Draft Water Resources Management Plan 2024

Main Report

United Utilities

Water for the North West

Summary

Background

We are committed to delivering reliable, safe, clean and resilient water supplies to over seven million customers, in around three million households and around 200,000 businesses (non-household customers) in the North West of England. This document is our draft Water Resources Management Plan 2024, which has been developed following a pre-consultation on key aspects of our plan, undertaken in early 2022. We are developing our plan collaboratively with regulators, stakeholders and customers, in particular through the regional group, Water Resources West, of which we are a leading member.

This report sets out our strategy to achieve a long-term, best value and sustainable plan for water supplies in the North West. It ensures that we have an adequate supply to meet demand over the 25 years from 2025 to 2050 and beyond. This is our most complex and ambitious plan to date, utilising the latest techniques to forecast supply and demand and taking into account new environmental and drought resilience requirements, as well as future customer needs assessed under regional and national planning frameworks.

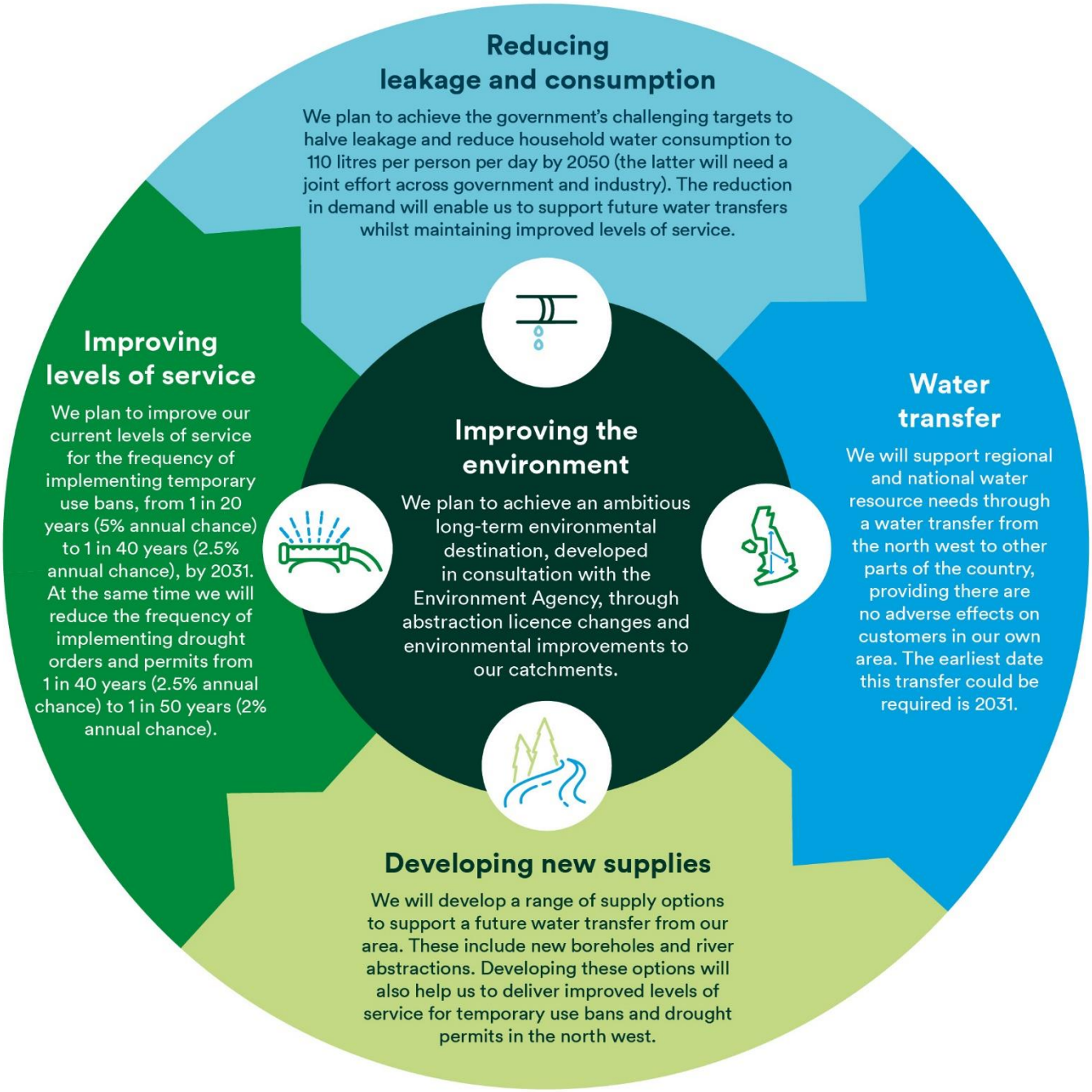
This draft Water Resources Management Plan 2024 reflects the merging in 2022 of the previous West Cumbria and Integrated Resource Zones, into our new combined Strategic Resource Zone, as determined through our Water Resources Management Plan 2015. This plan also reflects the continuation of our leakage reduction and water efficiency activities set out in our Water Resources Management Plan 2019 and continues to focus on these activities to meet future government aspirations for leakage and demand reductions across the country. Adopting a twin-track approach to supply-demand resilience, our plan also contributes to government objectives to deliver a national water transfer network and other new supply infrastructure to improve drought resilience and address increasing pressures on water supplies across England.

We have placed customers at the heart of our decision making and conducted research to determine their preferences, both in terms of future levels of service and how to ascribe value to our plan. Based on customer feedback, we are proposing to reduce the future risk of temporary use bans. Protecting the environment is also fundamental to our plan, and the changes to temporary use bans will be accompanied by a corresponding reduction in the risk of drought permits.

We have put processes in place to ensure Board assurance of this plan, including a statement to the Drinking Water Inspectorate that drinking water quality is fully considered under this plan.

This document provides a technical overview of the methodologies we have used to assess our supply-demand balance and decide on future options, taking into account key strategic objectives and feedback from the pre-consultation. It sets out our proposed ‘best value plan’, which provides benefits to customers and the environment. Further details are provided in additional technical reports, which are referred to within the individual sections of this report and also listed in Appendix A. We have also developed a non-technical summary of this report, *Shaping the future of water in the North West*.

Overview of our plan



Our draft Water Resources Management Plan 2024 provides the following key benefits:

- We plan to achieve ambitious government targets to halve the level of leaks and reduce water use per person per day to 110 litres by 2050; the reduction in demand for water will contribute to our commitment to reduce carbon emissions.

- Our plan supports national planning by developing options which would allow us to transfer large volumes of water outside our region, at times of need, making us a net exporter of water to address imminent water needs elsewhere in the country.

- Building these options for trading will help us to deliver improved levels of service for temporary use bans and drought permits by 2031, benefitting customers and the environment.

- In the longer term, these new supply options in the North West, progressive savings from reducing leaks and lowering water use by customers will mean we can deliver water transfers while maintaining our improved levels of service.

- Our plan protects the environment by assuming reductions in certain abstractions by 2050. This is our 'environmental destination' scenario, which will take shape over time in response to ongoing investigations.

- We have tested a range of scenarios and pathways to ensure that our plan can adapt to future uncertainty in the face of climate change, population growth and environmental changes.

In summary, our proposed best value plan offers a flexible, low regrets solution, which provides environmental improvements and benefits customers in the North West as well as supporting national water resource needs.

Your views

We have published this draft Water Resources Management Plan for consultation and would like to hear your views on it. This helps us to ensure that we take into account the preferences and priorities of customers and other key stakeholders as we continue to develop our plan. Responses to consultation on this plan should be sent to both us and Defra at the following addresses:

- **water.resources@defra.gov.uk; and wrmpconsult@uuplc.co.uk;**

Or by post at:

- **Defra, Water Resources Management Plan Water Services, Department for Environment, Food and Rural Affairs, Seacole 3rd Floor, 2 Marsham Street London, SW1P 4DF**
- **Water Resources Manager, Environment, Planning and Innovation, Haweswater House, Lingley Mere Business Park, Lingley Green Avenue, Great Sankey, Warrington WA5 3LP**

We expect public consultation to start in late 2022. We will then publish a revised draft version of this plan taking account of the feedback received.

Consultation questions

As well as inviting general feedback, we have a number of specific questions for consultation that we would welcome your feedback on to allow us to further develop our final Water Resources Management Plan.

1. We are planning to meet the new government requirement of being resilient to 1 in 500-year droughts by 2039 (before then we will be resilient to 1 in 200-year droughts). This improved resilience will be delivered by a combination of leakage reduction and demand management. We would appreciate your thoughts on:

    a. The importance of this increase in resilience to you;
    b. Our method of delivery, i.e. through reducing leakage and managing demand (e.g. offering smart meters, conducting water efficiency audits etc.); and
    c. The timing of the change, i.e. if 2039 is acceptable or you would prefer it to occur sooner or later.

2. By 2050, our ambition is to halve leakage through investment in asset health, innovation and network optimisation. This will require significant investment, what is your view on this approach?

3. By 2050, our ambition is to help reduce customer use per person by over 20 per cent (from around 140 to 110 litres per person per day). To achieve this we will implement a large-scale programme of smart metering, as well as providing water efficiency audits and our education programme. This will all require significant investment and will need to be combined with government interventions, for example the labelling of water-using products such as taps, showers, toilets, dishwashers and washing machines. What is your view on this approach?

4. With regards to water trading, our plan is to only export water to other areas of the country if the transferred water is replaced elsewhere in the North West. We have developed a set of key criteria which a future water transfer must adhere to: our water trading principles (see Section 7.3). There are also benefits of water trading for the North West, for example the options developed for trading can also be used to improve resilience here. What are your views on the potential for us to export water from the North West to other areas of the country when they are at risk of drought, and replace this water with other options in the North West? Are there particular aspects of water trading that you would like us to consider in our plan?

5. The North West is one of the most vulnerable areas in the country for temporary use bans (hosepipe bans), with a resilience of five per cent risk per year (1 in 20 years). In line with customer preferences identified by our research, our plan aims to improve this to 2.5 per cent risk per year (1 in 40 years) to be more aligned with neighbouring water companies. We would appreciate your views on whether this should be a priority for us?

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1. Introduction

i Key Points

- **This is our draft Water Resources Management Plan 2024. It sets out our proposals to ensure that we can continue to deliver a resilient, clean and reliable supply of water for the next 25 years and beyond, taking into account a range of factors including the impacts of climate change, population growth and environmental change and needs.**
- **We have developed our plan in line with national and regional planning frameworks and government aspirations for reducing demand in the future.**
- **This document contains a summary of the technical work to develop the plan. Further detail is available in technical reports published on our website alongside this document.**

United Utilities Water supplies water to a population of over seven million people across an area of approximately 13,800 km^2 in the North West of England. On average, we supply domestic and business customers with an overall demand of approximately 1,850 million litres a day, and through our Water Resources Management Plan we must ensure that we will continue to meet customers' needs in the future by delivering safe and clean drinking water, while at the same time meeting regulatory requirements and environmental objectives (see Section 1.1).

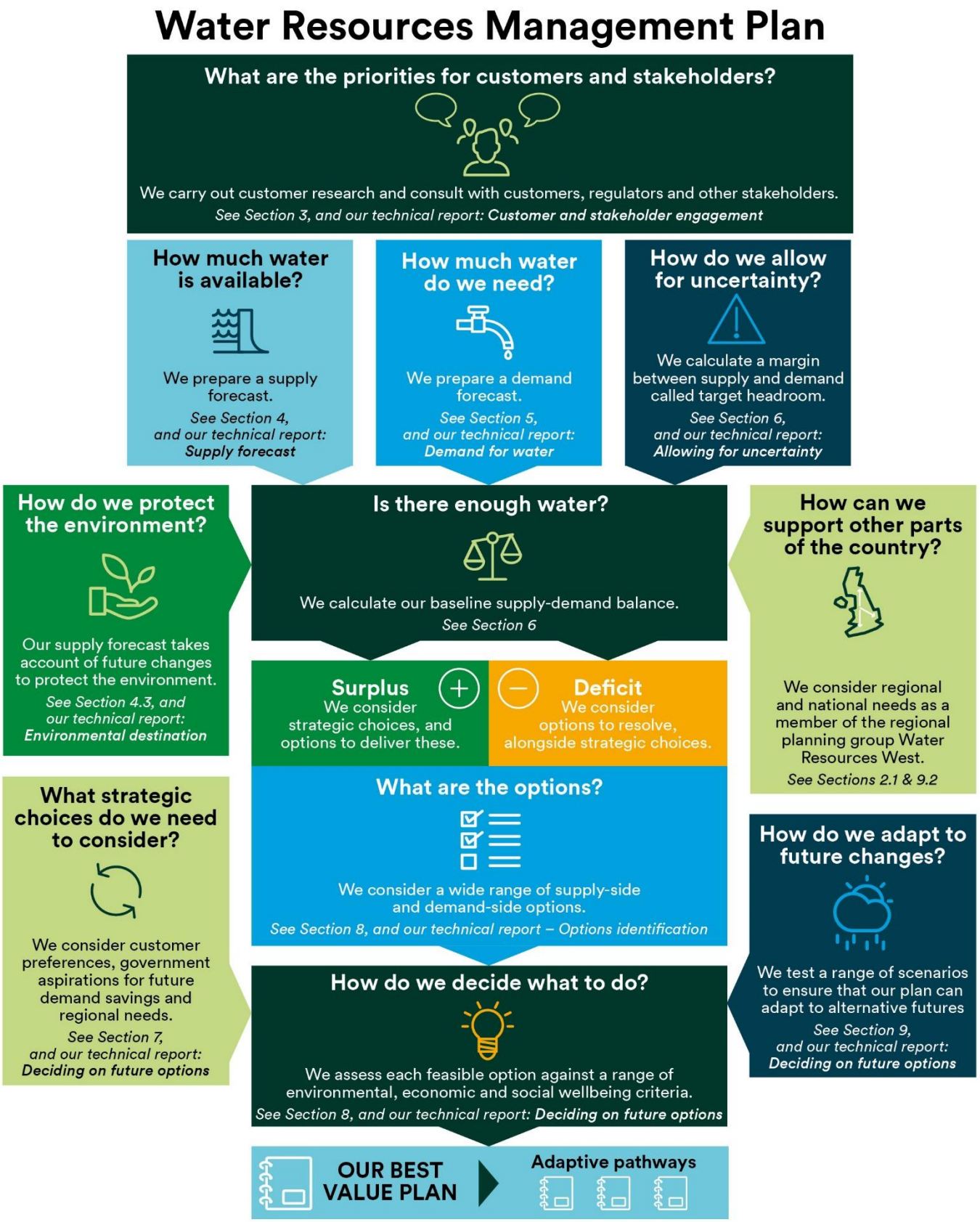
In common with all water companies in England and Wales, we are required by the government to produce a Water Resources Management Plan at least every five years, setting out our proposals to ensure that we can continue to deliver a secure and reliable supply of water over at least the next 25 years from 2025 to 2050. In fact, our plan also looks beyond this period, to the year 2100 (see Section 2.8). For the next five-year period (2025 to 2030) our plan aligns with our Business Plan proposals prepared for the Ofwat Price Review 2024, and also aligns with regional plans for the west of the UK (see Section 2.1).

This report, together with a number of more detailed technical reports, forms our draft Water Resources Management Plan 2024, which is being published in December 2022 for consultation with customers and stakeholders over a 14-week period during December 2022 to March 2023. Following the consultation period, we will update our plan taking into account the consultation responses received, and we then plan to publish our final Water Resources Management Plan in September 2023.

In order to develop our plan, we prepare forecasts of water supply availability and demand for water, taking into account a range of factors including the impacts of climate change, population growth and environmental changes. We then compare supply and demand, including a margin to allow for uncertainty in our forecasts, to determine our baseline supply-demand balance. If there are projected deficits, and/or if changes are required to meet environmental objectives and government and customer aspirations, then we assess a range of options against multiple criteria and select from these an optimal set of options, which forms our best value plan. We are also adopting an adaptive planning approach to prepare for alternative futures and uncertainties.

The process of developing our plan is summarised in Figure 1.

Figure 1 Overview of the water resources planning process



Following publication of our final Water Resources Management Plan 2024, the plan will become a live document covering the period of our next Business Plan, 2025–2030. We will monitor the delivery of the outcomes of the plan and report on progress through our annual water resources review.

1.1 Objectives of the Water Resources Management Plan

In preparing our Water Resources Management Plan we aim to meet the following key objectives:

- Maintain a resilient, safe and clean supply of water for customers;
- Ensure that our future water resources strategy is in line with government aspirations, particularly in relation to targets/ambitions for reducing leakage and customer water use;
- Develop a plan, which represents best value for customers, both in the near future and in the longer term;
- Ensure that our plan is flexible and can adapt to possible alternative future scenarios;
- Develop a plan to support national drought resilience through water trading and which is in line with our water trading principles (see Section 7.3);
- Ensure that our plan aligns with the relevant regional plan;
- Ensure that we adopt the latest methods and comply with regulatory guidelines in preparing our plan;
- Ensure that our plan enables us to meet our long-term environmental destination;
- Ensure that our plan takes into account customer and stakeholder preferences where it is feasible to do so; and
- Ensure that our plan delivers environmental benefits, taking into account sustainability and natural capital effects.

1.2 The national context

In recent years, there has been an increasing focus on water resources planning at a national and regional level, driven by increasing pressures on water supplies from climate change, population increases (especially in the drier south and east) and the need to protect the environment. In 2018, an assessment carried out by the National Infrastructure Commission (NIC)[1] identified that, without intervention, there would be a one in four chance of large numbers of households in England facing emergency drought measures such as standpipes and rota cuts in the next 30 years. The NIC identified a need to improve drought resilience in England through a twin-track approach combining demand management (including leakage reduction) with long-term investment in supply infrastructure. Their assessment identified that supply-demand improvements of 4,000 Ml/d would be needed in England to deliver the appropriate level of resilience, consisting of at least 1,300 Ml/d of new supply infrastructure including a national transfer network, over 1,400 Ml/d of leakage reduction and the remainder from demand management reductions through increased metering and other water efficiency measures.

The NIC made three key recommendations to the government in their 2018 assessment:

- To ensure that plans are in place to deliver additional supply and demand reduction of at least 4,000 Ml/d, including at least 1,300 Ml/d from a national transfer network and other supply infrastructure;
- To set an objective for the water industry to halve leakage by 2050; and
- To enable water companies to implement compulsory metering by the 2030s beyond water stressed areas, by amending regulations and requiring all companies to consider systematic roll out of smart meters as a first step in a concerted campaign to improve water efficiency.

In developing this draft plan, we have sought to ensure that our objectives (in Section 1.1 above) are fully aligned with these key national objectives.

