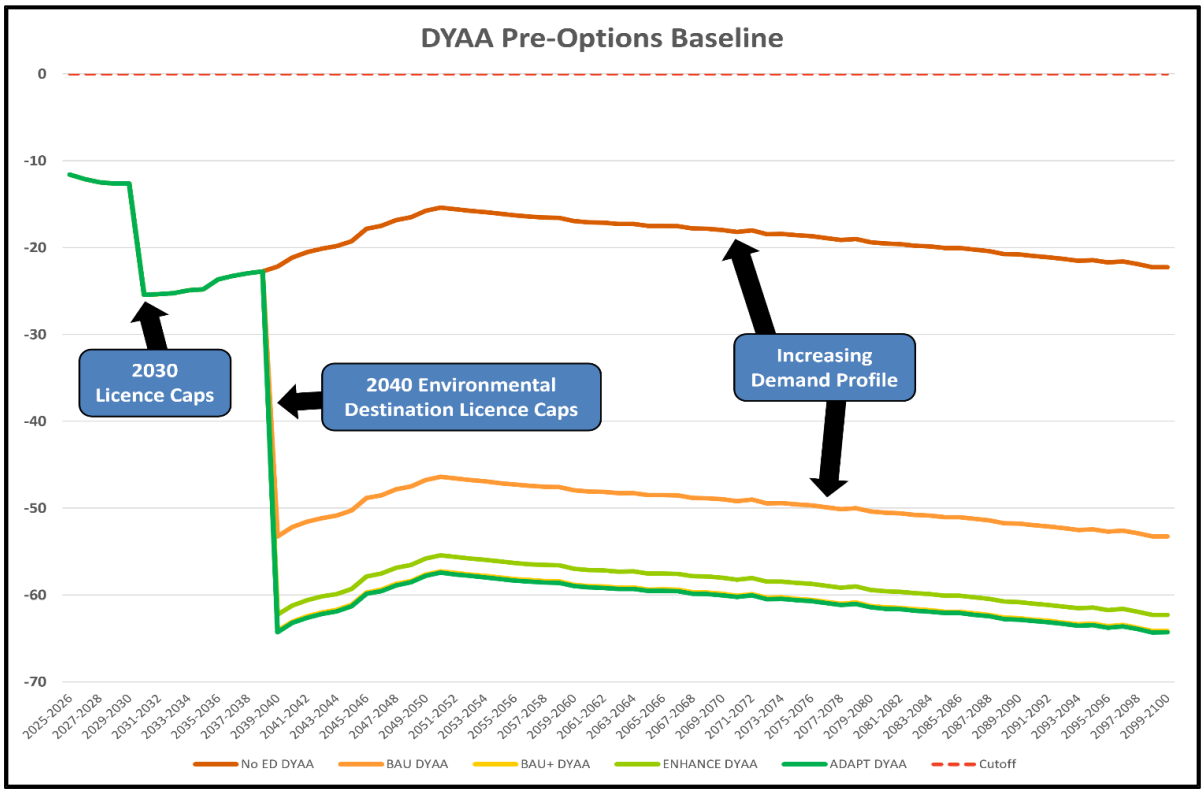
10.1.2 Considerations and Outputs

EBSD is capable of producing both a baseline supply-demand balance without options and a refined supply-demand balance with a full portfolio of selected options with respect to both Dry Year Annual Average (DYAA) and Dry Year Critical Period (DYCP) constraints. We have also used demand management options (DMOs) in all of the EBSD runs to ensure that the modelling is consistent with ValueStream's outputs (the DMOs used in ValueStream are covered in section 9.4.1). The model considered five different scenarios across six different runs and included demand management options. These runs and scenarios are shown in the below Table 31 while Figure 17 describes how all scenarios in a DYAA baseline run will be in an SDB deficit immediately without any options being selected.

Table 31 Runs and Scenarios used in EBSD modelling

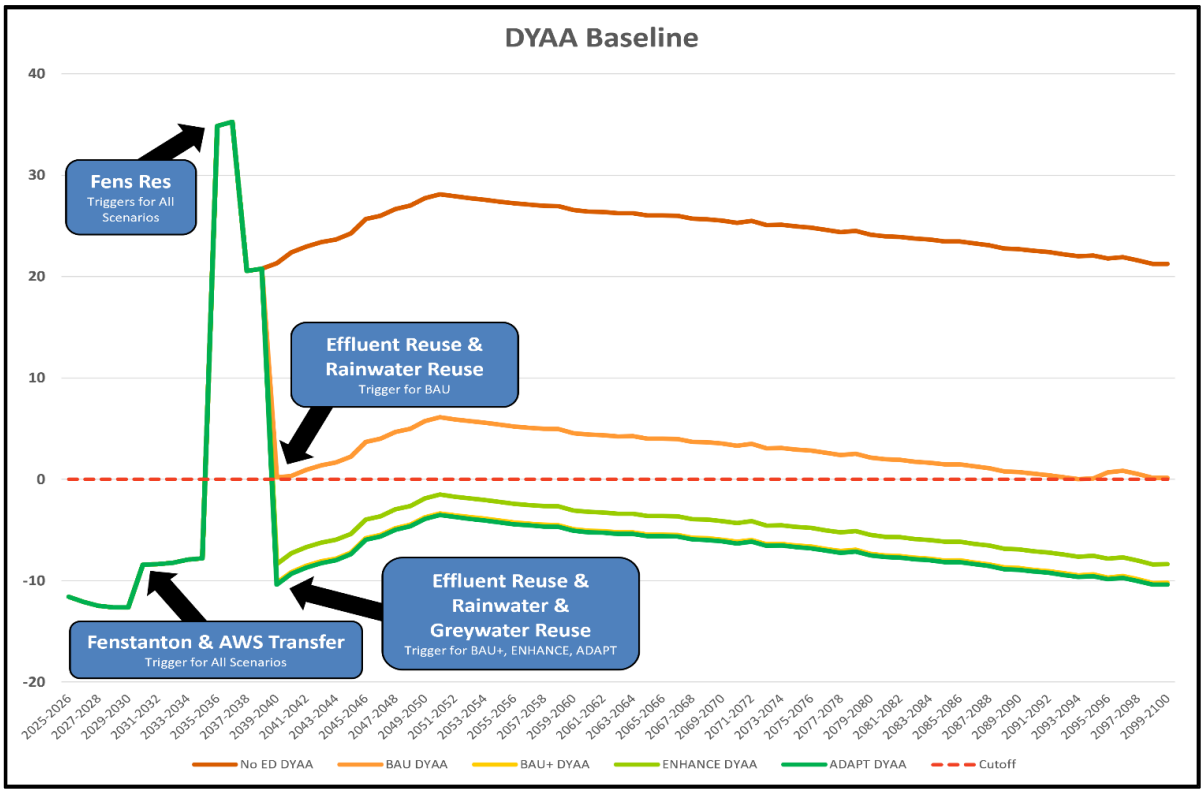
Run	Scenario
Baseline	BAU (Business As Usual)
No Greywater & Rainwater Reuse (CW24-37 & -38)	BAU+
AWS Transfer does not end (currently set to finish in 2036) (CW24-75)	ENHANCE
Fens Reservoir and Environmental Destination Caps delayed to 2040 (CW24-73A)	ADAPT
Environmental Destination Caps accelerated to 2035	No Environmental Destination

Figure 17 Supply-Demand Balance from 2025 to 2100 as modelled by EBSD without any options



The five scenarios considered by EBSD differ in the severity of the environmental destination licence caps that are due to be implemented in 2040, as can be seen above. While all scenarios will see a decline in SDB due to increasing demand anyway, the 2025 & 2030 licence caps and 2040 environmental destination licence caps will have the greatest impact on the supply-demand balance. By including the options into EBSD the selected options will change the baseline DYAA SDB. However, as Figure 18 explains all of the scenarios will see an SDB deficit at some point between 2025 and 2100, even with all options selected.

Figure 18 Supply-Demand Balance from 2025 to 2100 as modelled by EBSD with all options



This modelling would therefore suggest that the preferred supply and demand options in our Least Cost Plan will not be enough to solve the baseline SDB deficit. Our major strategic option, Fens Reservoir (CW24-73A) will provide a strong surplus when it is operational, however as EBSD shows this will not be enough to prevent the deficit caused by the 2040 environmental destination caps even with all other options in three of the scenarios. Additionally, in the near term, there will be a deficit from 2025 to 2035 (when Fens Res triggers) that cannot be fully solved by the current supply options, even when all of the available options have been picked. This has also been evidenced in other runs that consider different availabilities of options.

Figure 19 Supply-Demand Balance from 2025 to 2100 with all options except the grey- and rain-water reuse

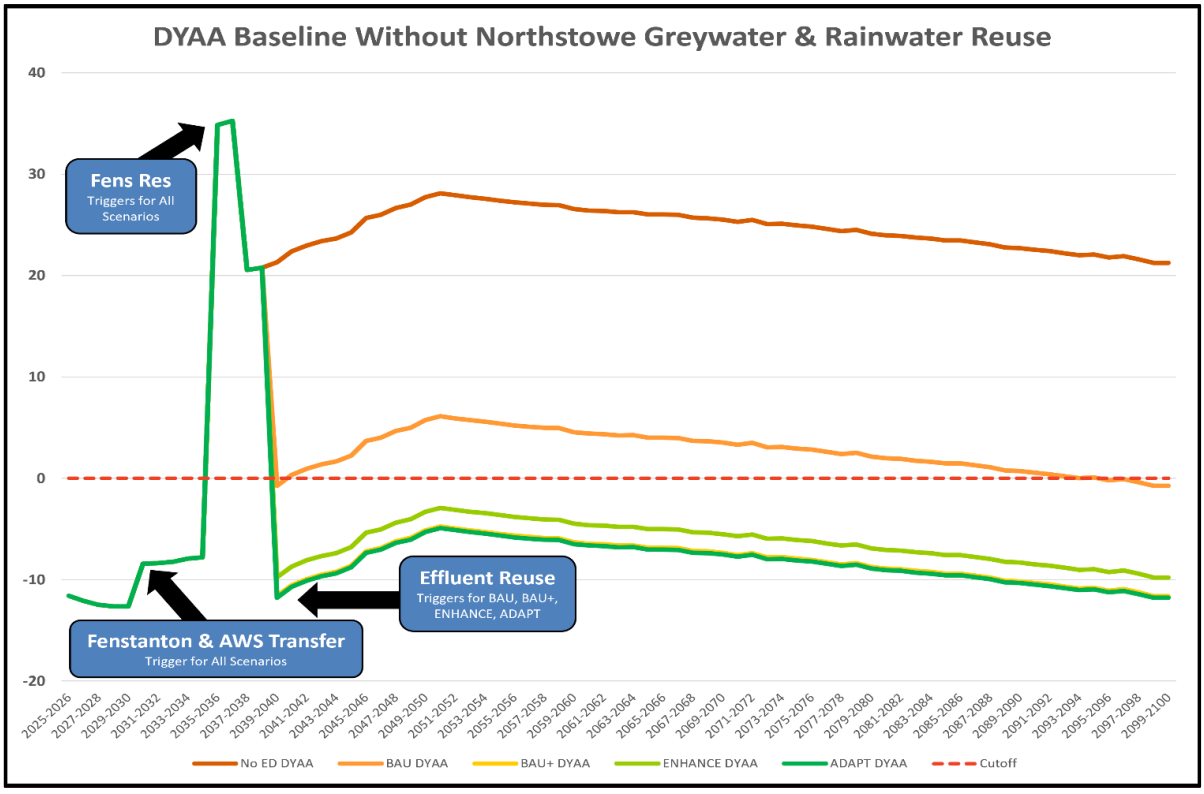
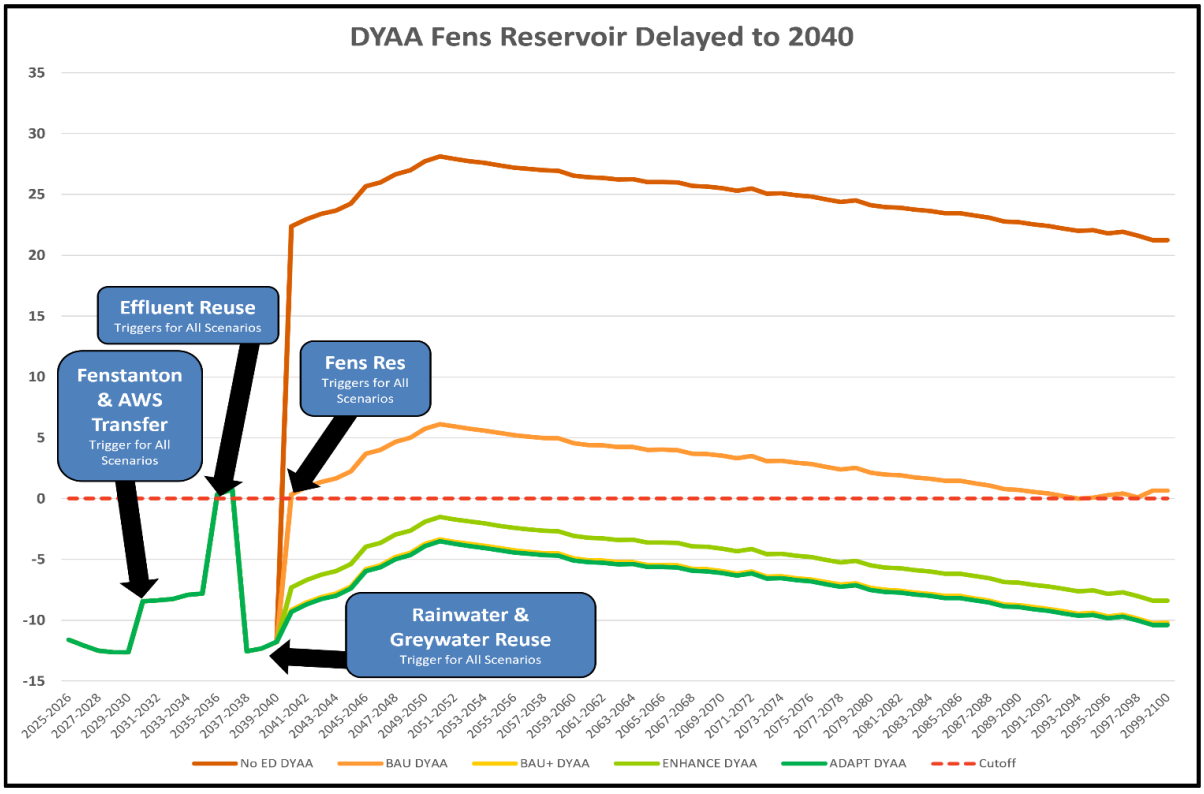


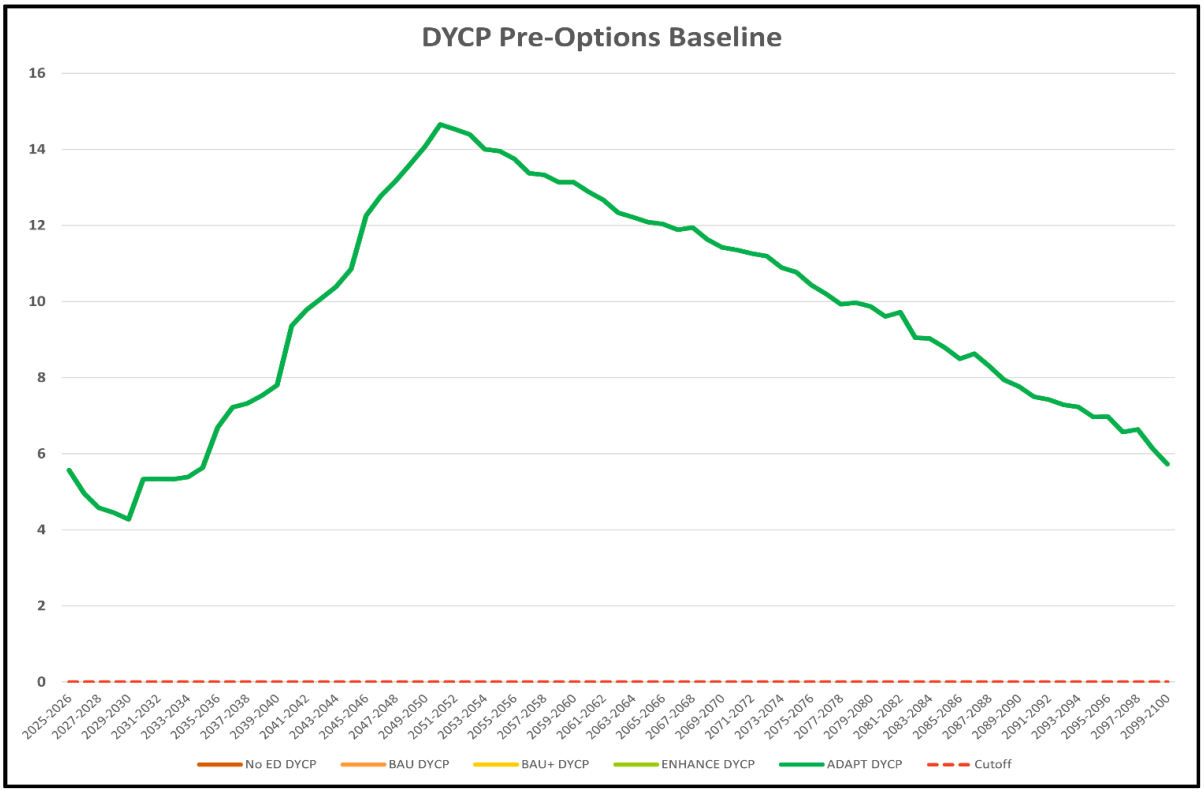
Figure 20 Supply-Demand Balance from 2025 to 2100 with Fens Reservoir delayed to 2040



As Figures 19 and 20 have shown, the SDB even in non-baseline scenarios is often negative, even though all options are almost always being selected as soon as they are available. Therefore, our EBSD DYAA modelling has shown that our Least Cost Plan will select all available preferred options as they are all needed to reduce the SDB deficit experienced in all scenarios.