1.3 Board assurance

We have adopted a tiered approach to governance to provide internal scrutiny on plan development, promote alignment with wider processes, support the internal team in developing the plan and ensure that the United Utilities Water Board is satisfied that the plan is capable of delivering our objectives. The analysis underpinning

[1] Preparing for a drier future – England's water infrastructure needs, National Infrastructure Commission, April 2018.

our plan has also been subject to rigorous third-party audit. The business governance and audit processes feed into and support final approval by the Board.

We have engaged with the Board throughout the development of the Water Resources West regional plan (see Section 2.1) and our own company draft Water Resources Management Plan, providing regular updates on technical approaches, key data and assumptions and implications for our company supply-demand balance. In July 2022, the Board endorsed and subsequently assured that this draft Water Resources Management Plan represents the most cost effective and sustainable long-term solution to meet our objectives.

Further details of our approach to governance, Board assurance and audit processes can be found in our *Draft Technical Report – Assurance and governance*.

2. Background

i Key Points

- **Our plan is a continuation of our previous Water Resources Management Plans, and our technical approaches have evolved and developed over time, enabling us to regularly implement improvements to the methodologies adopted and deliver better outcomes.**
- **We have developed our plan in collaboration with the Water Resources West regional group, of which we are a leading member.**
- **We have complied with the latest regulatory guidance; a key change to the guidance since our previous plan is the requirement to demonstrate resilience to 1 in 500-year droughts by 2039.**
- **We believe it is essential to increase our level of service for temporary use bans to be able to trade to other regions with currently higher levels of service for temporary use bans. Customers agree with this view.**
- **We supply water to four separate water resource zones, including the new Strategic Resource Zone created in 2022 by the Thirlmere transfer scheme, which links our former West Cumbria and Integrated Resource Zones.**
- **We recognise the importance of strong partnership working and local area planning to deliver a more resilient future, and we are trialling a collaborative place-based planning approach in three of our catchments.**

This section outlines the planning framework and regulatory guidelines which govern our approach to the Water Resources Management Plan and provides an overview of our supply area. We review and update all components of our supply-demand balance and water resources strategy at least every five years in order to update our plan in line with regulatory timescales, and to ensure that the plan is based on the best available data and methodologies.

2.1 Regional alignment

In March 2020 the National Framework for Water Resources was published, in which Defra confirmed their requirement for regional Water Resources Plans to be produced, to address the need for resilient and sustainable water supplies in a growing economy and changing climate. There are currently five regional groups across the UK, consisting of water companies, water industry regulators and stakeholders, working to address the requirement for regional plans to be developed in line with the National Framework.

United Utilities Water is a member of the Water Resources West (WRW) regional group, along with Severn Trent Water, Dŵr Cymru Welsh Water, South Staffs Water and the Environment Agency and a number of associate members (see Our members – Water Resources West). Our 2024 Water Resources Management Plans are being developed in collaboration with WRW, as the aim is for all individual company plans to align with the relevant regional plan. A key activity of the WRW Group, therefore, is to align all plans using consistent tools and methods to ensure that the overall regional plan is founded on a common approach.

In order to ensure consistency across the WRW region, agreed methodologies have been developed and applied to the key components of the supply-demand balance for all water companies in the group. Some aspects of our supply-demand balance (for example the future projections of household and non-household consumption incorporated in our demand forecasts) have been prepared by consultants on behalf of all WRW members, ensuring consistency and efficiency in both company and regional forecasts.

Further information on our alignment with regional planning activity can be found in WRW's *Draft Regional Plan for consultation,* which was due for publication in Autumn 2022.

2.2 Legislation and regulatory guidance

Our plan has been shaped by government policies and legislation, as summarised in Figure 2.

Figure 2 Legislation and policies shaping our plan

Our agreed planning methodologies follow the guidance set out by the Environment Agency in their Water Resources Planning Guideline (2021) and the guidance published by the Drinking Water Inspectorate on long-term planning for the quality of drinking water supplies (July 2021)[2]. The guidance has been developed through a range of UK Water Industry Research projects and other relevant studies. These are listed in Appendix B of this

[2] Incorporation of this water quality guidance is covered in section 4.5 of this document and in further detail within our supporting *Draft Technical Report – Supply forecast.*

document. Key changes since the publication of our 2019 Water Resources Management Plan can be summarised as follows:

- Water companies are now required to demonstrate resilience to 1 in 500-year droughts (i.e. droughts with a 0.2 per cent probability of occurrence in any given year) by 2039; previously the requirement was to be resilient to 1 in 200 year or 0.5 per cent annual probability events;
- Water company plans must align with the relevant regional plan (for United Utilities Water this is the plan developed by the Water Resources West regional group, see Section 2.1 above);
- Water companies are required to work with regulators and others to set a long-term destination for environmental improvement and sustainable abstraction, to be reflected in our plan;
- More emphasis is placed on the need to develop a 'best value plan', which considers government policy and wider objectives such as environmental benefit and facilitation of water trading;
- Water companies are expected to take account of government aspirations for leakage reductions and reductions in per capita consumption (PCC) in their final plans; and
- Water companies are required to consider and/or incorporate a biodiversity net gain and proportionate natural capital approach in their decision making processes, alongside the Strategic Environmental Assessment approach adopted for previous planning rounds.

Guidance for water resource planning in Wales is integrated into our decision making approach including the nine principles of sustainable management of natural resources (SMNR) as set out in the Environment (Wales) Act 2016. Further information on how our approach meets the requirements for water resources planning in Wales is provided in our *Draft Technical Report – Deciding on future options.*

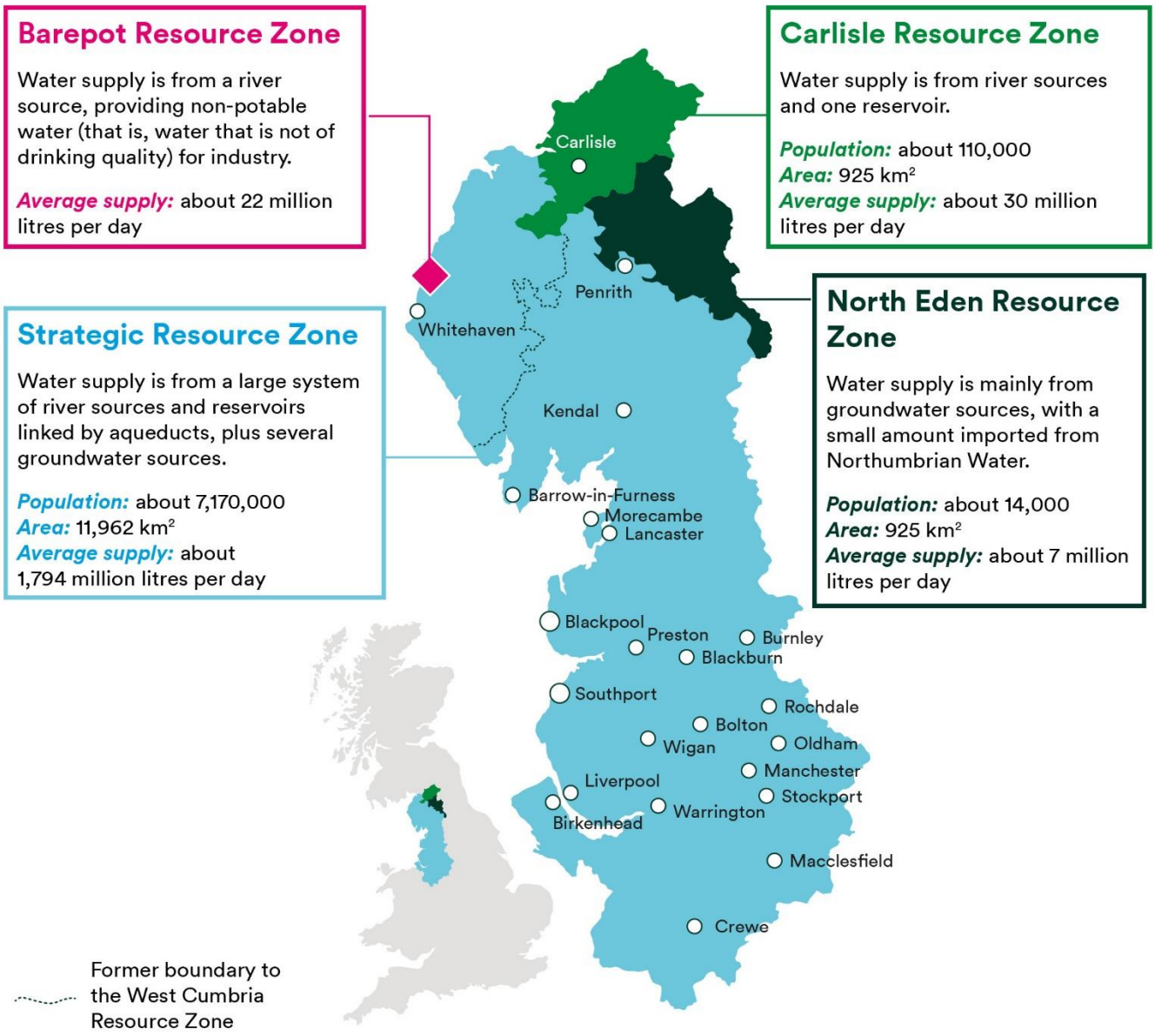
2.3 Water resource zones

Our supply area is divided into four separate water resource zones (WRZs), with limited connectivity between them. One of these consists solely of a non-potable water supply to an industrial customer (Barepot WRZ).

Since our last Water Resources Management Plan was published, in August 2019, we have completed the construction of a major raw water pipeline linking two of our previous water resource zones on which we reported in our 2015 Water Resources Management Plan. These were the Integrated WRZ and West Cumbria WRZ, which have been linked by the Thirlmere transfer pipeline project completed in 2022, to form a new combined resource zone known as the Strategic WRZ. We reported on the Strategic WRZ in our 2019 Water Resources Management Plan, as the merger was due to take place during the early years of that plan, and we continue to report on the new combined resource zone in this current plan.

The current boundaries and characteristics of our current water resource zones are shown in Figure 3.

Figure 3 Geographical locations of our water resource zones



2.4 Characteristics of our supply system

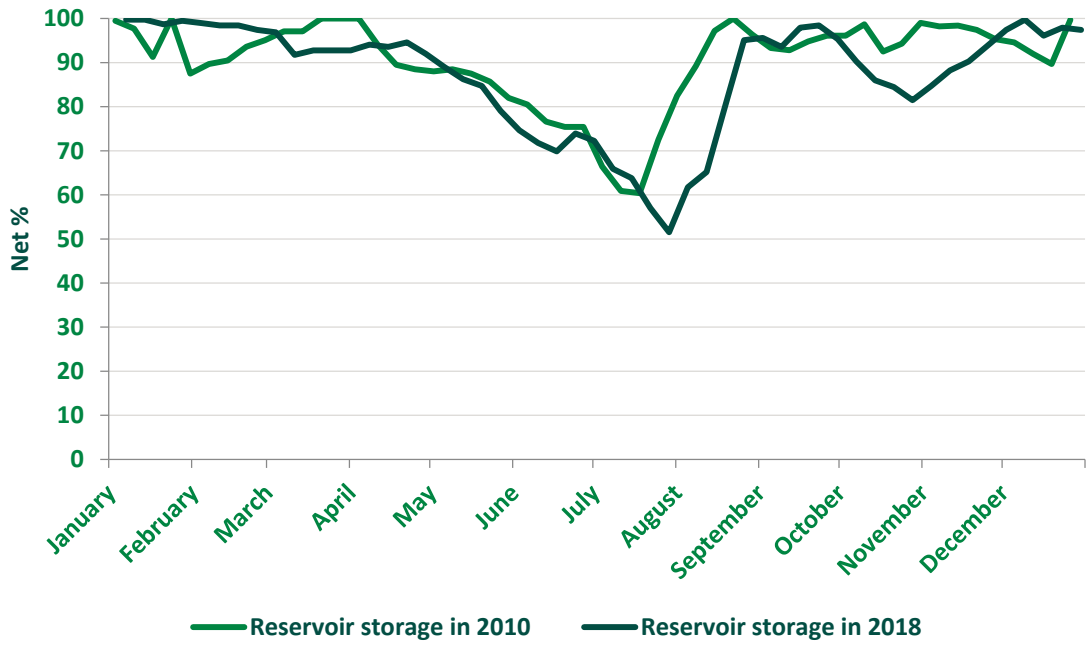
The nature of water supply systems and their response to weather patterns varies across different parts of the UK, depending on geology, topography, population density, average rainfall and other factors. In the North of England and many parts of Wales, relatively high rainfall and a hilly topography means that water resource systems are dominated by surface water sources including large numbers of impounding reservoirs. In our region, in a typical year 94 per cent of the water we supply comes from river or reservoir sources, and only six per cent comes from groundwater. This contrasts with the South and East of the country where extensive aquifers underlie many areas, and groundwater supplies typically make up a higher proportion of water resource systems (e.g. 65 per cent, on average, of Affinity Water's supply).

Storage in underground aquifers varies more slowly in response to long-term varying patterns of rainfall, and therefore groundwater sources are more resilient to short-term droughts. In contrast, during short intense periods of warm, dry weather, river flows and reservoir levels can drop rapidly as surface water reacts more directly to short-term changes in rainfall patterns. This can be exacerbated by parallel increased peaks in demand, for example reflecting increased garden watering during significant periods of little or no rainfall. However, for

similar reasons our surface water sources often experience rapid recovery after dry periods, due to a fast response to rainfall events, which can be of significant magnitude particularly in our upland reservoir catchments.

This is illustrated in Figure 4, which shows reservoir drawdown and recovery during and after two notable periods of dry weather in 2010 and 2018, in one of our Cumbrian reservoirs (Castle Carrock). In 2018, storage fell from around 95 per cent full to around 50 per cent full in a period of about three months; however, in response to rainfall events it then recovered to around 95 per cent in a period of only one month.

Figure 4 Castle Carrock Reservoir storage (percentage full)



The rapid drop in surface water levels during periods of intense dry weather makes our region particularly vulnerable to water use restrictions such as temporary use bans, as these are triggered when reservoir levels drop below specified drought control lines. However, due to the rapid refill characteristics of our upland reservoirs, our supply system is more resilient to more severe water use restrictions, which are triggered by much lower reservoir levels.

In the South and East of England, water companies are facing increased pressure on water resources due to a combination of lower annual average rainfall and higher population densities compared to the North and West of the country, along with environmental priorities to support the recovery of sensitive chalk-fed streams. These companies' supply systems are more resilient to short-term droughts due to the higher proportion of groundwater supplies, where storage varies more slowly in response to patterns of rainfall. However, they are more vulnerable to longer-term droughts in which groundwater levels drop well below average, and aquifers take longer to recover in response to rainfall events. The Environment Agency has estimated that 50 per cent of the extra water needed in the UK by 2050 is required for the South East of England (Meeting our Future Water Needs: a National Framework for Water Resources, Environment Agency, 2020).

Our current levels of service for temporary use bans are for these to occur no more frequently than once every 20 years on average (a five per cent chance in any given year); this is higher than many other UK water companies and we know from our research and consultation activities that a majority of customers (over 60 per cent) state that they would like to see this frequency reduced, even if this requires an increase in bills. This plan therefore includes proposals to improve our level of service for temporary use bans and use the resulting increase in resilience to support other companies in the UK through water trading. We will optimise the development of trading solutions, including supply options to support water trading, to deliver the best value plan to customers in our own region and in other parts of the UK. We believe it is essential to increase our level of service for temporary use bans to be able to trade to other regions with currently higher levels of service for temporary use bans. Customers agree with this view.

2.5 Levels of service

Our minimum stated levels of service are currently:

- Temporary use bans (often referred to as hosepipe bans, although their remit is broader than this): a five per cent annual chance or no more than once in 20 years on average;
- Drought permits/orders to augment supply: a 2.5 per cent annual chance or no more than once in 40 years on average, from 2025;
- Drought orders to ban non-essential water use: a 1.25 per cent annual chance or no more than once in 80 years on average; and
- Emergency drought orders involving standpipes or rota cuts: a 0.5 per cent annual chance or no more than once in 200 years on average.

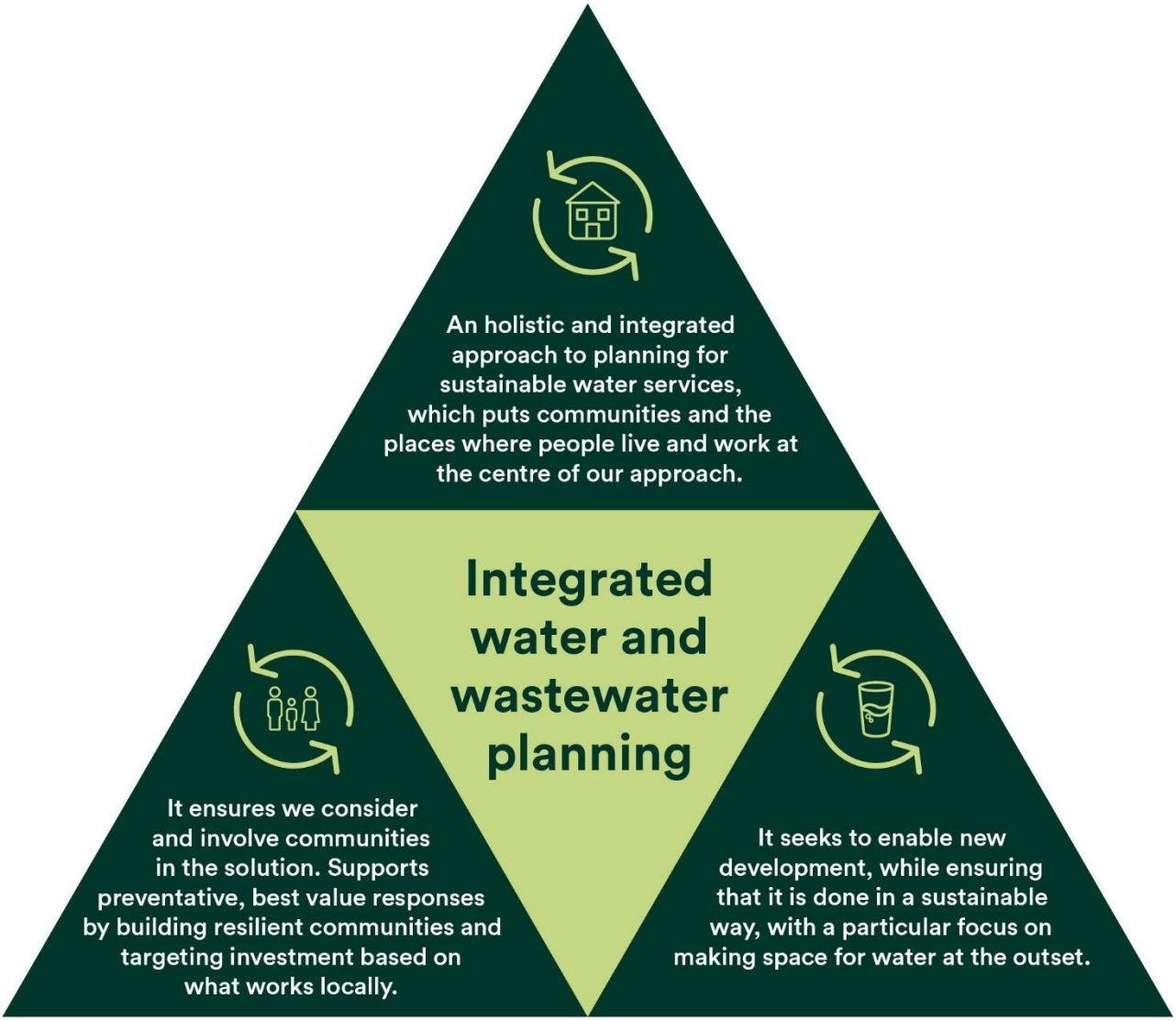
As outlined in Section 2.2 above, new regulatory guidance requires us to improve the frequency of emergency drought orders to a 0.2 per cent annual chance by 2039 (or no more than once in 500 years on average). In response to customer preferences, we are also planning to improve the levels of service for temporary use bans to a 2.5 per cent annual chance, and for drought permits/orders to a two per cent annual chance (see Section 7.2 for more details).

2.6 Working in partnership and local area planning

We recognise that a resilient future for the North West, and also the success of the Water Resources Management Plan, relies heavily on a twin-track approach between investment in water supply infrastructure and partnership working. Partnership working will help to facilitate innovative and collaborative solutions, as well as the behavioural changes necessary for the successful implementation of our demand management strategy. Managing water can be complex and involves multiple agencies; we are aware that the challenges of the future cannot be met through the actions of individual organisations alone. Strong partnerships and collaboration between organisations are required to deliver a more resilient future. Core stakeholders include the Environment Agency, local councils, the Rivers Trusts, communities and other landowners. This collaboration will be driven by pilots of place-based planning in priority areas, where there is significant potential to work more closely with stakeholders. The place-based planning concept and outcomes are outlined in Figure 5.

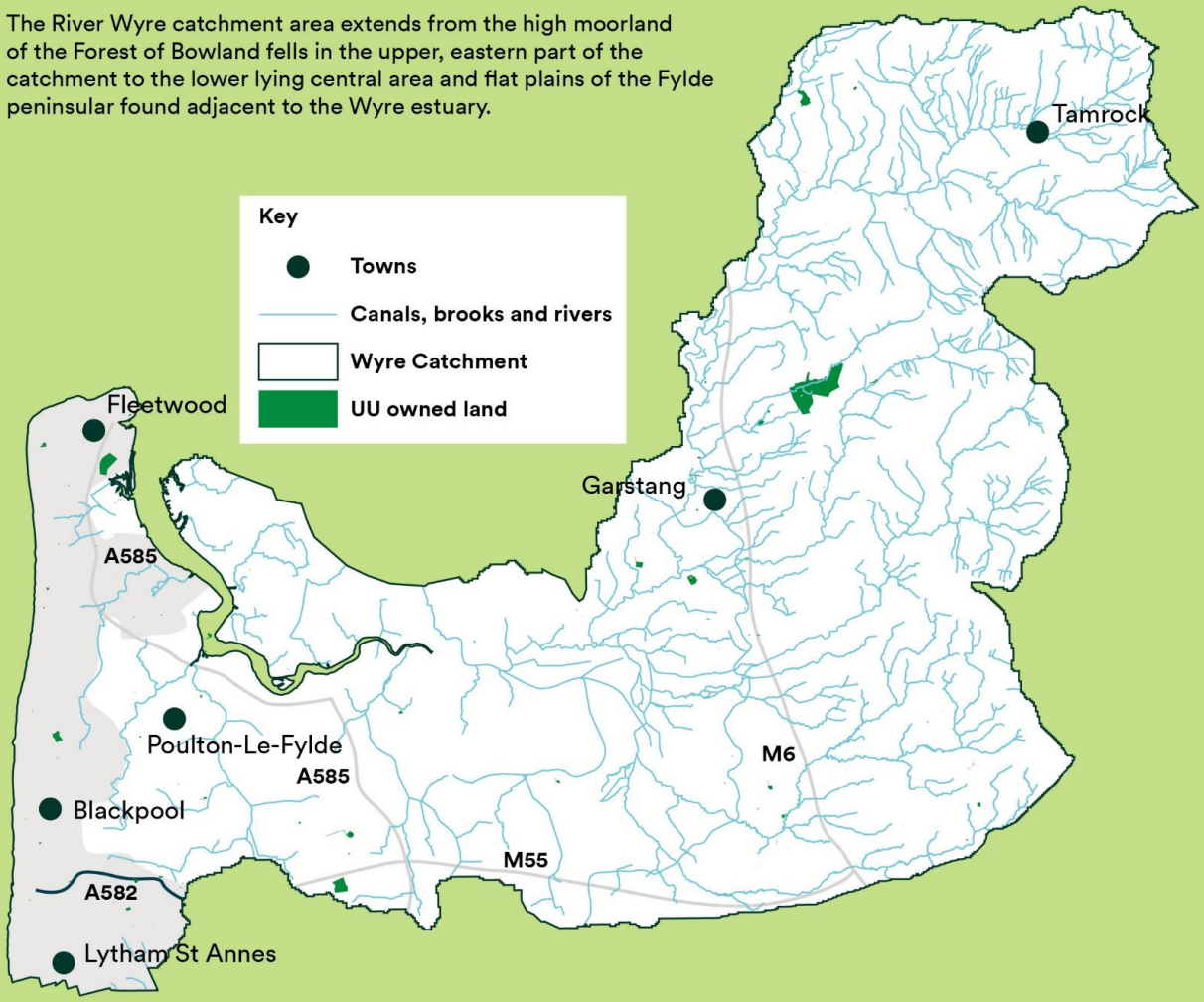
Climate change poses a risk to the long-term resilience of public water supply. Customer research has been conducted, which found that climate change is seen as one of the biggest long-term challenges. Customers expect us to take a proactive approach to tackling it. We recognise that climate change and nature recovery cannot be addressed in organisational silos, therefore partnership working will support cost-effective investment and planning within local areas. Place-based planning will help to diversify solutions to include a combination of traditional hard engineering approaches, nature-based solutions and behavioural change initiatives. Together, these will help to safeguard water resources for future generations.

Figure 5 Place-based planning concept for integrated water and wastewater planning



During our current business plan period 2020–2025, we are trialling place-based planning within the Eden, Wyre and Upper Mersey catchments. As an example of this approach, we have included a case study in this report for the Wyre catchment (see Figure 6).

Figure 6 The Wyre catchment – Place-based planning case study



The Wyre catchment has been selected as a trial area since we already have a history of partnership working and driving innovation with other organisations, through the Wyre Natural Flood Management project (Wyre NFM). Stakeholders included the Environment Agency, the Rivers Trust, Wyre Council, Wyre Rivers Trust and the Esmée Fairbairn Foundation.

The aim of the trial is to bring together all core stakeholders who have an influence over planning, development and management of water within the catchment. This will provide an opportunity to listen and share the activities, initiatives, opportunities and challenges faced in managing the water environment. A shared vision for how the catchment should be managed can then be developed, which will inform future decision making as part of a long-term adaptive plan. The Wyre NFM project will unlock new, private funding, demonstrating an innovative funding model for nature-based solutions to build flood resilience.

The Fylde coast, covering the Fylde, Blackpool and Wyre council areas, represents an area with several challenges around the quantity and quality of water. The surface water abstractions in the catchment have quality risks associated with the upstream land use and agricultural pollution which results in greater reliance on groundwater sources, which would be better reserved to manage the impact of dry weather events than for routine supply. The water environment has been actively managed here for many centuries, with extensive drainage and redirection of watercourses to enable agricultural development. This has led to very significant water quantity challenges facing the catchment. Schemes focused on improving ecosystem resilience are required to ensure that the catchment can recover quickly from extreme events, such as flooding. By improving ecosystem resilience this will also help to improve water quality.

In line with the challenges of climate change there is also an underlying need to secure reliable and sustainable water sources to ensure the water supply remains resilient as rainfall patterns change and we experience more periods of prolonged dry weather. Having multiple sources of high quality water will mitigate this risk. The challenge also goes beyond the Fylde Coast as the national water position identifies a need for water trading, and reliable sources in the Fylde area will help to secure supplies in the North West and increase the supplies available for trading.

Place-based planning will help to support the delivery of our Catchment Systems Thinking (CaST) approach (see Section 2.7). By working with local authorities and planning agencies, we will be better equipped to manage water close to where it falls and tackle issues at source. This will allow us to extend the work completed through the Wyre NFM project, for example, to tackle the challenge of pesticide use within the Wyre catchment. Existing monitoring currently in place identifies deteriorating water quality with regard to pesticides, E.coli, coliforms and ammonia, all of which can be linked to human and agricultural activity. Place-based planning, therefore, has the opportunity to improve these interactions with the environment to improve water quality and provide benefit for water resources.

2.7 Systems Thinking

The adoption and application of a Systems Thinking approach to the operation and maintenance of our assets is something that we have been working on since our 2015–2020 business plan period. We are focused on collaborating across our different operational teams, maximising the use of data, and embracing digital opportunities in order to enable Systems Thinking. It involves viewing our water assets and the environment in which they operate as one end-to-end water system, understanding how the components of that system interact and impact each other, and therefore being able to learn and predict the overall performance of our system for customers, stakeholders and ourselves. Throughout our 2020–2025 business plan period we have being trialling this approach as part of the development of our new water supply system in West Cumbria. This activity is focused on creating the required digital platforms and infrastructure to enable us to proactively monitor performance of the West Cumbria system and predict potential issues that could impact customer service or optimal system performance. We will use analytics and machine learning to optimise the system and determine required interventions. This automated decision making is being trialled through the use of a system optimiser across all critical sites, which will directly trigger remote control actions. Adopting an end-to-end system approach will enable us to work with partners across the North West to reduce demand on the water and wastewater systems and maximise outcomes within the wider community.

We will continue to build our capability to operate the system better by using real-time data to predict system performance, enabling us to optimise cost and service delivery to customers, as well as delivering the best possible environmental performance. We will also continue to focus on asset reliability and resilience, the reduction of unplanned service interruptions, and a move away from the traditional reactive response, to address problems proactively before they affect either customers or the environment within which we operate. Our final consideration will be to create additional capacity within our systems through efficient and sustainable solutions that minimise the impact on the environment and drive improved value for all stakeholders.

To achieve this ambition, we will need to make the most of the existing capability that sits within our teams and ensure that individuals are empowered to continuously improve and evolve our operational processes in order to drive the best performance possible.

Through Catchment Systems Thinking we are seeking to drive a new way of thinking across catchments, which understands and aligns the needs of United Utilities Water and other stakeholders to identify opportunities and deliver interventions, which meet multiple drivers, encouraging partnership working and driving greater delivery and efficiencies. Catchment Systems Thinking will drive a place-based planning approach to catchments that ensures the activities, which are prioritised and delivered, are aligned to long-term plans for the area, leaving a legacy for the North West. By working collaboratively with partners and delivering interventions that meet multiple objectives we will increase the uptake of catchment and nature-based solutions to maximise value for customers, but moreover we will deliver solutions that achieve greater resilience across catchments, protecting the services the customers expect from catchments as well as our assets.

2.8 Planning scenarios

The Environment Agency's Water Resources Planning Guidelines state that Water Resources Management Plans should consider the supply-demand balance at times when a company's supplies are low, and demand is high. The baseline scenario to be adopted for companies in England should be the Dry Year Annual Average scenario. However, the guidelines also encourage companies to assess additional planning scenarios where these may be

appropriate, to consider the supply-demand balance at critical periods when peak demands put the supply system under strain. In response to periods of high peak demand experienced across our region in recent years, we have reviewed the planning scenarios which are appropriate to adopt for each of our water resource zones.

The planning scenarios assessed in our 2024 Water Resources Management Plan are shown in Table 1. All resource zones are assessed using a Dry Year Annual Average (DYAA) scenario, while the Carlisle Resource Zone is also assessed using a Dry Year Critical Period (DYCP) scenario. The critical period selected for Carlisle Resource Zone is the Average Day in the Peak Week (ADPW).

Our demand forecasts have initially been prepared for the Dry Year Annual Average scenario, and suitable uplift factors have then been applied to produce Dry Year Critical Period demand forecasts (see Section 5.5 of this report). Our supply modelling has also been undertaken for both the Dry Year Annual Average and Dry Year Critical Period scenario (see Section 4).

Table 1 Planning scenarios adopted for each resource zone for supply-demand balance assessment

Resource Zone	Dry Year Annual Average	Dry Year Critical Period	Critical Period (if applicable)	Main reasons for choice of planning scenarios
Strategic	√	X	N/A	Conjunctive use system with significant raw water storage. Provided outage across the resource zone is maintained within the Water Resources Management Plan outage allowance, then peak demands are not driving investment decisions in the resource zone.
Carlisle	√	√	Average Day in the Peak Week	System model indicates constraints on deployable output when weekly demand profile used. Adopting the average day peak week for the critical period scenario ensures a more robust assessment of the system under peak demand conditions to support any future investment in asset capacity.
North Eden	√	X	N/A	Existing level of surplus and annual abstraction licence constraints mean that peak demands are not driving investment decisions in the resource zone.
Barepot	√	X	N/A	Non-potable supply only.

The planning period for which the supply-demand balance will be assessed for our 2024 Water Resources Management Plan is from 2025 through to 2100.

For reporting purposes, we also prepare forecasts for a Normal Year Annual Average (NYAA) scenario.

2.9 Problem characterisation

The UK Water Industry Research (UKWIR) problem characterisation methodology provides a question set and scoring mechanism to inform the assessment of the planning problem. Problem characterisation is a two-dimensional assessment with a ‘strategic risk’ score and a ‘complexity factor’ score. The combined score is then used to help select an appropriate decision making approach. The results of this assessment are shown in Table 2.

Table 2 Problem characterisation results

		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)	North Eden, Barepot			
	Medium (7–11)			Carlisle (4, 10)	
	High (11+)			Strategic (4, 16)	

North Eden and Barepot Resource Zones remain the same as in our 2019 Water Resources Management Plan, while Carlisle and Strategic Resource Zones have increased in strategic need and complexity.

2.10 Improvements from our previous Water Resources Management Plans

As outlined in Section 1, we update our Water Resources Management Plan at least every five years. Each update takes account of the actions we proposed in our previous plans, and our progress against the delivery of these actions. Through our annual review of our current plan, we carefully monitor actual performance and events against our forecasts, so that we can ensure that any variance is analysed and addressed as appropriate.

The technical approaches and decision making processes adopted in the preparation of this draft plan have evolved and developed over time through our work on our previous plans. This enables us to regularly implement improvements to our methodologies with confidence that these are both feasible and beneficial to developing a robust plan.

Table 3 provides an overview of how key aspects of this draft plan are influenced by the delivery of our previous two plans, published in March 2015 and August 2019 respectively, and by our ongoing review of our performance against previous forecasts.

Table 3 Development of key themes across recent Water Resources Management Plans

	Water Resources Management Plan publication		
Theme	**Final – March 2015**	**Final – August 2019**	**Draft – December 2022 (this plan)**
Protecting the environment in West Cumbria	We identified our preferred plan to link our West Cumbria Resource Zone into our Integrated Zone via a pipeline from Thirlmere Reservoir, to protect the sensitive environment of Ennerdale Water.	As the Thirlmere pipeline was due for completion in the early years of our plan, we based our plan on the combined Strategic Zone.	We continue to base our plan on the new, combined Strategic Zone (see Section 2.3).
Leakage reduction	We set out our aim to continue to operate the most economically sustainable level of leakage, finding and fixing repairs where it is of economic benefit to customers to do so.	We set out our strategy to achieve leakage reductions of 190 Ml/d over the 25-year planning horizon, a reduction of 40 per cent below the baseline position, with 67 Ml/d reductions (15 per cent) taking place from 2020–2025.	We plan to halve the current rates of leakage by 2050, in line with government aspirations (see Section 5.3).

	Water Resources Management Plan publication		
Theme	**Final – March 2015**	**Final – August 2019**	**Draft – December 2022 (this plan)**
Water efficiency	We set out our aim to be leaders in the area of water efficiency, to deliver a continued reduction in total demand for water.	We set out our plan to continue to promote how customers can save money and help save water through our water efficiency campaign.	We plan to reduce average per capita consumption (PCC) to 110 litres per person per day by 2050, in line with government aspirations (see Section 8.4).
Metering	We set out our aim to encourage customers to take up the Free Meter Option, and to undertake more targeted promotion of the free meter option to those customers who will financially benefit the most.	We set out our plan to encourage customers to take up the option of a free meter, including through trials of a 'lowest bill guarantee' scheme to help overcome barriers to switching to a metered supply.	We plan to increase meter penetration via a programme of options that deliver a large smart metering programme and targeted enhanced monitoring, as part of Dynamic Network Management (see Section 8.4).
Impacts of climate change	We developed our best estimates of the impacts of climate change on supply using the UK Climate Predictions 2009 and the latest national methodology.	We expanded our analysis, using a rapid emulator model to enable us to test a higher number of climate change scenarios.	We have used our Pywr and Hydro-Logic® Aquator models to test a much larger number of climate change scenarios from the latest UK Climate Predictions (UKCP18), applying the median impact to our supply forecasts for those resource zones where climate change impacts are applicable (see Sections 5.4 and 4.2).
Environmental protection	We assessed a number of sustainability changes to our abstraction licences, based on information provided in the Environment Agency's National Environment Programme, and set out a programme to include confirmed changes in our plan.	Our plan incorporated the delivery of sustainability improvements as part of the Water Industry National Environment Programme (WINEP), and we also identified and tested potential future sustainability changes requiring further investigations during 2020–2025.	In addition to ongoing WINEP investigations, to determine sustainability changes for the period 2025–2030 and beyond, we have also set out our ambitions for our long-term environmental destination in line with national planning aspirations (see Section 4.3).
Water Trading	We stated that we will continue to consider the potential for exporting water to other parts of the UK, where it is economic to do so and will result in benefits for customers in our region.	We developed an adaptive plan to account for changes needed if a water trade did occur in the future.	Regional planning groups have been established to look at national needs. This plan has been produced in line with the Water Resources West regional group and includes proposals to develop supply options to enable a water transfer from the North West to take place in future (see Section 7.3).