It is also important to note that EBSD has produced DYCP modelling data alongside DYAA information. Below in Figure 21 the DYCP no-option baseline is fortunately always positive in terms of its supply-demand balance. This means that no options are needed to be selected as there is no deficit to solve. This does not, however, circumvent the DYAA findings and so all options are needed for the Least Cost Plan.

Figure 21 Supply-Demand Balance from 2025 to 2100 DYCP baseline showing no deficit



10.1.3 Modelling Summary

Both the EBSD and ValueStream modelling have shown a clear relationship in their supply-demand balance predictions. The two models have seen a large deficit occurring from 2025 to 2035 due to licence capping, with an even steeper deficit in 2040 caused by the environmental destination licence caps. Almost all options with the highest Water Available for Use (WAFU) have been selected to cover these predicted deficits across the different environmental destination scenarios and differing runs. These selected options have gone some way to reducing the SDB deficit, particularly with the expected activation of the Fens Reservoir in 2035.

Yet these preferred options have not been enough to mitigate the deficit: the baseline run in EBSD predicts a 7.8 – 12.6 Ml/d deficit from 2025 to 2035, even with the highest Fenstanton and AWS transfer options selected. This near-term deficit has largely been caused by rising demand and increasing licence caps which will be carried out in two cycles – gradually at first in 2025 and then more heavily from 2030. As alluded to, Fens Reservoir will provide a significant increase to our supply. Its 43.5 Ml/d supply input will greatly contribute to reducing the modelled deficits in the next few decades.

Other options such as the effluent reuse as well as the grey- and rain-water reuse that also trigger in 2035 will help to additionally help to reduce the SDB deficit and counter demand. However, the 2040 environmental destination licence caps will pose a risk to the supply-demand balance as it will force many scenarios back into a deficit. This will place greater pressure on managing supplies and will increase the importance of reducing demand through more efficient and widely spread demand management options.

Ultimately EBSD and ValueStream both generally agree on which options to utilise and when. We have assessed our Least Cost Plan against the same metrics as the Best Value Plan to ensure consistency and we have seen that both plans show a deficit on multiple occasions through their modelling. This means that both our Least Cost and Best Value Plans are the same and that there is not Adaptive Program because all preferred options will be in use.

11. Our proposed programme

Summary

Demand Management

Our proposed programme has an ambitious demand management programme as its first commitment.

Our plan will achieve:

- 50% reduction in leakage (from 2017/18 levels) by 2050 and trebling of the rate of reduction in AMP8
- 110 l/h/d household consumption by 2050
- 9% reduction in non-household consumption by 2037

Key enablers for this delivery are:

- Delivery of the Government's water labelling scheme for white goods by 2025
- Universal smart metering installed across the region by 2035

Our customer engagement shows that our customer support a demand focused plan. They are also supportive of universal metering; however there is a strong theme that we need to ensure we have the appropriate support mechanisms in place to protect vulnerable and large families. We are developing these support packages and plans as part of our business plan submission PR24.

Supply options

We have include a number of supply options in our plan, these include all of those in our feasible list;

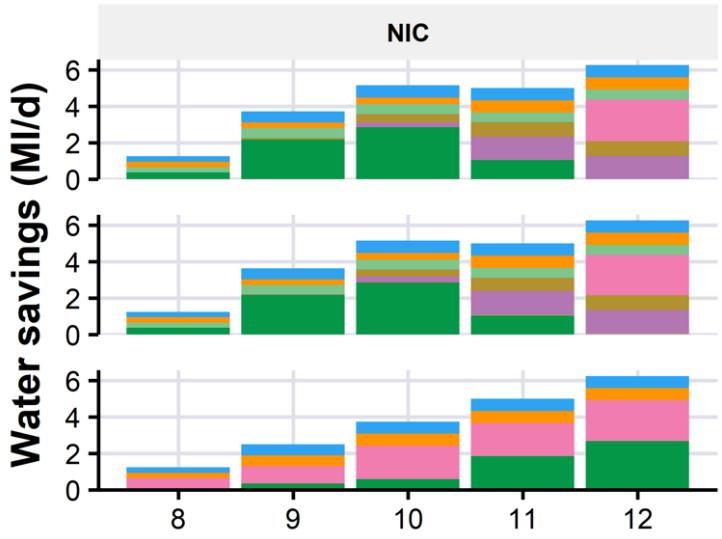
- 15 Ml/d of time limited transfers
- 1.4Ml/d of water re-use/recycling in development
- 7Ml/d of new resource – effluent re-use
- 2Ml/d of licence optimisation
- 43.5Ml/d of new regional reservoir and transfers (Fens)

11.1 Demand management proposals

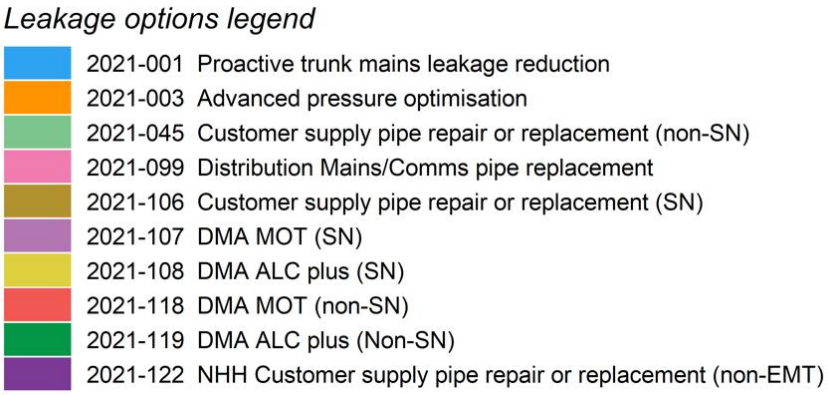
11.1.1 Leakage reduction

We are including delivery of the 50% leakage reduction by 2050, whilst tripling the rate of leakage reduction by 2030 in our proposed plan. The below graph shows how the combination of activities are proposed in order to deliver the 50% reduction, as per the results from the optimiser shown in Figure 22 below. The top chart shows if smart metering were in place by the end of AMP8, the middle chart shows is smart metering were in place by the end of AMP9 and the bottom chart shows if there were no smart metering/network in place.

Figure 22 Leakage reduction activities



The optimiser showed that we need a smart network (including smart metering) to be in place in order for the target to be achieved. Smart metering enables additional options to help reduce leakage after AMP9 which enables us to meet the target



As evidenced in chapter 4, 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.

Table 32 below shows the benefit each individual activity provides over the lifetime of the plan:

Table 32 Demand savings per leakage activity

				Cumulative benefit by AMP				
Activity	**ID**	**Year activity starts**	**Total benefit by 2050 Ml/d**	**AMP 8**	**AMP 9**	**AMP 10**	**AMP 11**	**AMP 12**
Proactive trunk mains leakage reduction	2021-001	2025	0.67	0.3	0.6	0.67	0.67	0.67
Advanced pressure optimisation	2021-003	2025	0.67	0.3	0.3	0.37	0.67	0.67
Customer supply pipe repair or replacement (without smart networks)	2021-045	2025	0.54	0.27	0.54	0.54	0.54	0.54
Distribution Mains/Comms pipe replacement	2021-099	2045	2.16	0	0	0	0	2.16
Customer supply pipe repair or replacement (with smart networks)	2021-106	2035	0.8	0	0	0.36	0.72	0.8
DMA MOT (with smart networks)	2021-107	2035	1.34	0	0	0.34	1.34	1.34
DMA MOT (without smart networks)	2021-118	2025	0.06	0.06	0.06	0.06	0.06	0.06

Our leakage plan looks to build on existing leakage activities and technologies in the first years on the plan – these activities are well understood and tested, and therefore confidence in delivery is high. As we move through the planning period, the introduction of smart metering enables additional activities or allows existing activities to be undertaken more cost effectively and efficiently.

Alongside this, we will continue to identify innovative opportunities to identify and reduce leakage. We are part of several bids as part of the Ofwat Innovation fund that relate to leakage e.g. a proposal to explore dark fibre to identify leakage. These activities will help to supplement the existing methods and technologies to support delivery of our ambitious targets.

11.1.1.1 Leakage reduction costs

We have included the cost of our proposed leakage reduction programme in the following table.