	Water Resources Management Plan publication		
Theme	**Final – March 2015**	**Final – August 2019**	**Draft – December 2022 (this plan)**
Supply forecasting methodology	We followed national best practice guidelines to assess supply availability, using a new water resources simulation model to significantly increase confidence in our assessments.	We continued to follow national best practice methods to assess our supply system, using updated water resources models as appropriate, and also developed sophisticated new techniques to test the response of our system to more severe and different patterns of drought than observed historically.	We have continued to develop our computer modelling techniques, including the use of stochastic weather data generators, to assess the resilience of our supply system to a drought of severity 1 in 500 years, in line with the latest guidelines (see Section 4).
Demand forecasts	We used national best practice methods and guidance to build up our demand forecast from separate forecasts of the various components of water use, with the latest available Office for National Statistics data used to predict population growth.	We updated our demand forecast, taking account of future economic and population growth and our predicted savings due to increasing water efficiency and metering. We used information from Local Authority Districts and Unitary Authorities together with occupancy assumptions to create a plan-based population forecast.	We have updated our demand forecast, again based on a plan-based population forecast, and taking into account the impacts of the COVID-19 pandemic on patterns of water use. Our forecasting approach aligns with regional planning methodologies (see Section 5).
Allowing for uncertainty	We included a 'buffer' known as target headroom to allow for uncertainties in our supply-demand balance, applying the national best practice methodology to determine target headroom values for each of our resource zones.	We continued to account for supply-demand uncertainty through our target headroom allowances, undertaking a full review of all components of the target headroom assessment.	We have developed our target headroom assessment to include a more detailed breakdown of supply-side uncertainty components, in particular to allow for uncertainty in our latest stochastic supply forecasting methods (see Section 6). We have also reviewed our target headroom due to the increased use of adaptive planning which also accounts for uncertainty.
Options appraisal	We considered a wide range of supply and demand options for all our resource zones, using an industry-standard process called the Economics of Balancing Supply and Demand (EBSD) to identify and appraise these options.	We considered around 350 possible options, a mixture of our own options and those from third parties and used many different screening criteria to assess their viability, resulting in about 150 options being taken forward for options appraisal.	We encouraged extensive stakeholder involvement in the development of a wide range of options for consideration. In collaboration with Water Resources West, we developed best value metrics and weighted these according to customer preferences. We used a decision-making tool known as ValueStream to assess feasible options according to these metrics and to create our best value plan (see Section 8).

3. Listening to customers, stakeholders and regulators

i Key Points

- **We have put customers at the heart of decision making for the development of our Water Resources Management Plan.**
- **We have engaged and collaborated extensively with regulators and stakeholders from the beginning of the planning process. We have aligned this engagement with the Water Resources West regional group.**
- **We have undertaken a wide range of customer research to prepare for our next Business Plan, our draft Drainage and Wastewater Management Plan and this Water Resources Management Plan, making optimal use of technology since the start of the COVID-19 pandemic.**
- **Our pre-consultation was held from January to March 2022, aligning with the pre-consultation for the Water Resources West regional plan.**
- **We have regularly consulted with our independent customer panel, 'YourVoice', to seek feedback and ensure that our approach is as effective and representative as possible.**
- **We are now publishing this draft Water Resources Management Plan for further consultation and would like to hear your views on it as we continue to develop our plan.**

In order to develop a successful Water Resources Management Plan, it is essential that we engage with customers, stakeholders and regulators. It is a requirement of the Environment Agency guidelines that our plan should 'demonstrate effective engagement with regulators, stakeholders and customers at key stages throughout the development of the plan'. Conducting this engagement, through research studies, consultation and collaboration, allows those parties to influence our plan and increases the likelihood that our plan will be supported by them.

3.1 Stakeholder and regulator liaison

We have held regular technical liaison meetings with the Environment Agency, Natural Resources Wales and Natural England during the development of this plan. Extensive collaboration has also taken place through Water Resources West with regulators and stakeholders. This has enabled us to discuss and develop our technical approaches to the plan in collaboration with these key regulators, as well as addressing key technical queries from these organisations in a timely manner. We have also conducted pre-consultations with stakeholders including the Environment Agency, Ofwat and the Drinking Water Inspectorate, ensuring that water quality is a strong feature in our plan. Details of this activity are provided in Section 3.2.

3.2 Pre-consultation

Our enhanced pre-consultation with the Environment Agency, Ofwat, Natural England and Natural Resources Wales was held during the period from November 2021 to January 2022. Our pre-consultation with almost 200 stakeholders was held from January to March 2022. It was planned to align with the pre-consultation phase of the Water Resources West regional plan. The pre-consultation phase gave us an opportunity to receive early feedback from stakeholders that we could use in developing the draft plan.

As well as inviting general feedback, we asked a number of specific questions for consultation that have helped us shape our draft Water Resources Management Plan. All comments that we received were logged and responses written. These responses were used to inform our plan. For more details of our customer research, and liaison

and consultation with customers and other stakeholders, please see our separate *Draft Technical Report – Customer and stakeholder engagement.*

3.3 Customer research and engagement

Our Water Resources Management Plan, together with our draft Drainage Wastewater Management Plan, forms a key component of our wider business planning process. We are undertaking a wide range of customer research projects to support the preparation of our next Business Plan covering the five-year period from 2025–2030, and the outcome of many of these projects directly informs our preparations and priorities for the Water Resources Management Plan.

Our current programme of research builds on previous research and consultation exercises undertaken for our 2019 plan and previous plans, and is based on a combination of techniques including focus groups, telephone interviews, videos, discussions and surveys, involving representative cross-sections of customers. Since the start of the COVID-19 pandemic, lockdown restrictions have meant that our research studies and customer engagement have been largely conducted either online or by telephone, making optimal use of the latest video communications technology.

Some examples of topics covered by our current research exercises are as follows, noting that this list is not exhaustive:

- Immersive research to explore customer preferences for water resources initiatives, which may be included in our plans, including water efficiency promotion, leakage reduction, metering, water reuse, catchment management, increasing supply capacity and water trading;
- Specific project to assess customers' willingness to pay for an improvement in the level of service for temporary use bans;
- Research to assess and understand the ongoing impacts of COVID-19 on customer attitudes and water usage behaviour;
- Research to understand customers' views on climate change, which climate change issues could be prioritised and how customers want to be kept involved in this;
- Research to inform the development of a water transfer scheme and enable such a scheme to be assessed and designed; and
- Research on customer preference of water to inform the choice of new options (e.g. groundwater and surface water).

Our regional group, Water Resources West, has commissioned a piece of research to review and update customer engagement undertaken by each of the four water companies for their previous (2019) Water Resources Management Plans. The research was split into qualitative and quantitative analysis, and the aim was to provide a robust evidence base for customers' preferences across the region, incorporating more recent research where possible to indicate how customers' views may have changed over time.

Our customer research findings are summarised in the following table, together with where we have used these findings to inform our plan.

Table 4 High level research findings and where they have informed our plan

Research finding	Where the findings have been used in our plan
A majority of customers state that they would like to see the frequency of temporary use bans reduced, from 1 in 20 years (five per cent annual chance) to 1 in 40 years on average (2.5 per cent annual chance), even if this requires an increase in bills.	We have incorporated this preference into our 'Best Value Plan' (Section 9).

Research finding	Where the findings have been used in our plan
Customers expressed a desire for us to harness technology and use progressive thinking and innovative approaches to tackle problems.	We have considered over 300 different options in our unconstrained list. This has provided the maximum opportunity to include innovative approaches to tackle problems. Our process for options screening can be found in our *Draft Technical Report – Options Identification.*
Demand management initiatives including water efficiency promotion, leakage reduction and metering are generally the most favoured options by customers.	We have incorporated this preference into our decision-making methods (Section 8.4).
A majority of customers see climate change as a high priority and want to see us take a proactive approach to tackling it.	We have incorporated this into the supply forecast (Section 4.2).
A majority of customers (two-thirds) cared about whether they were supplied with hard or soft water, however, most customers asked (85 per cent, or 67 per cent of customers in Cumbria) would find a change in supply acceptable if it was due to a water transfer outside the North West region to areas in need.	This has been used by the water trading team to develop supply-side options that are acceptable to customers. These options are summarised in Section 9.3.
Customers have provided a view on which social and environmental metrics they value most.	The best value metrics' weightings provided by the customer research have been used in our decision making. This is explained in our *Draft Technical Report – Deciding on future options.*
In acceptability testing, customers showed a strong preference for our preferred plan. Their willingness to pay exceeds the cost of the preferred plan, demonstrating that it represents good value for money.	This confirms that our preferred plan contains the right selection of strategic choices and is aligned to customers' preferences. Had this not been the case we would have refined our plan.

3.4 YourVoice

We have an established Customer Challenge Group (CCG) known as the 'YourVoice' customer and stakeholder panel. YourVoice is a group of independent representatives from different sectors, backgrounds and areas of expertise. The expertise embodied in the panel ranges from Citizens' Advice to the Confederation of British Industry, from environmental organisations to public health, and from flood and coastal defence organisations to consumer interests. The panel helps us to reflect on what type of consumer representation is needed and how this relates to the company's existing governance arrangements. To ensure that our stakeholder engagement and customer research was appropriate it was discussed with YourVoice at various stages. As an independent body the YourVoice panel aims to ensure that customers are at the heart of our business planning engagement. We have regularly presented detail on the regional plan and Water Resources Management Plan to the Environment and Social Capital sub-group of YourVoice. This plan is supported by this sub-group and feedback from the sub-group has been incorporated into our plan.

3.5 Consultation on this draft Water Resources Management Plan

We are publishing this draft Water Resources Management Plan for consultation and would like to hear your views on it. In particular, we would welcome responses to the specific questions set out in Figure 7 below.

Figure 7 Consultation questions

1. We are planning to meet the new government requirement of being resilient to 1 in 500-year droughts by 2039 (before then we will be resilient to 1 in 200-year droughts). This improved resilience will be delivered by a combination of leakage reduction and demand management. We would appreciate your thoughts on:
    a. The importance of this increase in resilience to you;
    b. Our method of delivery, i.e. through reducing leakage and managing demand (e.g. offering smart meters, conducting water efficiency audits etc.); and
    c. The timing of the change, i.e. if 2039 is acceptable or you would prefer it to occur sooner or later.

2. By 2050, our ambition is to halve leakage through investment in asset health, innovation and network optimisation. This will require significant investment, what is your view on this approach?

3. By 2050, our ambition is to help reduce customer use per person by over 20 per cent (from around 140 to 110 litres per person per day). To achieve this we will implement a large-scale programme of smart metering, as well as providing water efficiency audits and our education programme. This will all require significant investment and will need to be combined with government interventions, for example the labelling of water-using products such as taps, showers, toilets, dishwashers and washing machines. What is your view on this approach?

4. With regards to water trading, our plan is to only export water to other areas of the country if the transferred water is replaced elsewhere in the North West. We have developed a set of key criteria which a future water transfer must adhere to: our water trading principles (see Section 7.3). There are also benefits of water trading for the North West, for example the options developed for trading can also be used to improve resilience here. What are your views on the potential for us to export water from the North West to other areas of the country when they are at risk of drought, and replace this water with other options in the North West? Are there particular aspects of water trading that you would like us to consider in our plan?

5. The North West is one of the most vulnerable areas in the country for temporary use bans (hosepipe bans), with a resilience of five per cent risk per year (1 in 20 years). In line with customer preferences identified by our research, our plan aims to improve this to 2.5 per cent risk per year (1 in 40 years) to be more aligned with neighbouring water companies. We would appreciate your views on whether this should be a priority for us?

This helps us to ensure that we take into account the preferences and priorities of customers and other key stakeholders as we continue to develop our plan. Responses to consultation on this plan should be sent to both us and Defra at the following addresses:

- water.resources@defra.gov.uk; and wrmpconsult@uuplc.co.uk;

Or by post at:

- Defra, Water Resources Management Plan Water Services, Department for Environment, Food and Rural Affairs, Seacole 3rd Floor, 2 Marsham Street London, SW1P 4DF
- Water Resources Manager, Environment, Planning and Innovation, Haweswater House, Lingley Mere Business Park, Lingley Green Avenue, Great Sankey, Warrington WA5 3LP

4. Supply forecast

i Key Points

- **We forecast how much water is available from the supply system in each of our four water resource zones.**
- **The assessment methods we use are industry leading and aligned to the complexity of each resource zone and the strategic questions they face.**
- **In line with regulatory guidelines, we now assess how resilient our supply systems are to a 1 in 500-year drought (0.2 per cent annual chance of occurrence), using stochastic data series to simulate plausible droughts more severe than those experienced in our historic record.**
- **Over the planning horizon, available water supply is forecast to decrease by around 244 Ml/d in our Strategic and Carlisle Resource Zones combined, due to the combined effects of climate change impacts and environmental changes to our abstraction licences.**
- **Our supply forecast accounts for outage, raw and process water losses, environmental changes and climate change impacts, as well as the effects of water quality.**
- **We are undertaking catchment management programmes in partnership with tenants and other landowners to protect and improve raw water quality and quantity. This provides multiple benefits for water supply availability and for biodiversity, access and recreation.**
- **In 2020, the Environment Agency set out their aspirations for long-term environmental improvements to be incorporated in UK water resources management plans.**
- **We have worked with regulators and stakeholders to identify short, medium and long-term actions, including abstraction licence changes and improvements to our catchments, to enable us to achieve our environmental destination. Further work is needed to confirm the impact on our supply forecasts; however, we have incorporated the 'Business as Usual plus' scenario in our baseline supply forecast pending further investigations.**

In order to assess our future supply-demand balance, we need to forecast the available water from the supply system in each of our resource zones. Our supply forecast for each year across our planning period is calculated from the following key components:

- Deployable output – the maximum quantity of water that can be provided from a resource zone during a range of different weather conditions, including droughts of a defined severity, while meeting our stated levels of service;
- Climate change impacts – future changes to our deployable output due to the impacts of climate change;
- Sustainability changes – changes to our abstraction licences, which are necessary to protect the environment, often resulting in a reduction to our deployable output;
- Raw water and process losses – an allowance for small volumes of water, which are lost or used between the raw water intake and the water treatment works (raw water losses) and between the water treatment works inlet and the outlet into the distribution system (process losses); and
- Outage – an allowance for temporary reductions in deployable output, which are necessary from time to time, due to proactive maintenance and other issues including pollution, power failure and mechanical breakdown.

Key changes to our supply forecast since our 2019 Water Resources Management Plan include:

- We have updated our hydrological data series (river flows and reservoir catchment inflows), which support our water resources models; these now cover periods of between 57 and 91 years. We also use new spatially coherent stochastic data series, of up to 19,200 years, to enable us to assess the impacts of droughts more severe than those experienced in our historic record. Our approach aligns with that adopted by the regional group, Water Resources West.
- We have updated other key model parameters, including asset capacities, licences and other system constraints, and seasonal demand profiles, to reflect the latest available data and ensure that our simulation models represent our operational systems as closely as possible.
- We are now required to assess the resilience of our supply system to more severe droughts than we may have experienced in the past. Our target is to ensure that the probability of implementing emergency drought orders (e.g. rota cuts and standpipes) is no greater than 0.2 per cent in any given year (or 1 in every 500 years on average) and we aim to achieve this resilience standard by 2039.

Our approach to developing our latest supply forecast, as outlined in this section, is fully aligned to our operational practices and our Final Drought Plan 2022. Our latest Drought Plan takes the form of an operational tactical manual (with technical appendices) and sets out our approach to managing water supplies during a drought. It is based on an extensive update of our water resources models to improve operational realism, and to make use of 'stochastic' hydrological datasets of 19,200 years in length, produced by a weather generator. This provides a large range of plausible droughts, against which our system is tested. In line with new Environment Agency guidelines, we have switched from using drought triggers to drought levels, which have been reviewed on a geographical basis taking into account our new Strategic Resource Zone. The sequence of drought actions has been adjusted to provide the best possible protection for the environment, balanced against the need to maintain resilient supplies.

The new drought levels and control rules introduced in our latest Drought Plan supersede those in our 2019 Water Resources Management Plan and have been applied in our calculation of deployable output (the key component of our supply forecast) as set out in Section 4.1 below.

4.1 Calculating deployable output

For this plan, we assessed baseline deployable output for all resource zones and adopted different approaches in line with resource zone complexity (see Section 2.9).

Our North Eden Resource Zone has low complexity, being supplied by a number of individual groundwater sources with limited interconnectivity and no raw water storage. The deployable output for this zone is calculated by simply summing the individual source yields; a small import from Northumbrian Water is also added.

Our Barepot Resource Zone is a simple single source system consisting of a small number of industrial customers served by a non-potable supply from an intake on the River Derwent. The deployable output for this zone is calculated by examining the constraints on this river source including the abstraction licence limits, historical river flow, and any infrastructure constraints. Resource zone deployable output is defined by the abstraction licence with conditions in place.

The Strategic and Carlisle Resource Zones are more complex. These systems are surface water dominated and sources are used in a 'conjunctive' nature, as the supply network means that water from different sources can be moved around the resource zone to balance water resources risk. System constraints mean that it is inappropriate to simply sum together source yields, so we use sophisticated computer simulation models (using the Hydro-Logic® Aquator and Pywr software packages) to assess the deployable output of our supply system. All the information in these models is reviewed and updated regularly to ensure that the models represent our current supply systems as closely as possible. We run the models using long periods of hydrological data to reflect the wide range of weather conditions which may be expected to occur; this includes the use of stochastic data series, of up to 19,200 years, to enable us to assess the new 1 in 500-year resilience standard for emergency drought orders. This is documented further in our *Draft Technical Report – Supply forecast*.

All deployable output assessments take into account our customer levels of service relating to the average frequency of water use restrictions and other drought measures. These are currently as follows:

- Temporary use bans (often referred to as hosepipe bans, although their remit is broader than this): a five per cent annual chance or no more than once in 20 years on average;
- Drought permits/orders to augment supply: a 2.5 per cent annual chance or no more than once in 40 years on average (from 2025);
- Drought orders to ban non-essential water use: a 1.25 per cent annual chance or no more than once in 80 years on average; and
- Emergency drought orders involving standpipes or rota cuts: a 0.5 per cent annual chance or no more than once in 200 years on average up to 2039.

Our North Eden and Barepot Resource Zones have 1 in 500 drought resilience (i.e. emergency drought orders would be implemented no more than once every 500 years on average) from 2025 and all other levels of service outlined above are maintained from our previous plan. For our Carlisle and Strategic Resource Zones, during 2025 to 2038, deployable output is defined by 1 in 200 drought resilience. From 2039 onwards, our deployable output is defined by the new 1 in 500-year resilience standard for emergency drought orders. All our other levels of service are maintained from 2025 and it is only the level of service for emergency drought orders that changes over time.

Our deployable output for each resource zone is shown in Table 5 below from 2025/26 to 2049/50.

Table 5 Summary of baseline deployable output by resource zone

	Deployable output (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Strategic	2083.7	2086.0	2088.3	1985.2	1984.5	1983.9
Carlisle	35.4	35.4	35.4	34.4	34.4	34.3
North Eden	8.0	8.0	8.0	8.0	8.0	8.0
Barepot	34.1	34.1	34.1	34.1	34.1	34.1

Further adjustments are made to the deployable output values to determine the net water available for use (WAFU), as outlined in the following sections.

4.2 Impact of climate change on supply

The potential future impact of climate change on our supply forecast was assessed using data from the latest UKCP18 climate projections, along with a range of sophisticated tools such as our water resources models. We utilised projections from a wide range of UKCP18 products, including:

- 12 Regional Climate Models; and
- 3,100 probabilistic projections (3,000 for the North-West River Basin and 100 for England and Wales).

The UKCP18 climate change projections are available for alternative future emissions scenarios, referred to as Representative Concentration Pathways or RCPs. Our adaptive plan (Section 9.5) explores the impacts across a range of RCPs from RCP 2.6 (1.6 ^{0}C temperature increase by 2081–2100[3]), which represents the lowest degree of warming, to 8.5 (4.3 ^{0}C temperature increase by 2081–2100) with the most warming. However, our central pathway is based on RCP 6.0 (2.8 ^{0}C temperature increase by 2081–2100), which is considered by the Climate Change Committee, and its Independent Assessment for the UK government, to be the most likely outcome, reflecting current global ambition to reduce greenhouse emissions.

[3] The increase in global mean surface temperature averaged over 2081–2100 compared to the pre-industrial period (average between 1850–1900) for the RCP pathways (best estimate, 5–95 per cent range). From IPCC AR5 WG1 Table 12.3.

Due to the considerable uncertainty around climate change, impacts are typically expressed as a range. For the Strategic and Carlisle Resource Zones we used the median value from this range directly in the supply forecast. The remainder of the range was inputted into our target headroom model to help represent uncertainty in the supply-demand balance (Section 6.2). For these resources zones the results reflect the impact on the supply system as a whole, as carefully simulated using our water resources models.

For the Barepot Resource Zone, our hydrological assessment indicated that while climate change would impact on river levels, we would still be able to abstract everything permitted by our abstraction licence. The picture in the groundwater-dominated North Eden Resource Zone is very similar; although climate change does affect aquifer levels, we would still be able to access all of the water we are permitted to take, or that we are able to abstract and treat through our infrastructure.

More information about our approach to climate change assessment is provided in our *Draft Technical Report – Supply forecast*.

4.3 Environmental changes

4.3.1 Water Industry National Environment Programme

Sustainability changes are changes to our abstraction licences for environmental reasons, which may have an impact on our supply forecasts (typically a reduction in our assessed deployable output for the relevant resource zone). These are determined through ongoing investigations in collaboration with the Environment Agency under the Water Industry National Environment Programme (WINEP).

In our 2019 Water Resources Management Plan, three sustainability changes were identified within our Strategic Resource Zone to be implemented during the period 2020–25. The impact of these changes, and changes previously implemented in the period prior to 2020, has been included within our baseline supply forecasts. There were no sustainability changes identified in the Barepot, Carlisle or North Eden Resource Zones for the period 2020–25.

Further WINEP investigations have taken place during 2020–25 and all have been finalised and included in our supply forecast. The Wirral and West Cheshire investigation is still to be finalised. An assumption for the draft plan covering all sources in the group has been agreed with the Environment Agency and included in this draft plan, however, it will be updated for the revised draft plan once the investigations have concluded in spring 2023.

4.3.2 Environmental destination

In the National Framework for Water Resources, the Environment Agency has set out its aspirations for long-term environmental improvements to be incorporated into each regional and company resources plan. The Environment Agency has undertaken a national catchment data exercise to identify waterbodies, which are at risk of not meeting their environmental flow objectives by 2050, taking into account the future impacts of climate change. In parallel with this work, we have identified priority catchments within our own region and will be consulting with stakeholders in those areas.

Our target is to achieve our long-term environmental destination by 2050 in line with the national framework, and this will require a number of short, medium and long-term actions including abstraction licence changes and environmental improvements to our catchments. There are a number of possible scenarios under consideration, relating to the degree of environmental protection provided and the assumptions relating to abstraction rates. We will apply the 'BAU+' (Business as Usual plus) scenario in the baseline plan, with the 'Ofwat low' and 'Enhance Future Potential' scenarios to be used in the adaptive plan. Further details on the specific scenarios and our wider plan for our environmental destination are provided in our *Draft Technical Report – Environmental destination*.

We have discussed and agreed our screening out approach with the Environment Agency. These include:

- Reservoirs – Licence reductions will have very limited benefit to the downstream environment. Compensation flows will have a net benefit to the wider catchment considering climate change;
- River sources – Locally agreed new or recently reviewed hands-off flow conditions will provide a net benefit to the wider catchment considering climate change; and

- Groundwater sources – sources which have been subject to licence capping from recent WINEP investigations will not be reduced further to 2050 due to the very high uncertainties attached to groundwater licence reductions from the EA Waterbody abstraction tool (subject to investigations).

We have assessed a number of possible scenarios using our water resources models to determine the impact of these environmental ambitions on supply availability. The scale of the potential abstraction reductions from implementing the 'Business as Usual plus' (BAU+) scenario into our baseline supply forecast is significant. Currently, we estimate that the impact is a reduction of 131 Ml/d in our company deployable output by 2050 (this impact is inclusive of sustainability reductions over the period 2025–2035).

In order to give a more realistic indication of when licence reductions could occur, we have profiled licence reductions over the period from 2035–2050. These are based on likely order of impacts, i.e. reductions with highest potential uncertainty considering environmental impacts applied by 2050. The profile for potential licence reductions is an initial indicator only and will be refined for our next (2029) Water Resources Management Plan. Due to significant uncertainty about the detail of the catchment priorities and abstraction licence changes, further site-specific investigations need to be undertaken. We will work with the Environment Agency to confirm the necessary actions to achieve the environmental ambitions. Until this work is complete, we are incorporating the 'Business as Usual plus' scenario in our baseline supply-demand balance, while the 'Enhance Future Potential' and 'Ofwat low' scenarios are included in our adaptive plan.

4.4 Raw water and process losses

For this draft Water Resources Management Plan, we have improved our approach to calculating our forecast allowances for raw and process water losses and operational use using metered data from our operational assets. Our forecast allowances for these components are now based on a detailed analysis of abstraction, transfer, inlet, outlet, and wash water metered data, for the six-year period from 2015–2021.

The average volume of raw water and process losses at an individual site does not translate directly to a reduction in water available for use (WAFU), as this will depend on many factors such as seasonal patterns of demand, network constraints and utilisation of maximum treatment capacity at each site. Output from the metered data calculations is therefore assessed within our Hydro-Logic® Aquator water resources models, in order to simulate the overall net impact on supply of the combined losses at all sites within each resource zone.

Using this method, the combined raw water and process loss allowances for our Water Resources Management Plan were determined to be:

- Strategic Resource Zone: 74.0 Ml/d;
- North Eden Resource Zone: 0.16 Ml/d;
- Carlisle Resource Zone: 0.86 Ml/d; and
- Barepot Resource Zone: 0.03 Ml/d.

The forecast allowances are subtracted from the modelled deployable output values as part of the calculations of WAFU for each water resource zone.

4.5 Raw water quality and drinking water protected areas

We own around 56,000 hectares of catchment land in North West England, providing raw water to our reservoirs and other sources, and we work with third parties with the aim that the remaining 720,000 hectares of catchment land not in our ownership is managed to the same high standard. Together this land supports a resilient water supply and protection against downstream flooding as well as wider environmental and social benefits including biodiversity, carbon sequestration and recreational opportunities.

We ensure that our plans continue to meet drinking water quality standards now and in the longer term, while also making sure that there is no deterioration in the quality of the water that is supplied. This is in line with the

guidance issued by the Drinking Water Inspectorate (DWI), on long-term planning[4] and the latest supplementary note on resilience of water supplies[5]. As part of our water resources planning, we have, at a high level, assessed the long-term impact of changes in raw water quality on our water resources. However, in line with the recent DWI guidance and as part of our planning activity for our 2025–2030 business plan, we are undertaking a more in-depth study to further understand the impact of external factors including climate change and emerging contaminants on the change in raw water quality that may impact availability and our ability to treat those resources. The outcome of this study may identify the need for enhancement cases through the price review process to ensure continued provision of safe and clean drinking water to the North West.

The Water Framework Directive specifies that where water is taken for human consumption, the areas where that water drains from (i.e. the catchments) must be designated as Drinking Water Protected Areas (DWPAs). The Environment Agency is required to monitor these areas and coordinate measures to prevent deterioration in water quality. In DWPAs where water quality is shown to be deteriorating due to human activity, the Water Framework Directive allows the Environment Agency to establish safeguard zones. We have worked with the Environment Agency to provide evidence for safeguard zones to be applied to a number of catchments in the North West.

Understanding the interactions between the land and the water is crucial to the successful management of our essential water resources. Catchment management investigates these interactions and works to combat or mitigate the activities in the catchment that are detrimental to the sustainability of the water quality and biodiversity, as well as reducing the risk of flooding to downstream communities. A scheme that we are progressing is the Wyre Natural Flood Management scheme[6]. This scheme includes planting trees, which enhance biodiversity, improve water quality and help mitigate flooding.

We continue to manage water catchments in the most effective, efficient and responsible manner to protect and improve raw water quality and quantity. We manage our catchments in partnership with our tenants and other landowners to enable the restoration of the upland ecosystems to deliver multiple benefits in terms of water quality, quantity, biodiversity, access and recreation. For example, our partnership with the RSPB[7] at our Haweswater and Dovestone Reservoirs has delivered a range of environmental benefits including the restoration of Swindale Beck, which has greatly improved the habitat for salmon spawning and reduced the impacts on our abstraction infrastructure, and peat restoration, which has improved the resilience of Dovestone catchment to drought and wildfires. In non-owned catchment land, we work creatively with landowners and tenants to influence the land management practices and enhance water quality.

We work with organisations such as the Water Research Council (WRC) and UK Water Industry Research (UKWIR) on innovative research to understand the mechanisms driving water quality deterioration. Seasonal variation in raw water quality is generally related to complex natural biological changes in the sources, resulting in the production of geosmin or 2-MIB, or changes in turbidity and colour. We are a sponsor of the research project 'Water quality in water resources planning' by the Water Research Council. We are currently spending substantial amounts on enhancing our treatment works to be able to treat deterioration of water quality and may have to in the future.

Catchment management is successful at reducing deterioration of raw water quality, and over time has the potential to reverse declining water quality trends; however, many catchment management techniques, such as fully functioning peatland hydrology, can take several decades to mature. Despite an extensive ongoing programme of catchment management activities, seasonal spikes in water quality parameters can still occur,

[4] Long-term planning for the quality of drinking water supplies, Drinking Water Inspectorate, June 2020.

[5] Resilience of water supplies in water resource planning (a supplementary note to long-term planning for the quality of drinking water supplies), Drinking Water Inspectorate, July 2021.

[6] The Wyre Natural Flood Management scheme was initiated by United Utilities Water, Environment Agency, and The Rivers Trust in 2019, https://www.wyre.gov.uk/news/article/180/-1-5m-to-be-invested-in-natural-flood-management-in-lancashire

[7] https://www.unitedutilities.com/corporate/newsroom/latest-news/rspb-and-united-utilities-sign-up-to-shared-vision-in-the-north-west/

which require restrictions on the throughput of a water treatment works. We have also seen increasing quantities of algae leading to unacceptable concentrations of geosmin and 2-MIB.

Further information on water quality can be found within our *Draft Technical Report – Supply forecast*. This includes information on the benefits of catchment management programmes and further information on Catchment Systems Thinking (CaST), which is our approach to managing catchments in a holistic, integrated manner. The technical report also covers how we have made an allowance for the effect of water quality on deployable output, as part of our supply forecast.

4.6 Outage allowance

In our analysis of the forecast supply-demand balance for each of our water resource zones, we need to make allowances for outages (short-term reductions in asset capacities) which will occur and which may temporarily reduce the supply capacity of our system.

Outages can occur for a variety of reasons, such as due to water quality where we can choose to reduce or stop abstraction to meet water quality regulations and ensure acceptability with customers. Outages may be planned (i.e. scheduled maintenance and asset upgrades) or unplanned (such as emergency repairs). Outages due to water quality can be driven by temporary pollution events or seasonal and event-driven deterioration in raw water quality. Raw water quality outages are not related to the 'health' of our assets like some other types of outage, but they can reduce the amount of water we abstract and are therefore an important type of outage to take into account in our supply forecast.

Where an outage is planned, a risk assessment is undertaken for each outage request to consider hydrology, headroom, resilience and contingency. The outage planning process is designed to minimise the risk to water resources and the supply-demand balance, while at the same time enabling essential repair and maintenance work to be undertaken.

Our outage management process is underpinned by a comprehensive database of recorded outage events, known as the Production Outage Permit System (POPS). It should be noted that the impact on deployable output does not directly equate to the total loss of production capacity at water treatment works. For local sources (e.g. Pennines sources) the reduction in capacity is assessed against the latest assessments of source yield. The impact on deployable output at strategic sources (e.g. Haweswater, Dee) is assessed by modelling the effect of asset capacity reductions during a 1 in 500 drought scenario, using the relevant water resource zone Hydro-Logic® Aquator model.

The outage allowances determined for our Water Resources Management Plan take into account any outage events, which would affect the ability to supply during a 1 in 500 'dry year' (termed legitimate outage events) and are determined in accordance with the Environment Agency's water resources planning guidelines. The guidance recommends the use of the methods set out in 'Risk-based planning methods' (UKWIR, 2016) and 'Uncertainty and Risk in Supply and Demand Forecasting' (UKWIR, 2002), and also following the guiding principles in 'Outage allowances for water resources planning' (UKWIR, 1995). The analysis uses a statistical technique known as Monte-Carlo simulation to combine probabilities of individual events into an overall probability distribution representing the combined impact of all potential events together. An overview of the methodology is provided in the separate *Draft Technical Report – Supply forecast*.

The resulting outage allowances for each of our water resource zones are shown in Table 6.

Table 6 Summary of outage allowance by resource zone

Resource Zone	Outage Allowance (Ml/d)
Strategic	94.1
Carlisle	1.3
North Eden	0.04
Barepot[8]	0.0

For the majority of planned outages we predominately calculate an allowance based upon our experience of planned outages during previous years, because the scale and type of future works over the full 25-year planning horizon is unpredictable and is dependent on future legislation and the outcome of price review determinations. However, there are two planned large-scale capital projects which affect the capacity of two of our strategic aqueducts:

- Vyrnwy Aqueduct Maintenance Programme, which is a legal undertaking with the Drinking Water Inspectorate to improve potable water quality; and
- Haweswater Aqueduct Resilience Programme, which involves the replacement of all six tunnel sections along the length of the aqueduct and may require temporary outages to construct.

Future planned outages may be required for enabling works associated with the portfolio of supply options to support a water transfer, however the details of these outages are not yet confirmed.

In line with the water resource planning guidance, these impacts have been included within the supply-demand balance in the form of temporary deployable output reductions, rather than within outage allowance. These reductions are termed 'Change in deployable output from prolonged outage reduction'.

Similarly to the raw water and process losses, the forecast allowances, as shown in Table 6, and deployable output reductions due to prolonged outage are subtracted from the modelled deployable output values to calculate WAFU for each water resource zone.

4.7 Summary of baseline water available for use

Table 7 presents a summary of the baseline WAFU, after taking into account the allowances for raw and treated water losses, outage, climate change impacts and sustainability changes to our licences. These figures also account for imports and exports from or to each resource zone, where applicable.

Table 7 Summary of baseline dry year annual average Water Available for Use by resource zone

	Water Available for Use (Ml/d) for year:					
Resource Zone	2025/26	2030/31	2035/36	2040/41	2045/46	2049/50
Strategic	1729.4	1736.4	1721.4	1606.0	1564.4	1486.5
Carlisle	33.3	33.3	33.2	32.2	32.2	32.1
North Eden	9.1	9.1	9.1	9.1	9.1	9.1
Barepot	34.1	34.1	34.1	34.1	34.1	34.1

The values shown in Table 7 are incorporated into the baseline supply-demand balance analysis for each resource zone.

[8] Our outage allowance for Barepot Resource Zone is assessed as zero as there are no recorded outage events within our database affecting supply to this resource zone.

Over the 25-year planning period supply is forecast to decrease by around 244 Ml/d in our Strategic and Carlisle Resource Zones combined, due to the effects of the new 1 in 500-year resilience standard, climate change impacts and environmental changes to our abstraction licences.

We recognise that there is uncertainty in each of the components that make up our forecasts of WAFU as shown in Table 7 above. In order to allow for this, we include a margin in our supply-demand balance, termed target headroom. The calculation of target headroom includes allowances for key areas of uncertainty in our supply forecast; further details are given in Section 6 and in our *Draft Technical Report – Allowing for uncertainty*.

5. Demand forecast

i Key Points

- **We have followed regulatory guidance and used the best available data and the latest methodologies to prepare our baseline demand forecasts.**
- **Working with industry experts Artesia we developed a new demand forecasting model for this Water Resources Management Plan, which is shared with other Water Resources West companies.**
- **Our forecasts are based on projections of the following components of demand: household and non-household consumption, leakage and minor components.**
- **Our population and property forecasts are based on local authority plans, in line with regulatory guidance.**
- **We adjust our forecasts of household consumption for the effects of weather variations and the impacts of climate change.**
- **Our forecasts also account for changes in patterns of water use due to the impacts of the COVID-19 pandemic.**

The total demand which we must supply from our water resources system comprises the following key components (see Figure 9 for the percentage breakdown) and a summary of each one is provided in this section:

- Household consumption;
- Non-household consumption;
- Leakage; and
- Minor components.

Our demand forecast has been prepared in line with regulatory guidance, using the latest available methods, and covers the statutory planning period from 2025 to 2050 as well as an extended period through to 2100. This section provides an overview of the key components of demand for water, and the data and methods which we have used to prepare a robust demand forecast for each of our resource zones to ensure that we can plan for the future. We have included more detail of the methods and results from our assessments within our *Draft Technical Report – Demand for water*.

Figure 8 shows the trend in our annual average demand over the last 50 years. Since the early 1990s, demand has reduced significantly, despite an overall increase in population over this period. However, in recent years we have seen an increase in demand. Changes in demand trends are a key reason for reviewing our company demand forecasts at regular intervals in line with our Water Resources Management Plan process, and we continue to monitor demand on a regular basis.