Table 33 Cost of our proposed leakage reduction programme

	Option ID	**AMP8 £M**	**AMP9 £M**	**AMP10 £M**	**AMP11 £M**	**AMP12 £M**	**Total £M**
Proactive trunk mains leakage reduction	2021-001	1.96	1.96	0.46	0	0	4.38
Advanced pressure optimisation	2021-003	0.05	0	0.01	0.05	0	0.11
Customer supply pipe repair or replacement (without smart networks)	2021-045	0.11	0.13	0.04	0.04	0.04	0.36
Distribution Mains/Comms pipe replacement	2021-099	0	0	0	0	7.77	7.77

Customer supply pipe repair or replacement (with smart networks)	2021-106	0	0	0.11	0.13	0.07	0.31
DMA MOT (with smart networks)	2021-107	0	0	0.91	2.68	0	3.59
DMA MOT (without smart networks)	2021-118	1.45	0.04	0.04	0.04	0.04	1.61

11.1.2 Metering

At WRMP19, our customer engagement found that customers did not support a compulsory metering approach. Since then, Cambridge Water region has been declared an area of serious water stress by the Environment Agency. As a result, we have again explored the concept of compulsory metering with our customers for WMRP24.

It is important to understand the background changes since our last round of customer engagement at WRMP19. Energy smart meters are now common place in homes as technology over the last five years has increased. With the recent energy price rises, customers are turning more and more to smart meters to have better information and take control of their usage. Having access to this level of data is now seen by customers are necessary, rather than a nice to have. Throughout our surveys, those customers with smart meters acknowledged that they had changed their behaviours as a result to reduce their usage and save money.

As a result, we saw a change in attitude to compulsory metering among our customers at WRMP24. It should be noted that we have used the term “universal metering” to customers, although we have explained the link to compulsory metering. This is because our aim would be to achieve universal metering over a set period of time in order to better inform our own activities and to help customers change their behaviours.

As evidenced in chapter 4, customers viewed increased metering as a necessary and important approach for us to undertake. They believe it to be a fair way for all. However they did raises concerns around affordability especially in the most recent customer engagement completed in the summer of 2022 as the cost of living crisis intensified, and wanted South Staffs to ensure they made provisions to support vulnerable and large families.

As also explained in chapter 4, we did receive majority support from our customers for universal metering. We take the issue of affordability extremely seriously, and are developing plans that will be included at PR24 detailing how we will build on our existing support packages and offerings. We will also look at options such as “host metering” – in this case, we would install meters but not immediately convert the customer to a metered bill. Over a period of one or two years, we would provide regular information to the customer to share the bill impacts of transferring, with the aim to convert customers to metered bills sooner where savings are achieved, or enable customers to prepare adequately or seek support from us in situations where bill increases would be seen.

In our WRMP tables, metering is shown as delivering zero supply or demand benefit. This is because we believe installing meters does not automatically deliver demand savings – it is more an enabler for additional activities that will reduce household consumption, such as customer education and innovative tariffs. Therefore, it may look in the tables as though there are better options to pick that would be cheaper and deliver more benefit. However, it is critical to understand that many of the other activities in the tables and the preferred plan depend on having smart meters in place in order to enable them. An example would be innovative tariffs – without smart metering in place we are unable to create green or community tariffs that incentivise customers to use less water. There is data that suggests that installation of a meter can lead to between 10% and 15% reduction in household water use – however, we believe that this needs to be supported through the provision of information and education to customers to understand their water usage if these reductions are to be recognised, particularly as research has shown that this reduction reduces over a 5 year period to potential 5% or less. Hence our conservative approach of counting now direct water saving benefit from solely installing a meter.

Therefore our plan looks to install smart metering across our entire customer base, achieving 100% penetration (or as close to this as feasibly possible, accepting there will be properties where this is not possible, such as shared supplies) by 2035. This 10 year roll out programme will be achieved efficiently by rolling out meters geographically, focusing on DMAs with high water usage first in order to make the biggest impacts.

Our plan assumes these smart meters will all be AMI. In reality, there will be situations where AMR is more appropriate, e.g. rural areas, and this split will be better understood for PR24. We will aim to use AMI wherever possible, and the cost difference between the two types of meter is minimal.

We estimate we currently have 30,340 unmeasured household properties in our region. To deliver universal metering, we will be looking to install circa 3000 meters per year across the ten years from 2025 to 2030. New properties will be metered upon completion. However, there are also currently some properties, approximately 12,000, that currently have a dumb metered fitted. As part of our programme, we will look to replace these with AMI smart meters. In total therefore we will be looking at installing 4,200 meters per year.

As we believe metering is a key enabler for activities with drive leakage reduction as well as PCC reduction, we are keen to accelerate this work wherever possible. As such, as part of the Defra accelerate spend initiative, we have proposed to accelerate this work by two years and therefore starting in 2023. This would enable us to complete the work two years earlier in 2033, should our bid be successful. This will add more security in the delivery of both the leakage and PCC ambitions as we will have more data and information to enable these activities.

11.1.2.1 The cost of metering

We have included the cost of our proposed household metering programme in the following table.

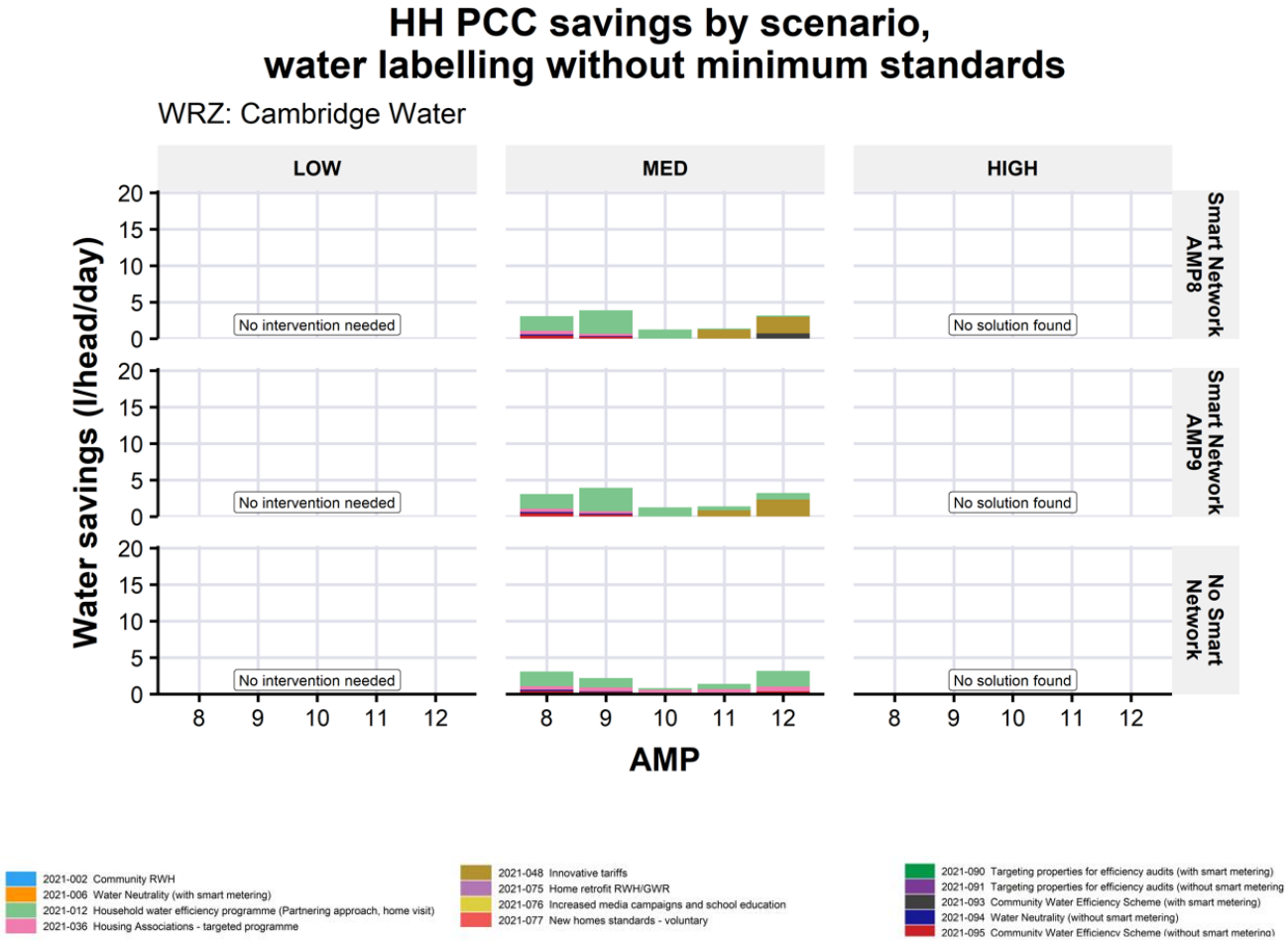
Table 34 Cost of our proposed household metering programme

	AMP8	AMP9
Capital costs	1.88m	£1.88m
Opex Costs	£7.15m	£7.15m

11.1.3 Water efficiency

We are including delivery of 110 l/h/d by 2050 in our proposed plan. The below graph shows how the combination of activities are proposed in order to deliver this household consumption reduction, as per the results from the optimiser shown in Figure 23 below:

Figure 23 Water efficiency activities



The optimiser showed that we need a smart network (including smart metering) to be in place in order for the target to be achieved. Smart metering enables additional options to help reduce leakage after AMP9 which enables us to meet the target.

As evidenced in chapter 4, our customers have stated that they want us to do more to educate customers in their water usage and the ways to save water. As well, they want us to share more information to all of our customers of why this is so important; so to share more on our water stress status, the future challenges and the link between demand and the environment.

Table 35 below shows the benefit each individual activity provides over the lifetime of the plan:

Table 35 Water efficiency demand savings for Cambridge Water

				Cumulative benefit by AMP				
Activity	**ID**	**Year activity starts**	**Total benefit by 2050 Ml/d**	**AMP 8**	**AMP 9**	**AMP 10**	**AMP 11**	**AMP 12**
Household water efficiency programme (partnering approach, home visit)	2021-012	2025	3.22	0.78	2.08	2.60	2.83	3.22
Housing associations - targeted programme	2021-036	2025	0.30	0.18	0.30	0.30	0.30	0.30
Innovative tariffs	2021-048	2040	1.34	0	0	0	0.35	1.34
Water neutrality (without smart metering)	2021-094	2025	0.12	0.07	0.12	0.12	0.12	0.12
Community Water Efficiency Scheme (without smart metering)	2021-095	2025	0.26	0.16	0.26	0	0	0

We also propose to continue with our Developer incentive programme, which has helped to deliver reductions in proposed demand throughout AMP7 and we will include these proposal in our PR24 submission.

We are also partners in various proposals that have been submitted to the Ofwat Innovation Fund relating to reducing household consumption. One project looks at trialling the installation of flow reducing devices at properties, which in early trials has been shown to reduce usage by 10 litres per person per day. Another project looks at reviewing shower water usage and helping to understand behaviours that can then enable education and awareness programmes, as well as identify further technological opportunities for innovation to save water. We continue to actively pursue these opportunities and other innovative options and technologies to help ensure delivery of this target.

It is important to note that PCC reductions in AMP7 remain a challenge following the Covid-19 pandemic. Whilst levels of household usage are reducing, we are not yet seeing pre-Covid levels despite extensive water efficiency work above our proposed WRMP19 programme. The uncertainty of what the new “normal” will be, with hybrid working more established as a working pattern since the pandemic, will be monitored through our annual WRMP reviews.

11.1.3.1 Water Labelling

As mentioned, the introduction of water labelling provides large volumes of proposed savings to household efficiency. By providing information on water consumption to customer buying white goods and bathroom fittings, evidence from a similar scheme in Australia and the rollout of the energy labelling scheme in the UK has shown that it does drive changes in customer behaviour.

It is therefore critical that the Government progresses with the proposed scheme, which is currently out to consultation in autumn 2022. We are also keen that the scheme should develop to include minimum standards for buildings, as this would help deliver additional savings in the future.

The below table highlights the level of savings proposed through water labelling:

Table 36 Water labelling demand savings for Cambridge Water

				Cumulative benefit by AMP				
Activity	**ID**	**Year activity starts**	**Total benefit by 2050 Ml/d**	**AMP8**	**AMP9**	**AMP10**	**AMP11**	**AMP12**
Water labelling no minimum standards	WL_02	2025	5.65	0.61	1.97	3.77	4.94	5.65

11.1.3.2 Water efficiency costs

We have included the cost of our proposed water efficiency programme in the following table.

Table 37 Cost of our proposed water efficiency programme

	Option ID	AMP8 £M	AMP9 £M	AMP10 £M	AMP11 £M	AMP12 £M	Total £M
Household water efficiency programme (partnering approach, home visit)	2021-012	4.16	0	0	1.23	0.03	5.42
Housing associations - targeted programme	2021-036	0.82	0	0	0	0	0.82
Innovative tariffs	2021-048	0	0	0	0.13	0.24	0.37
Water neutrality (without smart metering)	2021-094	0.59	0	0	0	0	0.59
Community Water Efficiency Scheme (without smart metering)	2021-095	0.41	0	0	0	0	0.41

11.1.4 Non-Household Consumption

Following the introduction of the new Environment Act and the proposed targets within, we have included the option to reduce non-household consumption by 9% in our preferred plan. This target was initially proposed as part of the Act, and we believe it is a key area for focus. Whilst we are conscious that many companies focus on household reduction work water, we are keen to drive efficiencies and improvements across the non-household sector. This is more challenging as we must work with Retailers, who own the relationship with non-household customers, but we believe there are real benefits to be delivered in this area.

The optimisation work by Artesia showed that this saving could be achieved through fitting Enhanced Meter Technology to all of our existing non-household customer base. This would provide nearly 4 Ml/d demand saving.

We have undertaken some engagement throughout the WRMP process, and continue to do so, with Retailers in order to understand how we can better work with them to support and incentivise water efficiency proposals to non-household customers. This could be supporting with on-site audits for non-households, providing leakage detection and water efficiency advice. We are conscious that Retailers own the relationship with non-households since the market opening in 2017, but we see a key role for water companies to play to support demand reduction in this area. We will continue to work with other water companies and Retailers to agree the best way to help deliver support and incentives in this area.

11.1.4.1 Non-household consumption reduction costs

We have included the cost of our proposed non-household reduction programme in the following table.

Table 38 Cost of our proposed non-household metering programme

	AMP8	AMP9
Capital costs	0.35m	£0.35m
Opex Costs	£0.53m	£0.53m

11.2 Final planning demand forecast

As a result of our ambitious demand management proposals the final planning DYAA demand forecasts are 20.92Ml/d lower than the baseline forecasts by 2050. The savings are broken down as follows in Table 39:

Table 39 Summary of demand management savings by option

Demand Management Option	Saving by 2050 / Ml/d
50% leakage reduction	6.25
110 l/h/d (including water labelling)	10.89
9% NHH reduction	3.78

11.3 Supply Proposals

Our modelling confirms the initial views that the baseline supply demand balance (SDB) is dominated by growth in demand and reductions to supplies as a result of environmental reductions to our existing licences. Our least cost Economic Balancing of Supply & Demand (EBSD) modelling of our feasible list of supply and demand options selects all available options under most future scenarios – the only difference is related to timing of implementation, and the immediate effect of Fens reservoir creating a temporary surplus prior to environmental destination impacts.

For the screening and evaluation of available supply options, we reviewed an initial list of 106 options for feasibility, which increased by 25 through the process. The screening process then reviewed each supply option, and options unsuitable for progression rejected, these were mainly due to technical feasibility and environmental sustainability.

Our screening approach is detailed in Appendix N2, and the options log which details the decision making process for screening from unconstrained to feasible in Appendix N3. Due to the environmental constraints and the nature of our small supply area and water resources zone, 13 options were progressed to the constrained list. The full list of options details in included in Appendix N1.

11.3.1 Supply options selected

All feasible options were put into the EBSD modelling which selected the options with the highest deployable output, as soon as they are available to be selected, allowing for any interdependencies of options. Those options that are mutually exclusive of any others are selected are in the table below. Despite selecting all supply options available, alongside the preferred demand management options, there remains a deficit from the beginning of the planning period, once licence caps are applied as sustainability changes. This deficit is primarily a result of the need to reduce abstraction licences for no deterioration, and of the assessment period being historical, along the assessment approach for no deterioration baseline changing from WRMP19. Our demand management measures offset a large proportion of growth in demand, however these will take some time to become fully effective.

Practically, we are unable to produce a plan that shows a deficit, and therefore we have explored further options that would ensure no deficit. These include applying drought management measures each year in the dry year scenario, and, deferring some of the licence cap reductions, until additional new supply options can be implemented. The former may require a variation to our drought planning principles and levels of service, whilst the latter is in effect an exemption to meeting the objectives, as defined by EA methodologies, under Regulation 19 of the water framework directive (WFD) Regulations 2017[20].

Table 40 Supply options selected

Option	DYAA yield Ml/d	CP yield Ml/d
CW24-75C: Potable transfer from AWS grid main crossing West to East through CAM area of supply (15Ml).	15	15
CW24-73A: Fens Reservoir potable water transfer	43.5	43.5
CW24-1B: Combined Ouse gravel sources - Fenstanton to St Ives (01B).	2.0	2.0
CW24-71: Milton WWTW Effluent re-use post effluent discharge.	7	7
CW24-37A Site-scale greywater re-use	0.5	0.5
CW24-38 Site-scale rainwater harvesting	0.9	0.9

11.3.2 Regulation 19 & Overriding Public Interest to defer licence changes

In producing our WRMP, we have had regard to the objectives in the RBMP as per the WFD Regulations. We have accordingly made adjustments to our baseline deployable output as sustainability changes, as advised by the

[20] https://www.legislation.gov.uk/uksi/2017/407/made

Environment Agency. The approach to defining no deterioration licence caps has been provided by the Environment Agency, and this has been revised since our WRMP19 plan, with a considerably greater impact on deployable output.