Figure 8 Annual average demand (excluding non-potable supplies) – United Utilities Water region

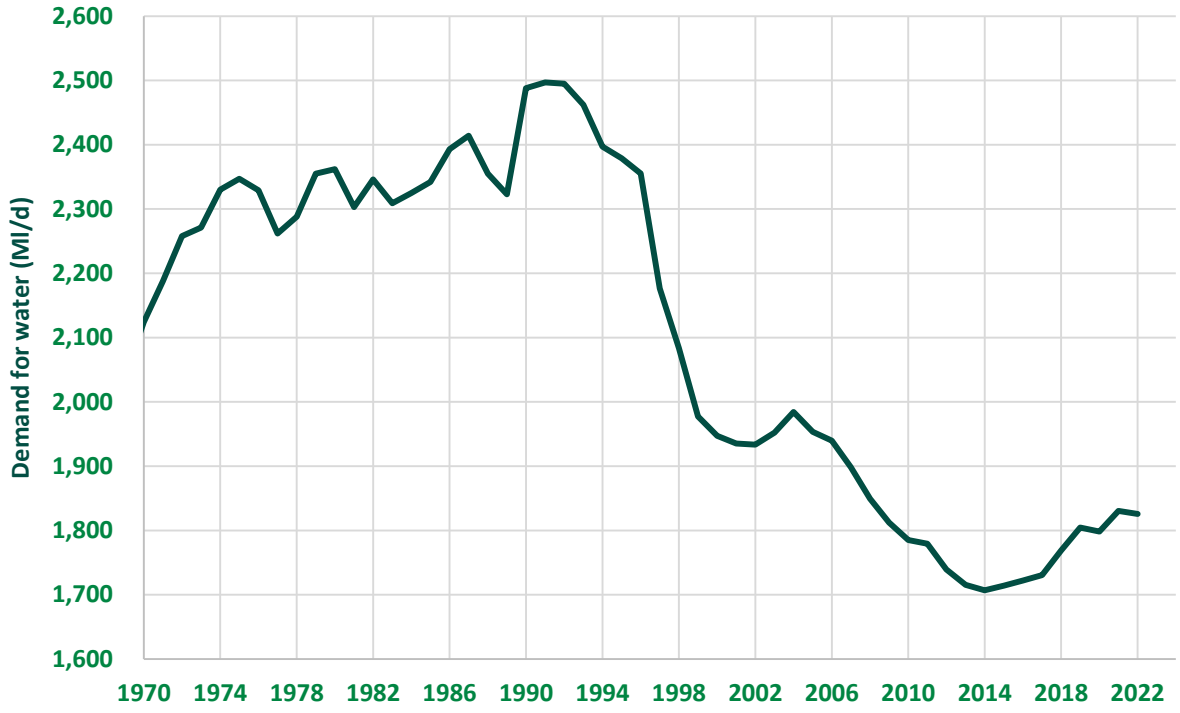
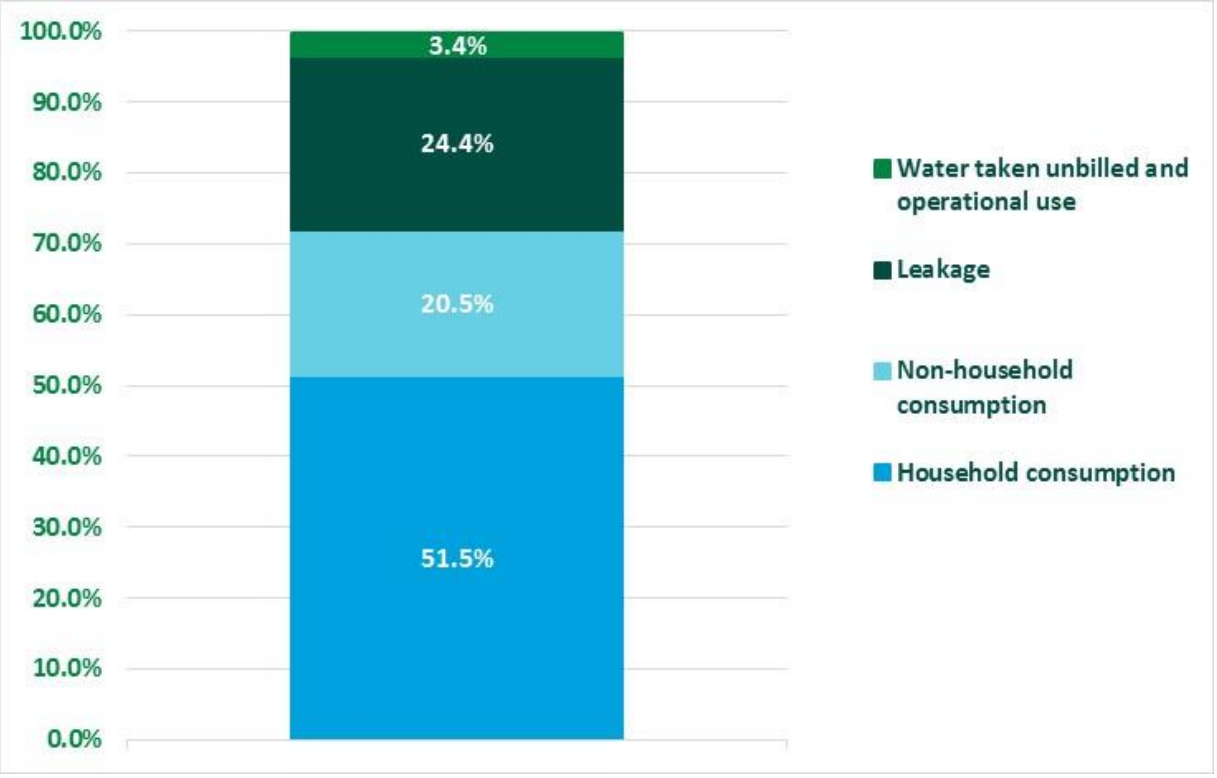


Figure 9 Summary of key components of demand



Note that Figure 9 excludes our non-potable supply to Barepot Resource Zone.

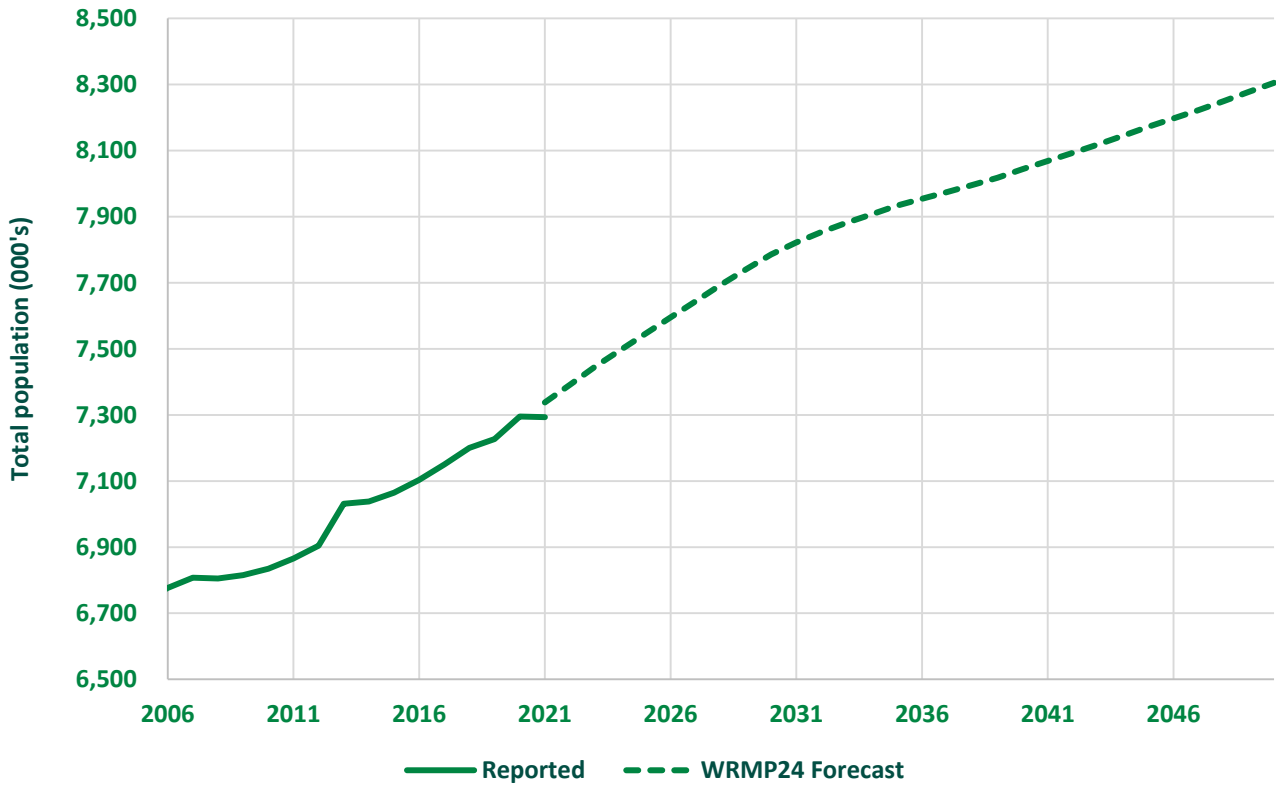
In this section we also outline how we adjust our demand forecast to take account of variations due to the weather, the potential impacts of climate change and other factors.

5.1 Household consumption

Household consumption is the volume of water that we supply to domestic customers, and accounts for just over half of all the water we supply. It includes both measured (metered) and unmeasured water consumption in household properties. Currently, around 47 per cent of households have a meter installed; this percentage is increasing over time as more customers opt to have a free meter installed, and all new household properties are automatically metered. Projections of likely future household consumption form a key part of our demand forecasts.

Population growth has the potential to lead to higher total household customer consumption. To forecast population change, we have considered the latest Office for National Statistics (ONS) projections. However, in line with the Environment Agency's *Water Resources Planning Guideline*, we have also engaged with Local Authority Districts and Unitary Authorities to understand how many household properties are likely to be built in our region over the planning horizon. Using this information, along with assumptions for occupancy, we have created a plan-based population forecast (see Figure 10). We have also carried out an initial impact assessment of the Census 2021 on our population data for the Water Resources Management Plan. From the census in 2011 to the census in 2021, there has been slightly higher growth than we predicted. However, this is less than one per cent of total population, so it is of relatively minor significance. This has provided greater evidence towards projecting demand with plan-based data and not the lower ONS forecast.

Figure 10 Our population forecast



During the development of our Water Resources Management Plan, we tested a range of different scenarios for our forecasts of household consumption, based on different assumptions regarding the housing and population growth, rate of meter switching and other factors. We selected a preferred (most likely) forecast to adopt for our plan; this forecast is used in our analysis of the baseline supply-demand balance to assess the potential timing and magnitude of any future supply-demand options which may be required. Figure 11 shows the range of household consumption forecasts for the United Utilities Water region, for our 'upper', 'most likely' and 'lower' forecast scenarios.

Figure 12 shows the historic trends in measured and unmeasured household consumption (to 2019/20) and our preferred (most likely) forecasts from 2020/21 to 2049/50.

Figure 11 Household consumption forecast range - United Utilities Water region

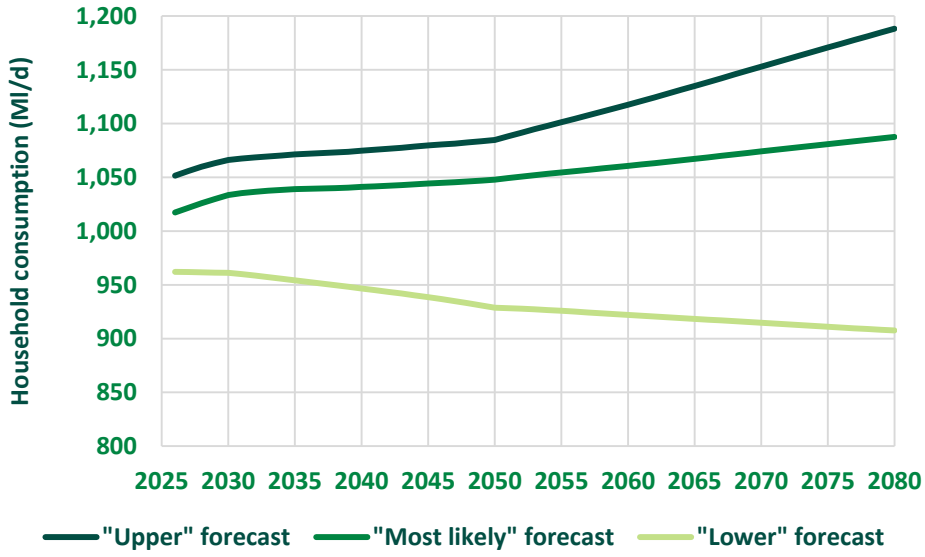
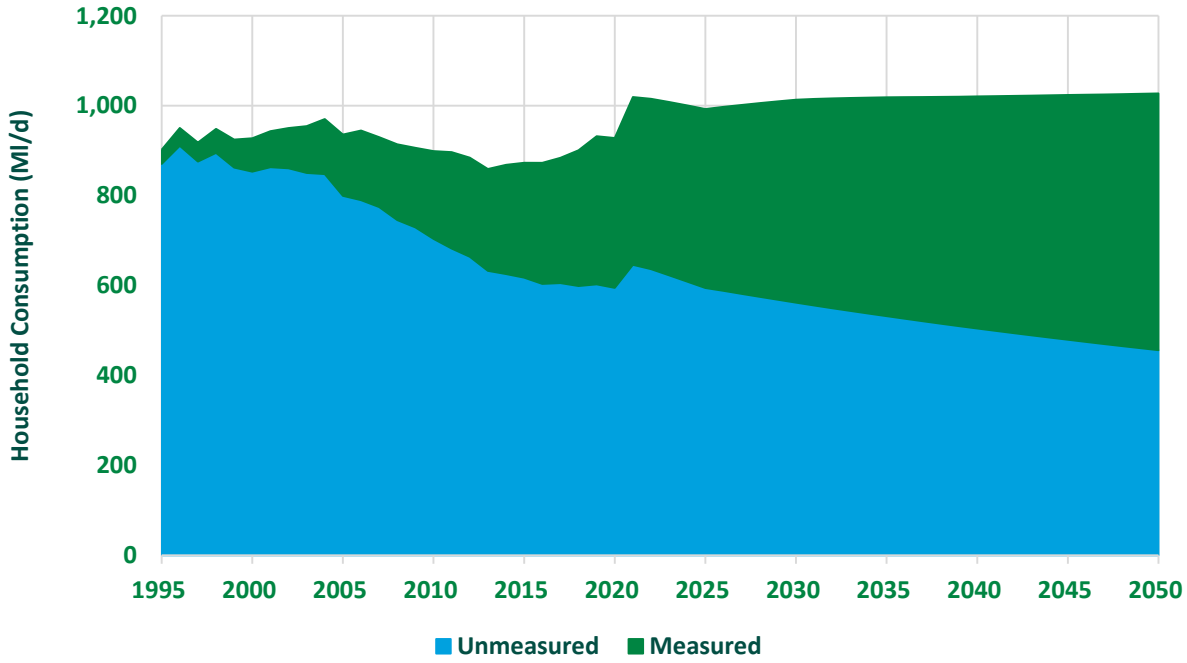


Figure 12 Measured/unmeasured household consumption trends and projections – United Utilities Water region



5.2 Non-household consumption

Non-household consumption is the volume of water we supply to commercial and industrial customers. The majority of non-household customers are metered, and non-household demand accounts for just over a fifth of the total volume of water we supply. Projections of non-household consumption are a key part of our demand forecasts and are linked to assumptions relating to economic growth and environmental protection policies, for example the extent to which tariffs and pricing structures influence the uptake of water efficiency measures within industry and business.

Our forecasting approach, based on trend and regression econometric models, takes into account the changes in the non-household sector arising from market separation and uses Market Operator Services Ltd (MOSL) data. This covers a number of non-household water retailers across the Water Resources West region, with around 90 per cent of the supply to customers in the United Utilities Water operating area being supplied by WaterPlus. The baseline forecasts include existing water efficiency initiatives planned by both the wholesaler and retailer but exclude any further interventions as these will be considered as part of the final planning forecasts. Our forecast also allows for recent requests for water for hydrogen production in the North West.

Figure 13 and Figure 14 show our preferred (most likely) forecasts from 2025/26 to 2049/50. Further details can be found in our *Draft Technical Report – Demand for water*.

Figure 13 Measured non-household consumption projections – United Utilities Water region