We do not propose any new licence permits, or for increases in abstraction to meet growth. Growth in demand is largely offset by our demand management programme, and the need for a Regulation 19 exemption would be largely driven by the scale of licence caps to a historic level of abstraction. With a small exception for time limited licences, our abstraction licences are permanent and would remain in force until we voluntarily changed these or the EA required mandatory changes if they believed these were the cause of serious environmental impact. With an exemption, public water supplies would be secure with the licence caps in place; however there remains the risk of impact to waterbodies at current licence use, although this may not actually occur, even in a dry year scenario. We have decided not to take the route of Regulation 19 exemptions in this instance, based on advice from the Environment Agency. However, this does not preclude us from utilising Regulation 19 inside the planning period. If in future, we use this option we would undertake a full Regulation 19 assessment at the licence and waterbody scale to ensure the lowest risk approach is taken.

11.3.3 Acceleration of transfer from Anglian Water

Currently, the transfer of water from Anglian Water's Grafham Water is scheduled to be available from circa 2031. As detailed, we have a significant resource challenge in the short term due to licence caps required by 2030. Following discussions with Anglian Water, as part of the Defra Accelerated Scheme we have proposed the acceleration of the Grafham Transfer scheme. Anglian Water have also proposed the acceleration of the work required by them to enable this through the same process. If approved, this would enable the water to be available in circa 2027. This 15 Ml/d would ensure that the licence caps proposed could be met in the timescales prescribed by the Environment Agency and alleviate this short term water resource challenge until the Fens Reservoir would be available for commissioning. We believe this would ensure that both the environmental and growth needs can be met without delay.

11.3.4 Drought Management measures

As an alternative to Regulation 19 we have included the full benefits of our drought plan demand management measures in any year for the dry year scenario. This is in line with the Environment Agency guidance for completion of the WRMP tables, and recent discussion post our original submission of our draft plan.

This totals 10Ml/d as a result of our appeals for restraint communications, restrictions on use for domestic purposes under temporary use bans (TUBS) and commercial activities under ordinary drought orders (non-essential use bans – NEUBs). However, there is a risk that our approved Drought Plan triggers and levels of service may now become inconsistent with the WRMP dry year scenario. This is because the triggers for TUBS are derived from a 2 dry winter drought sequence and NEUBS from a modelled lack of recharge, typically following a 3 dry winter drought sequence. Therefore, in a single dry year scenario as presented in the WRMP, our drought triggers for these demand management options may well not be reached. This means we may not trigger those options as stated in our drought plan. In that situation, we would therefore be in a deficit situation without implementation of drought measures, which are not always effective throughout the year. In addition, if we were to implement them in successive years the forecast reduction in demand may not be achieved.

As we have included the demand management benefits in our WRMP we will need to review both our drought triggers, and potentially our drought plan, to ensure we maintain consistency. This may result in a change to current published levels of service if we adapt our drought plan triggers to allow for restrictions to be applied in any single dry year scenario. Therefore we have undertaken a review of our Levels of Service, which has prompted a review of the trigger levels in the drought plan. We will undertake this review of trigger levels through the consultation period prior to final plan publication. Levels of service may require updating, and if this is the case we will engage with our customers and stakeholders on the impacts before making any changes to our drought plan, which would then be reflected in our WRMP.

We welcome any views on change to our levels of service for restrictions, and the application of drought measures in our plan in lieu of Regulation 19 in the consultation period.

11.3.5 Water Industry Environment Programme

To support our WRMP and our environmental ambitions before our supply side options can be effective, we have undertaken an assessment of waterbodies which may be impacted by our abstractions for mitigation measures and improvement work to be included in our Water Industry National Environment Programme (WINEP) proposals for PR24. We have screened 7 of these where WFD status may be most as risk from abstraction and other pressures, and where we can implement river restoration measures to support WFD status and prevent deterioration. These are;

- Cherry Hinton Brook
- Hoffer Brook
- Mill River
- River Granta
- River Mel
- River Shep
- Vicars Brook

Each waterbody has been surveyed and a bespoke programme of proposed mitigation measures to support, and improve WFD ecological status developed for inclusion in our WINEP. Implementation of these will be phased so that risk of deterioration can be appropriately mitigated. The technical reports for these proposals are not published as appendices to the WRMP, but may be available on request.

The restoration options considered are listed below, these will vary for a specific water body;

Restoration Options
Gravel Augmentation
Bank Reprofiling
Riparian buffer
In-channel Features
Riparian Tree Planting
Gravel Augmentation (for higher winter flows)
Tree Management (Thinning)
Riparian Buffer (Planting)
Weir Removal
Removal of hard bank reinforcement
Replacement with clear span bridge
Channel Realignment
Removal of bank reinforcement
Tree management (thinning)
Removal of weir/bed reinforcement
Removal of hard bank reinforcement
Bank Reinstatement
Sluice Removal
Ford Removal
Channel Realignment
Wetland

In channel features (Berms)
High flow channel
Floodplain reconnection/secondary high flow channel
Addition of further features/restore existing features (replanting etc
Designated drinking area/trough
Formalise Ford
Wetland/floodplain connection
Floodplain re-connection/wetland
Tree management
Tree Thinning
Gravel Augmentation (finer gravel for spawning habitat)
Addition of further in-channel features/restoration
Riparian buffer
Wetland/floodplain connection

11.3.6 Enhanced monitoring

Our WFD No deterioration review of the receptors which may experience impacts due to increasing licenced abstraction above recent actual has indicated a number of locations where, if this was to occur, there is a risk of deterioration. For these water bodies we have also created detailed monitoring plans, to assess the baseline conditions and any changes to flows and ecology if we needed to increase abstraction. Some of these waterbodies are also included for mitigation above, others have been assessed as less suitable for river restoration mitigation measures appropriate for our WINEP – for example if discharges, or other impacts on status are not attributable to abstraction, or abstraction mitigations unlikely to be effective measures. The waterbodies with enhanced monitoring included to support our WRMP are;

- Bottisham lode
- Cherrry Hinton Brook
- Hobsons Brook
- Lt Ouse River
- Millbridge Common
- River Granta

Monitoring plans at various sites on these waterbodies would include as a minimum spring and autumn macroinvertebrate sampling, monthly spot flow gauging and groundwater level recording, alongside daily abstraction rate records. Monitoring frequency can be adapted according to level of risk as abstraction and results develop over time.

Our enhanced monitoring programmes are not published as WRMP appendices, but are available on request.

11.4 Scenario testing & Adaptive planning

In order to ensure that our plan is robust and capable of dealing with changing circumstances, we have stress tested this plan against different scenarios. These scenarios are directly related to the Ofwat Common Reference Scenarios proposed for the PR24 business plan. They key areas we have tested are:

- What if we only achieve 50% of the demand reductions we’re proposing?

- Ofwat Compound High scenario
- Ofwat Compound Low scenario

Firstly, we use ValueStream (section 9.3) to understand if a different plan is selected to meet each scenario, compared to the baseline plan, which was the demand management plan detailed previously in chapter 10. In all cases, ValueStream showed that our baseline plan is the same for each scenario. When we have tested the least cost plan for each scenario, it has also selected the same plan. This then allows us to propose this baseline plan as our preferred plan as it is selected in all scenarios, and is both our best value and least cost plan.

As our plan is solely dependent upon demand reductions, and some of these elements rely on third parties influences such as customer behavioural changes and government led initiatives, it is critical to understand the impact of not being able to achieve these ambitious targets. When our preferred plan was tested, we still did not see a deficit in the planning period.

In the Common Reference Scenarios, Ofwat propose a range of variables to test plans against. These include variations to climate change, demand management, technology and environmental destination. As agreed through the regional planning groups, we have tested our WRMP two compound versions of these:

Table 42 Compound scenarios

Scenario	Environment	Demand	Climate change
Low	BAU+ scenario and use local reviews to remove waterbodies with significant uncertainty about whether the reduction is needed	ONS 2018 principal projections	RCP 2.6
High	Enhanced	Local plan based projections Retain policy target 110PCC and 50% leakage reduction	RCP 8.5 (RCM)

In both of these scenarios, there is no change to our preferred plan, as it selects all feasible options. As a result, there is no available alternative or adaptive plan as part of this WRMP.

11.5 Strategic environmental assessment

The SEA of our WRMP includes a scoping and an assessment stage. The scoping stage and scoping report included our proposed SEA methodology, and was issued for a 5-week statutory consultation period. The methodology is based on the South Staffs Environmental Assessment Scoping Report which has been previously agreed with the statutory consultees (Natural England, Environment Agency and Historic England)

The 30 feasible options for the WRMP were appraised and SEA appraisal matrices populated incorporating information from the Natural Capital Assessment, (NCA), Biodiversity Net Gain (BNG), WFD, Invasive non-native species (INNS) assessments and Habitats Regulations Assessment (HRA) screening as this information informs appraisal against several SEA topics.

Any material adverse effects identified from the SEA assessments have been incorporated into review of the options for the final feasible list to include mitigation measures to reduce any significant effects. The SEA report and assessment summaries are in Appendix P and summarised in table 43 below.