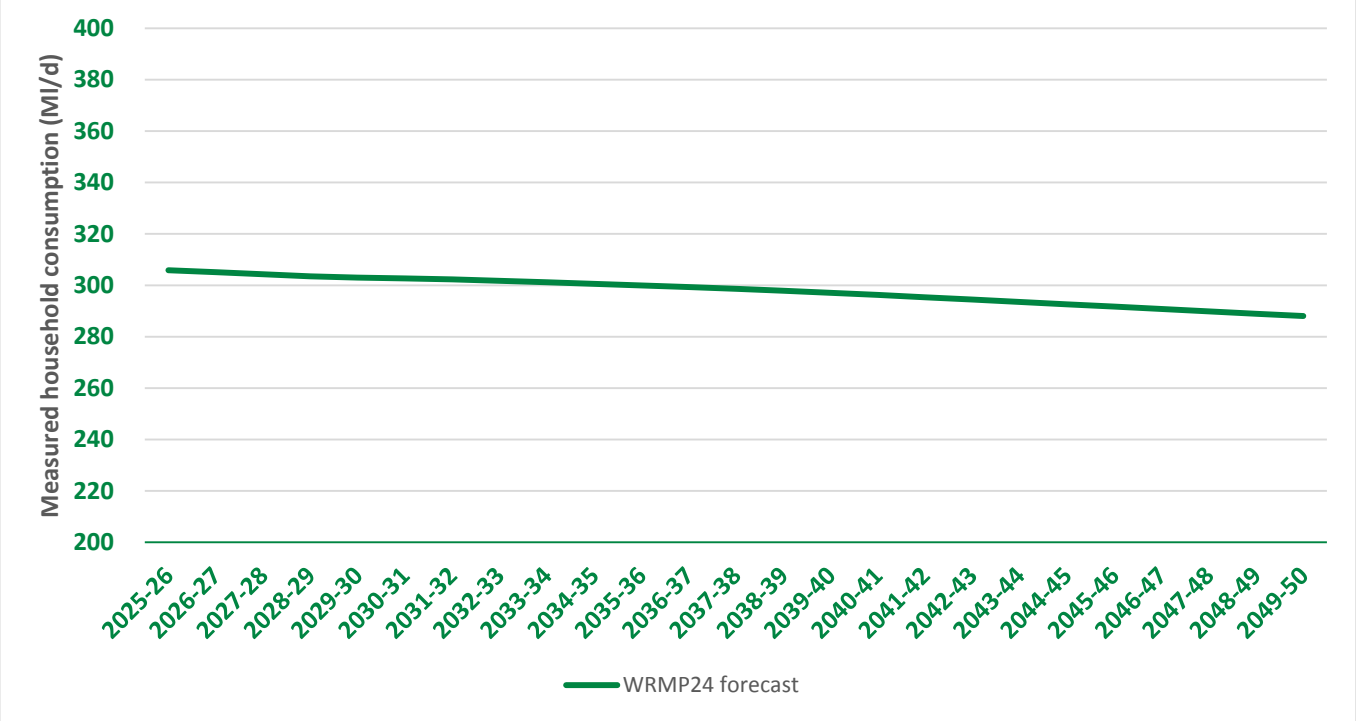
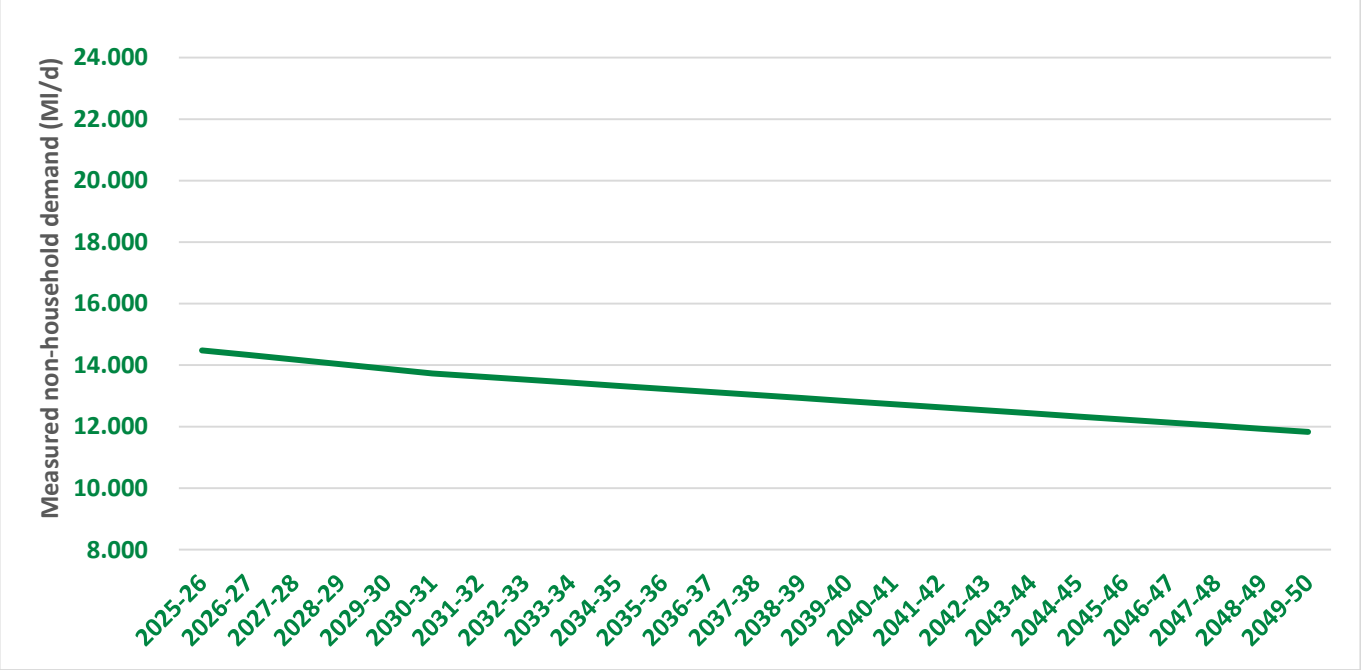


Figure 14 Unmeasured non-household consumption projections – United Utilities Water region



5.3 Leakage and minor components

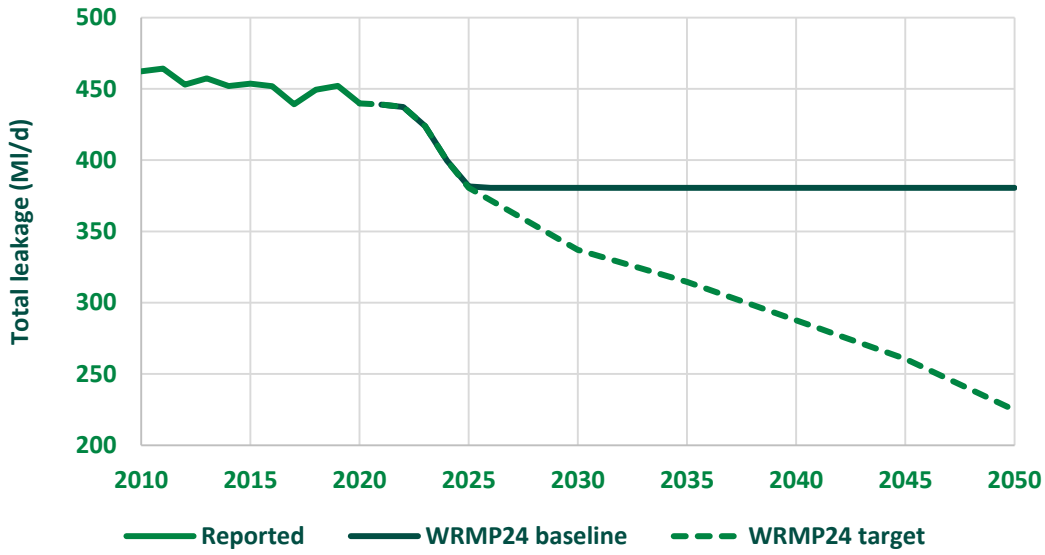
In addition to consumption by household and non-household customers, leakage and minor components also contribute around 28 per cent of the overall demand for water from our supply system (see Figure 9). Leakage management is an important part of our plans to reduce demand, which contributes to maintaining the overall supply-demand balance in our region.

Within our Water Resources Management Plan, leakage is defined as the loss of treated water from any point downstream of the distribution input meter at a water treatment works, up to the internal stop tap in a customer property. Raw water losses upstream of water treatment works are considered separately. The key components of leakage are as follows:

- **Upstream leakage**: leakage from trunk mains and service reservoirs;
- **DMA (District Metered Area) leakage**: leakage from distribution pipes and connections to properties (communication pipes); and
- **Customer side leakage**: leakage from customer supply pipes, also known as supply pipe leakage.

Our baseline leakage forecast includes our existing commitments for leakage reductions over the current Business Plan period (2020–2025). Our final plan forecast reflects our aim to achieve government targets for leakage reduction by 2050 (see Sections 7.1 and 8.4.1 for more details). Both the baseline and final leakage forecasts are shown in Figure 15.

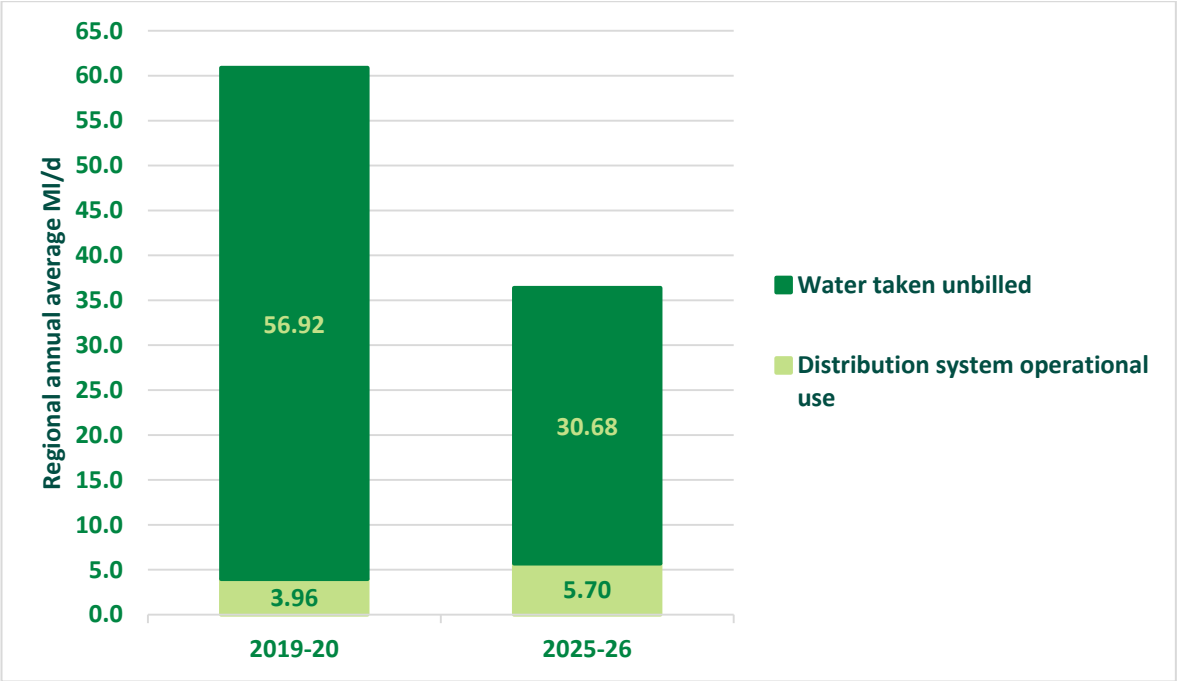
Figure 15 Regional leakage baseline and final forecast from 2020 to 2050



Minor components include our own water use within our water treatment and distribution systems, known as distribution system operational use and including uses such as service reservoir cleaning and mains flushing, and water which is taken from our system but not billed, including legitimate uses such as firefighting and water taken illegally.

Our forecasts for distribution system operational use are based on the most recent five-year average data (2015–2020), while our forecasts for water taken unbilled are based on projected changes from 2019/20 base year data taking into account our void billing programme. Figure 16 shows the effect of this programme on minor components, comparing the observed base year data from 2019/20 with the first year of forecasts, 2025/26.

Figure 16 Regional minor components – baseline and forecast



5.4 Impact of climate change on demand

The findings of the UKWIR 'Impact of Climate Change on Water Demand' project (UKWIR, 2013) were used to calculate forecasts of climate change impacts on household water consumption. In the UKWIR project, five case studies were analysed to derive relationships between water use and variations in weather. These relationships were then combined with UKCP09 climate projections to derive estimates of the impact of climate change, expressed as percentage uplifts in household water consumption. These estimates are presented in the form of look-up tables for each UK river basin and for a range of percentiles (the 10th, 25th, 50th, 75th and 90th percentiles), reflecting the range of uncertainty associated with the climate change projections.

For our draft Water Resources Management Plan 2024, we have applied the 50th percentile or median climate change factors for the North West England river basin to our baseline projections of household consumption. This additional uplift to demand is applied to the external use component of household consumption and the overall impact on demand is small, ranging from 1.7 Ml/d in 2025/26 (0.2 per cent of household consumption) to 8.5 Ml/d in 2050/51 (0.8 per cent of household consumption), for our region as a whole.

This is in line with the approach applied in our 2015 and 2019 Water Resources Management Plans and also aligns with the approach adopted for the Water Resources West regional plan. The UKWIR project on climate change (2013) is still the principal source of climate change demand uplift information available at the time of preparing our draft plan.

5.5 Weather and other adjustments

In order to assess all water resource zones for the normal year and dry year annual average planning scenarios (see Section 2.8), forecasts of both normal year and dry year demand are required. Demand projections are initially prepared from a base year, and then a dry year uplift factor is applied to household consumption to represent the increase in demand that would be expected in a year in which a significant period of hot, dry weather is experienced. Similarly, an adjustment factor is applied to the base year demand projections to prepare demand forecasts for a 'normal' year: a year in which demand is neither increased due to dry weather, nor decreased due to relatively cooler and/or wetter weather conditions.

In previous Water Resources Management Plan updates (2015 and 2019) we have worked with the Met Office to develop models, which relate water demand to weather parameters. The demand for water attributed to these weather parameters is termed 'weather-dependent usage' (WDU). The Met Office Demand-WIM (Weather

Intelligence Model) enables us to determine the magnitude of weather-dependent usage and, therefore, to understand the relationship between 'dry' and 'normal' years in our observed demand data. This relationship is used to determine the appropriate normal year and dry year uplift factors to apply to our base year demand, to produce forecasts for the required planning scenarios.

Changes in working patterns due to lockdown restrictions during the COVID-19 pandemic had significant impacts on water consumption in 2020/21. In particular, we saw a large change in the magnitude of demand components from non-household consumption to household consumption due to large numbers of people either working from home or furloughed from their normal occupations due to temporary business closures. The influences of COVID-19 on future patterns of working are uncertain but likely to continue to some degree, affecting the balance between household and non-household water consumption. We have, therefore, applied an adjustment to our forecasts by shifting an estimated proportion of demand from the non-household (five per cent) to the household component. This leads to an overall increase in the total dry year demand forecasts, as the dry year uplift factor is applied to household consumption (see our *Draft Technical Report – Demand forecast* for more details).

5.6 Summary of baseline demand forecast

Table 8 presents a summary of the dry year annual average demand forecasts for the first year of forecasts 2025/26 and at five-yearly intervals to 2049/50. These forecasts are also shown in Figure 17, Figure 18 and Figure 19.

Table 8 Summary of baseline dry year annual average demand forecasts by resource zone

	Dry Year Annual Average Demand (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Barepot	26.9	26.9	26.9	26.9	26.9	26.9
Carlisle	29.3	30.1	30.8	31.3	31.4	31.2
Strategic	1,716.5	1,730.6	1,731.3	1,729.3	1,727.9	1,727.2
North Eden	5.9	5.9	5.9	5.9	5.9	5.8

Our demand forecast shows a very small increase of around 0.7 per cent across the 25-year planning horizon, excluding the impacts of our ambitious demand management programme (see Section 9.1 for details).

Figure 17 Lower, most likely and upper range dry year annual average forecasts (Carlisle Resource Zone)

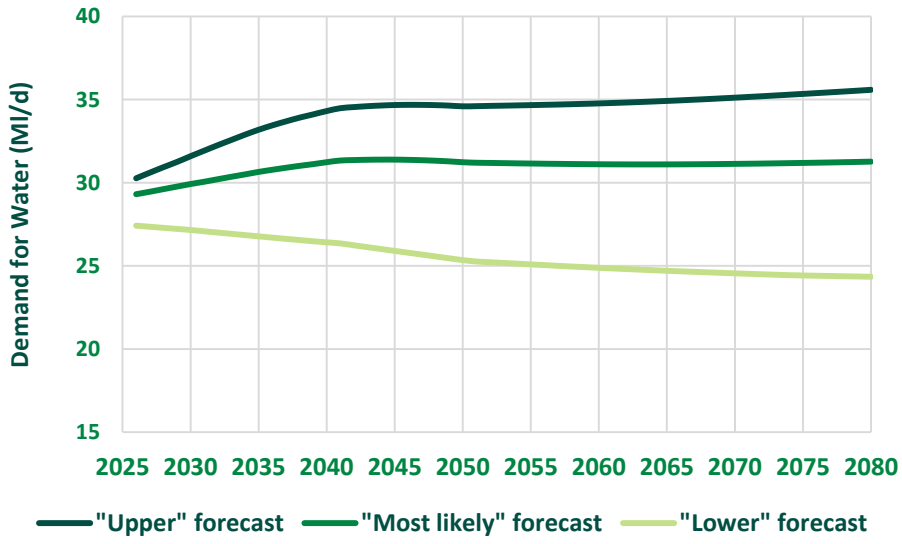


Figure 18 Lower, most likely and upper range dry year annual average forecasts (North Eden Resource Zone)

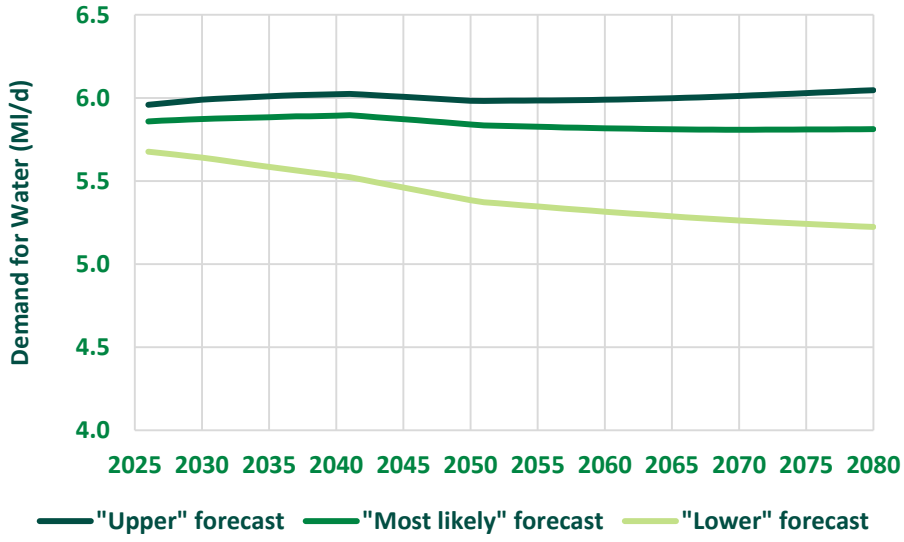


Figure 19 Lower, most likely and upper range dry year annual average forecasts (Strategic Resource Zone)

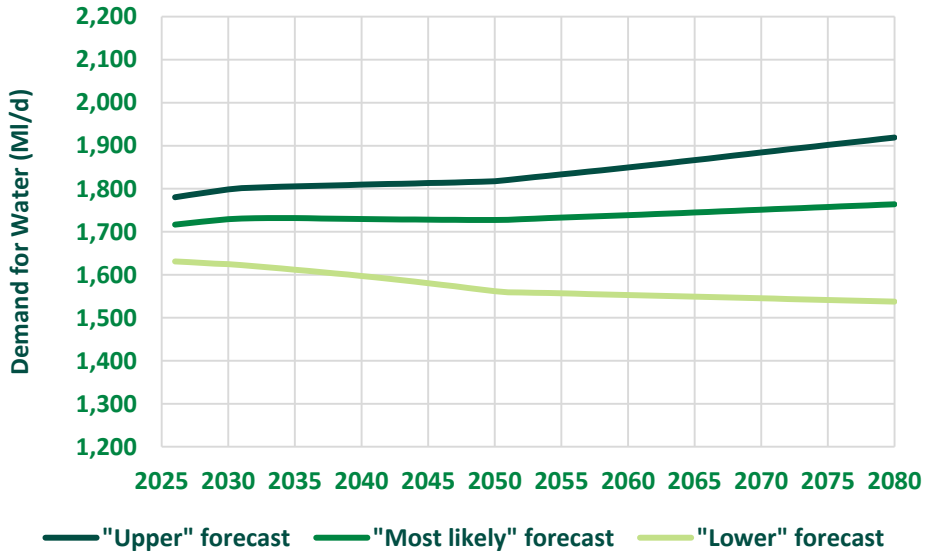


Table 9 presents a summary of the dry year critical period demand forecasts, for the first year of forecasts 2025/26 and at five-yearly intervals to 2049/50 (Carlisle Resource Zone only).