11.5.1 Water Framework Directive Regulations Assessment

Our approach has been primarily based on that set out in the updated UKWIR Guidance[21] of a sequential 3-stage process for undertaking WFD compliance assessments to deliver a proportionate WFD compliance assessment that complies with statutory requirements and regulatory guidelines. The sequential stages are as follows:

1. Option-level assessment: Each option will go through an option-level assessment which consists of the following steps:

- Step 1. Screening based on activities - to either exclude options from further assessment where it could be reasonably expected that the option would not have an influence on any WFD status elements or supporting elements, or identify which activities require progressing to Steps 2 or 3 assessment
- Step 2. Screening based on magnitude of hydrogeological/hydrological impact and water body context - to either exclude options from assessment where they are negligible or low hydrological/hydrogeological impact, or identify which activities require progressing to Step 3 assessment
- Step 3. Impact assessment – either using existing assessments or an expert judgement approach based on source-pathway-receptor to establish likelihood of compliance with agreed WFD Assessment Objectives in all relevant water bodies. A confidence rating will be given to all assessments to reflect the amount of uncertainty in the design, environmental baseline and magnitude of impact

Step 4. Detailed impact assessment - specific to the option using measured baseline data, including additional bespoke collected evidence, and detail on design and operating pattern. (Note: This level of detail would be by exception and is not currently costed for).

2. Programme level assessment: The options selected for the preferred programme will be cross-referenced, using the option-level assessment, to identify those that impact the same water body. Where this occurs, a cumulative assessment will be undertaken against the agreed set of WFD Assessment Objectives. (Note: costing has assumed that only the preferred programme will be generated and the assessment of alternative programmes is not currently costed for).

3. Preferred plan WFD compliance statement: This involves a statement of the compliance of the preferred plan against each of the WFD compliance objectives (set out below). This involves assessment of the set of options within

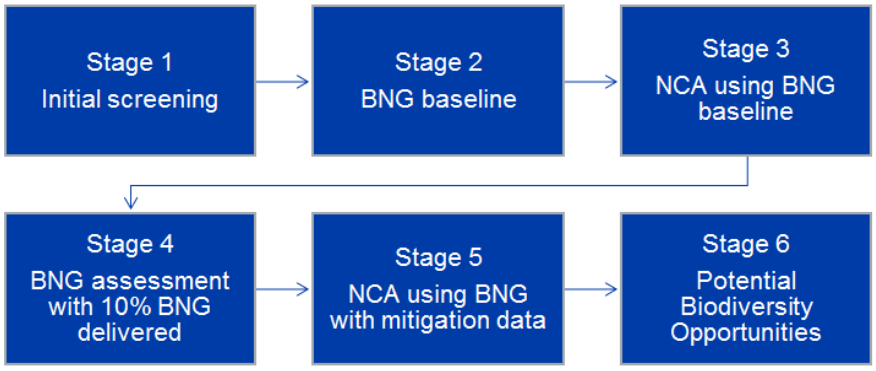
[21] UKWIR (2021) Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans. Report Ref. No. 21/WR/02/15

the programme, both alone and in combination with other options within the WRMP and with the WRMPs for other water companies.

11.5.2 Biodiversity Net Gain and Natural Capital Assessment

Our approach to BNG and NCA follows the recommendations in the in the WRPG supplementary guidance and the revised UKWIR guidance. The UKWIR guidance accounts for all most up to date published guidance and requirements for England, including for example, the All Company Working Group (ACWG) recommendations, and the UKWIR Best Value Water Resources Plan. The NCA compliments the SEA, HRA, and WFD assessment, and follows the steps in Figure 25

Figure 25 BNG and NCA screening



We have undertaken a high-level assessment of the biodiversity that is present in the feasible supply options and undertaken a RAG rated score to support the assessment of options noting where habitat is likely to be affected and high-level opportunities that may present to potentially achieve 10% BNG. The RAG rating will inform the NCA stages

The Defra's BNG metric 3.0 calculator has been used to identify mitigation and compensation requirements, to be used together with local biodiversity strategies and plans to identify high level biodiversity opportunity areas. A summary of BNG units is included in the BNG report and this is integrated into the SEA assessment for options.

The NCA approach incorporates data and metrics for the following;

- Biodiversity
- Climate regulation
- Natural hazard regulation
- Recreation
- Water Regulation & Purification
- tourism
- Agriculture

The report on Biodiversity Net Gain and Natural Capital Assessment is in Appendix P3.

Table 43 Assessment of the Draft WRMP24 Feasible List of Supply Options

Option	Stage	1. Biodiversity	2. Sustainable Natural Resources	3. INNS	4. Soils, Geodiversity and Land Use	5. Water Quantity	6. Water Quality	7. Flood Risk	8. Air Quality	9. Greenhouse Gas Emissions	10. Climate Resilience	11. Economy	12. Tourism and Recreation	13. Human Health and Well-being	14. Water Resource Use	15. Waste and Resource Use	16. Cultural Heritage	17. Landscape
Option 01A	Construction (negative)	-/?	-	-	-	0	-	-	-/?	-/?	0	0	--	-	0	0	0	0
	Construction (positive)	0	0	0	0	0	0	0	0	0	0	+/?	0	0	0	0	0	0
	Operation (negative)	-/?	0	0	0	-	-	0	0	-	0	0	0	0	0	-/?	0	0
	Operation (positive)	0	+	0	0	0	0	0	0	0	+	+	0	0	0	0	0	0
Option 01B	Construction (negative)	-/?	-	-	-	0	-	-	-/?	-/?	0	0	-	-	0	0	0	0
	Construction (positive)	0	0	0	0	0	0	0	0	0	0	+/?	0	0	0	0	0	0
	Operation (negative)	-/?	0	0	0	-	-	0	0	-	0	0	0	0	0	-/?	0	0
	Operation (positive)	?	+	0	0	0	0	0	0	0	+	+	0	+	0	0	0	0
Option 37A	Construction (negative)	-	0	-	--	0	-	-	-/?	---	0	0	-	--/?	0	--/?	-/?	0
	Construction (positive)	0	0	0	+	0	0	0	0	0	0	+/?	0	0	0	0	0	0
	Operation (negative)	0	0	0	0	0	0	0	-/?	-	0	0	0	0	0	-	0	0

	Operation (positive)	0	0	0	0	0	0	0	0	0	+	+	0	+	0	0	0	0
Option 38	Construction (negative)	-	0	-	--	0	-	0	-/?	---	0	0	0	--	0	--/?	0	-
	Construction (positive)	0	0	0	+	0	0	0	0	0	0	+/?	0	0	0	0	0	0
	Operation (negative)	-	--	0	0	0	-	0	0	-/?	0	0	0	0	0	0	0	--/?
	Operation (positive)	0	0	0	0	0	+	+/?	0	0	+	+/?	0	+	+	++	0	0
Option 57	Construction (negative)	---/?	--	-	---	0	-	--	-/?	---/?	0	0	-	-	0	--/?	---	-
	Construction (positive)	0	0	0	0	0	0	0	0	0	0	++/?	0	0	0	0	0	0
	Operation (negative)	-	0	--	0	-	-	0	0	--/?	0	0	0	0	0	--/?	0	0
	Operation (positive)	0	+	0	0	0	0	++	0	0	+	++	0	++	++	0	0	0
Option 71	Construction (negative)	-	--	-	--	0	-	0	-/?	--/?	0	0	-	-	0	-/?	---	-
	Construction (positive)	0	0	0	0	0	0	0	0	0	0	+/?	0	0	0	0	0	0
	Operation (negative)	-	0	-	0	-	-	0	0	--/?	0	0	0	0	0	-/?	0	0
	Operation (positive)	0	++	0	0	0	+	0	0	0	+	++	0	++	+	0	0	0

Option 73A	Construction (negative)	-/?	---	-	--	0	-	--	--/?	---/?	-/?	0	--	-	0	---/?	-	--
	Construction (positive)	0	0	0	0	0	0	0	0	0	?	++/?	0	0	0	0	0	0
	Operation (negative)	-	0	-	0	-	-/?	0	0	---	0	0	0	0	0	-	0	-
	Operation (positive)	0	++	0	0	0	0	++	0	0	++	+++	+	+++	++	0	0	0
Option 75A	Construction (negative)	-	-	-	-	0	-	0	-/?	-/?	0	0	0	-	0	-/?	0	-
	Construction (positive)	0	0	0	0	0	0	0	0	0	0	+/?	0	0	0	0	0	0
	Operation (negative)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-/?	0	0
	Operation (positive)	0	+	0	0	0	0	0	0	0	+	+	0	+	+	0	0	0
Option 75B	Construction (negative)	-	-	-	-	0	-	0	-/?	-/?	0	0	0	-	0	-/?	0	-
	Construction (positive)	0	0	0	0	0	0	0	0	0	0	+/?	0	0	0	0	0	0
	Operation (negative)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-/?	0	0
	Operation (positive)	0	+	0	0	0	0	0	0	0	+	++	0	++	+	0	0	0
Option 75C	Construction (negative)	-	-	-	-	0	-	0	-/?	-/?	0	0	0	-	0	-/?	0	-

Construction (positive)	0	0	0	0	0	0	0	0	0	0	+/?	0	0	0	0	0	0
Operation (negative)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-/?	0	0
Operation (positive)	0	+	0	0	0	0	0	0	0	+	++	0	++	+	0	0	0

11.5.3 Invasive Non-Native Species (INNS) Risk Assessment

The latest Water Resource Planning Guidelines requires a review of current abstraction operations and future solutions against the risk of spreading INNS or create pathways which increase the risk of spreading INNS. Where there are increased risks, we must propose measures to manage that risk. The Environment Agency guidelines indicate that all water companies should consider:

- Pathways of spread (understanding and reducing the risk from different pathways);
- Preventing spread (controlling, eradicating or managing INNS to prevent spread where this will contribute to WFD prevention of deterioration); and
- Action on INNS to achieve conservation objectives of SSSI and Habitats Directive sites

These have been assessed for the feasible options for the construction, operation and maintenance stages, and the full report is in Appendix P1.

11.5.4 Habitats Regulation Assessment (HRA)

An HRA determines whether there will be any likely significant effects on any European site as a result of proposals in this WRMP being implemented, either individually or 'in-combination' with other plans or projects.

This HRA report documents the HRA Stage 1 Screening for the feasible list of options in the draft WRMP24. It also identifies those options where Stage 2 Appropriate Assessment would be needed if the option were to be included in the preferred programme of the WRMP24. Stage 2 assessment would be required if the options are carried forward and agreed in our final plan. The draft assessment report is in Appendix P2 and the Stage 1 screening results presented below.

Table 44 Screening of supply-side feasible options for impacts on European sites

Option No.	Option Name	HRA Outcome	Comments
CW24-01A	Combined Ouse gravel sources - Fenstanton and St Ives (01A)	LSEs identified – construction and operation	The Ouse Washes SAC/SPA and Ramsar is located downstream at approximately 8.85km. Construction works in proximity to the River Great Ouse could give rise to site-derived pollutants (principally oils and other contaminants) and sediment entering the watercourse. Additional abstraction during operation of the boreholes may affect water availability downstream (uncertain). As such, a Stage 2 Appropriate Assessment will be required if this option is selected within the preferred programme.
CW24-01B	Combined Ouse gravel sources - Fenstanton and St Ives (01B)		
CW24-37A	Site-scale greywater reuse	No LSEs anticipated	

Option No.	Option Name	HRA Outcome	Comments
CW24-38	Site-scale rainwater harvesting		There are no European sites within 10km of the scheme components, or impact pathways over a greater distance.
CW24-57	River Cam abstraction & treatment works	LSEs identified – construction only	Fenland SAC includes spined loach *Cobitis taenia* as a qualifying feature. Spined loach may be present within the River Cam of which the confluence is located ~700m from Fenland SAC. Site-derived pollutants (principally oils and other contaminants) and sediment from construction activities may enter the watercourse and affect off-site supporting habitat. No new abstraction licence is required for the option, and the abstraction of water will be managed through the Hands Off Flow arrangement. As such, no LSEs during operation are anticipated.
CW24-71	Milton Wastewater Treatment Works (WWTW) Effluent re-use surface water abstraction post effluent discharge	No LSEs anticipated	There are no European sites within 10km of the scheme components, or impact pathways over a greater distance. The ultimate downstream receptor is The Wash and North Norfolk Coast SAC. None of the qualifying features are migratory fish species, where use of functionally linked habitat within the River Cam could have been an issue. Similarly, freshwater input is not identified in the SACO as a key attribute/target. The Wash SPA and Ramsar, are considered sufficiently distant such that the River Cam does not provide functionally linked habitat for any of the qualifying features.
CW24-73A	Fens Reservoir internal potable water transfer - Chatteris	LSEs identified – construction only	The Ouse Washes SAC, SPA and Ramsar is located downstream of the option components, construction of which could lead to site-derived pollutants and sediments entering the watercourse and causing deterioration to supporting habitat. Option 73A does not include an abstraction of water, or increase in water abstraction only the transfer of the potable water from the new Fens reservoir (being assessed separately) therefore no operational LSEs are anticipated.
CW24-75A	Potable transfer from AWS grid main crossing West to	LSEs identified –	The Ouse Washes SAC, SPA and Ramsar is located downstream of the option components, construction

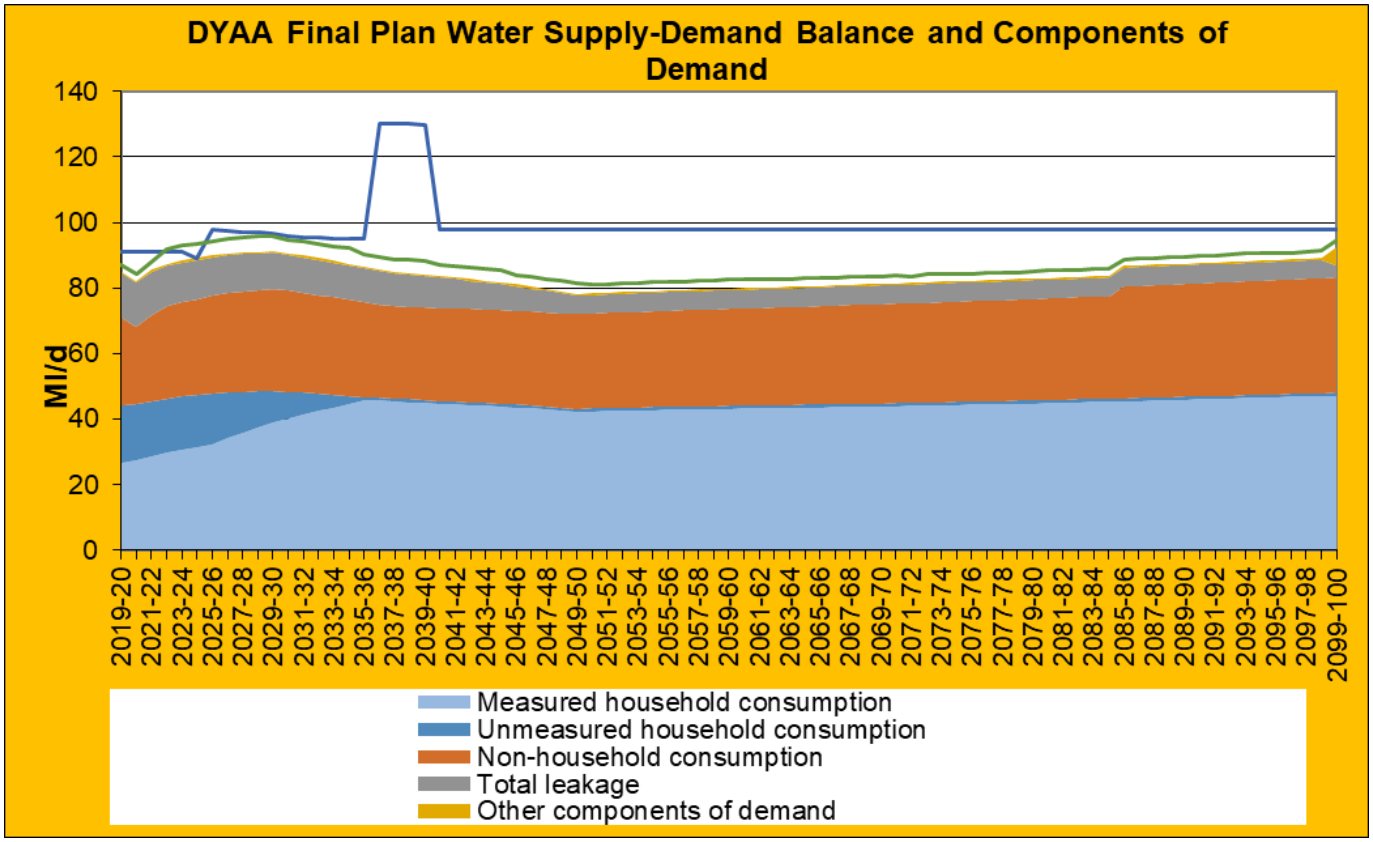
Option No.	Option Name	HRA Outcome	Comments
	East through CW area of supply 5Ml/d	construction only	of which could lead to site-derived pollutants and sediments entering the watercourse and causing deterioration to supporting habitat. The availability of surplus water has been identified by Anglian Water. The option does not require an abstraction licence, or change to abstraction licence, therefore no operational LSEs are anticipated.
CW24-75B	Potable transfer from AWS grid main crossing West to East through CW area of supply 10Ml/d		
CW24-75C	Potable transfer from AWS grid main crossing West to East through CW area of supply 15Ml/d		

12. Final supply/demand balance

12.1 Dry Year Annual Average

The chart below shows the final planning supply/demand balance for the DYAA scenario.

Figure 26 Final planning DYAA supply/demand balance and components of demand



12.2 Peak Week critical period

The chart below shows the final planning supply/demand balance for the critical period scenario. The options remove the initial deficits and maintain a surplus throughout the planning period.

Figure 27 Final planning critical period supply/demand balance and components of demand