Table 9 Summary of baseline dry year critical period demand forecasts by resource zone

	Dry Year Critical Period Demand (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Carlisle	35.1	36.0	36.9	37.5	37.6	37.4

We recognise that there are a range of factors affecting future demand for water. While we aim to employ the best available data and methodologies to forecast future demand, there is inevitably uncertainty inherent within our forecasts. In order to account for this uncertainty, we therefore also selected a 'lower' and 'upper' demand forecast to represent the possible range of forecasts. The lower and upper range of our demand forecasts are incorporated into our target headroom allowance (the margin between supply and demand to allow for

uncertainty in the various components of the supply-demand balance). Further details are given in Section 6 and in our *Draft Technical Report – Allowing for uncertainty*.

We have also addressed potential variations in our demand forecasts through our adaptive planning approach, in which we have tested several alternative scenarios and prepared alternative pathways, which may be implemented should any of these scenarios occur in future. Further details are given in Section 9.5 and in our *Draft Technical Report – Deciding on future options*.

6. Our baseline position

i Key Points

- **Our baseline supply-demand balance shows that without the drought supply and demand measures included in our drought plan there is a potential deficit in our Strategic Resource Zone, of 56.5 Ml/d in 2025/26 and without new interventions this rises to 321.9 Ml/d by 2049/50.**
- **All other resource zones maintain a positive supply-demand balance across the 25-year planning horizon.**
- **We account for uncertainty in our forecasts by using 'target headroom', with the choice of percentile reflecting both the degree of confidence in data and potential risk.**

A key priority for our Water Resources Management Plan is to ensure that we have a reliable supply to meet customer demand, both now and in the future. In this section we outline how we prepare our baseline supply-demand balance by comparing our supply and demand forecasts and including an allowance for uncertainty in our forecasts.

6.1 Allowing for uncertainty

Sections 4 and 5 have outlined how we prepare the forecasts of supply and demand, which are used to calculate the supply-demand balance for each water resource zone over the 25-year planning period from 2025 to 2050. In accordance with statutory guidelines and industry standard practice, the supply-demand balance also includes a margin between supply and demand to allow for uncertainties inherent within the supply and demand forecasts. This margin is known as 'headroom', and we calculate appropriate values of headroom for each planning scenario considered in our plan for each resource zone. The headroom value determined for each year across the planning horizon is termed the target headroom allowance.

There are a range of factors leading to uncertainty in our forecasts of supply and demand over the 25-year planning horizon. These include accuracy of meters measuring abstractions and distribution input, uncertainty in hydrological and hydrogeological data, modelling and operational uncertainty, variation in the company's future demand forecasts, uncertainty in the future impacts of climate change, risks of future pollution impacts on supply availability, and risks of changes to the company's abstraction licences for sustainability or other reasons. The aim of calculating a target headroom allowance is to provide a reasonable margin to cover the statistically combined impact of all of these factors on the supply-demand balance, at a defined level of risk.

6.2 Target headroom methodology

As for our previous 2019 Water Resources Management Plan, we have adopted the industry standard method for the calculation of target headroom allowance in each of our resource zones. The method is outlined in An Improved Methodology for Assessing Headroom (UKWIR, 2002) and referred to by the Environment Agency in their Water Resources Planning Guidelines (December, 2021).

In this approach, a probability distribution is assigned to each individual risk or uncertainty factor within the supply-demand balance, and the probability distributions are then combined using the statistical technique of Monte Carlo simulation, which iteratively takes random samples from each distribution and sums them according to specified rules. This process is used to create a probability distribution of combined headroom uncertainty for each year across our planning period. From this, a target headroom allowance is selected at the required level of risk in each year. Our selected risk profile is based on a probability of 80 per cent at the start of the period (representing a risk of 20 per cent that the headroom allowance is exceeded), tapering down to a probability of 70 per cent in 2049/50 (30 per cent risk). Accepting an increased level of risk further into the future, when there is

more time to plan and adapt to the factors included in the headroom allowance, is in line with Environment Agency guidelines and Ofwat feedback from pre-consultation.

More details on our assumptions and approach to calculating our target headroom are provided in our *Draft WRMP24 Technical Report – Allowing for uncertainty*.

6.3 Summary of target headroom allowance

The selected profiles of target headroom allowances for each of our water resource zones are shown in Table 10 and Table 11.

Table 10 Summary of target headroom allowance by resource zone (Dry Year Annual Average Planning Scenario)

	Dry Year Annual Average Target Headroom Allowance (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Strategic	69.4	69.1	71.6	74.6	77.0	81.2
Carlisle	0.4	0.5	0.6	0.5	0.4	0.3
North Eden	1.3	1.3	1.3	1.3	1.3	1.3
Barepot	1.4	1.4	1.4	1.4	1.4	1.4

Table 11 Summary of target headroom allowance by resource zone (Dry Year Critical Period Planning Scenario)

	Dry Year Critical Period Target Headroom Allowance (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Carlisle	0.2	0.4	0.5	0.5	0.3	0.2

In order to calculate the baseline supply-demand balance for each of our resource zones across our planning period, we subtract the demand forecast plus the target headroom allowance for the appropriate planning scenario, from the water available for use (WAFU) in each year. If the resulting value is positive, this means that we are forecasting a surplus for that particular year and resource zone, whereas a negative result represents a forecast deficit.

We have also addressed a number of significant uncertainty factors through our adaptive planning approach, in which we have tested several alternative scenarios and prepared alternative pathways which may be implemented should any of these scenarios occur in future. These scenarios include alternative futures relating to the key uncertainties of climate change, demand forecasts, water quality, demand management savings, water trading and environmental changes. Further details are given in Section 9.5 and in our *Draft Technical Report – Deciding on future options*.

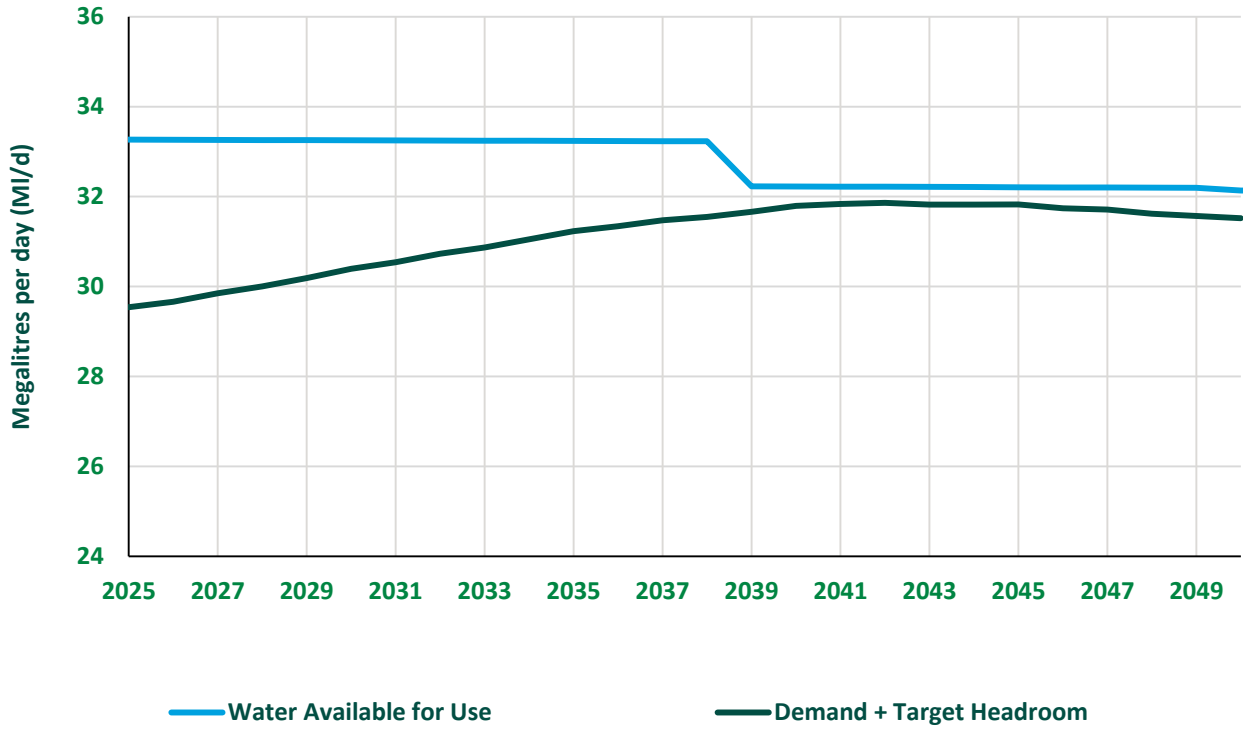
6.4 Baseline dry year annual average supply-demand balance

Table 12 presents a summary of the baseline dry year annual average supply-demand balance, for the first year of forecasts 2025/26 and at five-yearly intervals to 2049/50. See also Figure 20, Figure 21, Figure 22 and Figure 23.

Table 12 Summary of baseline dry year annual average supply-demand balance by resource zone

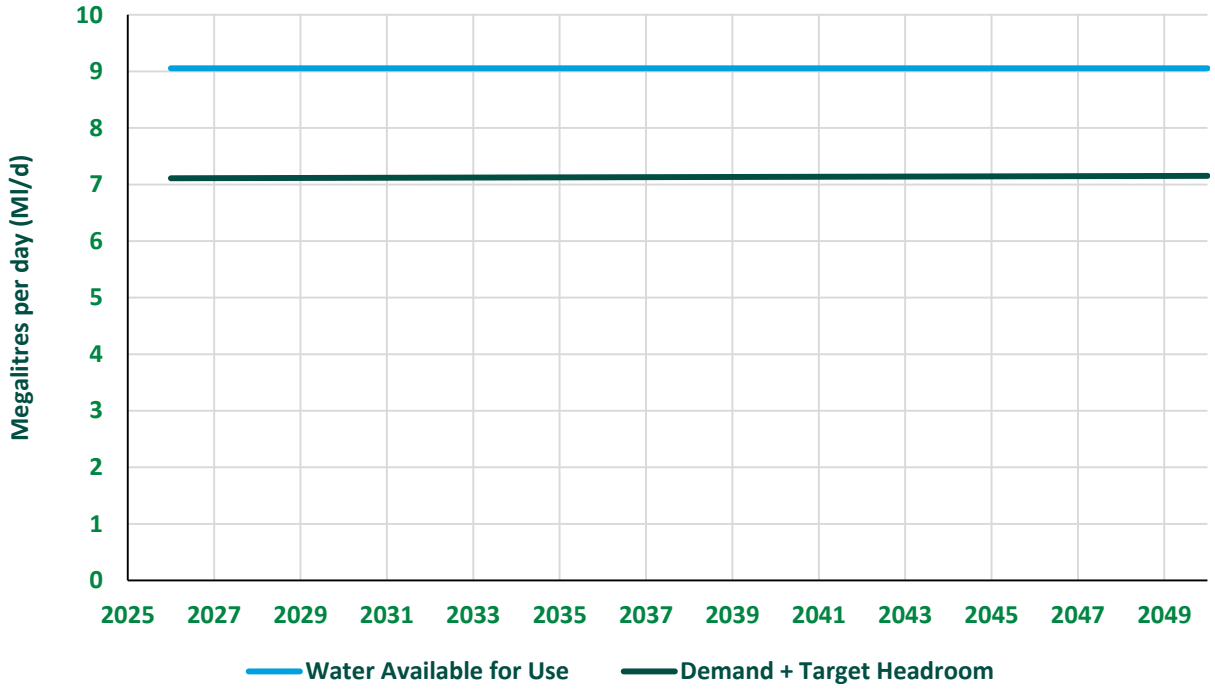
	Dry Year Annual Average Supply-Demand Balance (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Strategic	-56.5	-63.3	-81.5	-197.9	-240.5	-321.9
Carlisle	3.6	2.7	1.9	0.4	0.5	0.6
North Eden	1.9	1.9	1.9	1.9	1.9	1.9
Barepot	5.8	5.8	5.8	5.8	5.8	5.8

Figure 20 Carlisle Resource Zone – Dry Year Annual Average Supply-Demand Balance



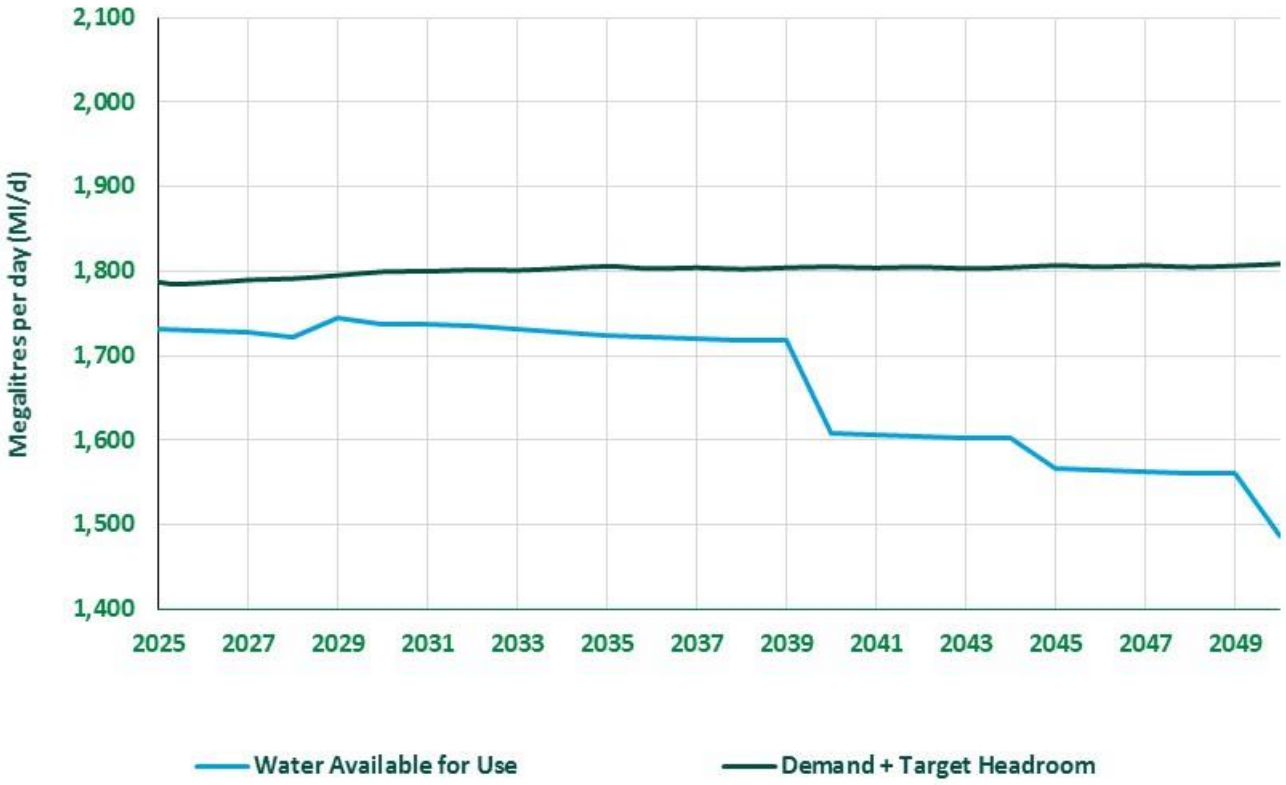
The step change in Water Available for Use in Carlisle Resource Zone, from 2038 to 2039, is due to the requirement to meet the new 1 in 500-year resilience standard for emergency drought orders from 2039 onwards. This leads to a reduction in the supply-demand surplus for that period, although the resource zone remains in surplus throughout the statutory planning period to 2050.

Figure 21 North Eden Resource Zone – Dry Year Annual Average Supply-Demand Balance



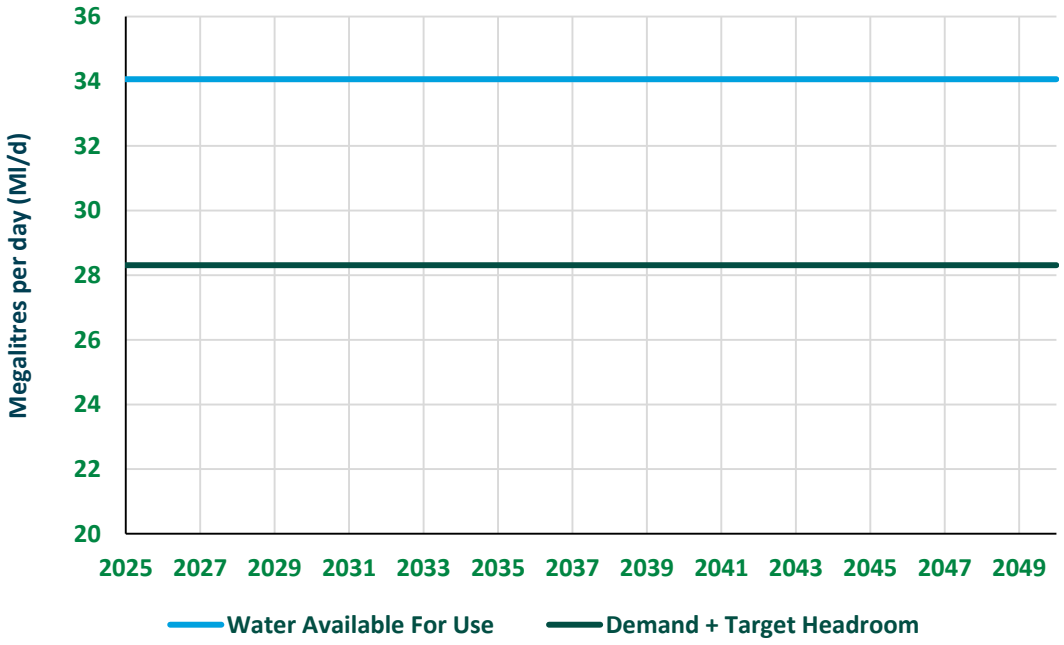
As shown in Figure 21, our North Eden Resource Zone is forecast to remain in surplus throughout the statutory planning period to 2050.

Figure 22 Strategic Resource Zone – Dry Year Annual Average Supply-Demand Balance



The baseline supply-demand balance shown in Figure 22 indicates that without any intervention, our Strategic Resource Zone would potentially face a deficit such that available supplies would be insufficient to meet demand plus target headroom across the planning period. Our baseline forecast of water available for use includes reductions due to the effects of the new 1 in 500-year resilience standard (2039), environmental changes to our abstraction licences (2044 and 2049) and climate change impacts. The baseline forecast deficit is 56.5 Ml/d in 2025/26 but increases to 321.9 Ml/d by 2049/50. The demand and supply drought measures included in our Final Drought Plan 2022 are sufficient to resolve this deficit and put the supply-demand balance into a surplus of 50 Ml/d. We need to ensure that our final plan addresses the deficit in 2049/50, however, there are many other objectives to take into account in determining our best value plan; these are discussed further in Sections 7 and 8.

Figure 23 Barepot Resource Zone – Dry Year Annual Average Supply-Demand Balance



As shown in Figure 23, our Barepot Resource Zone is forecast to remain in surplus throughout the statutory planning period to 2050.

6.5 Baseline dry year peak week supply-demand balance

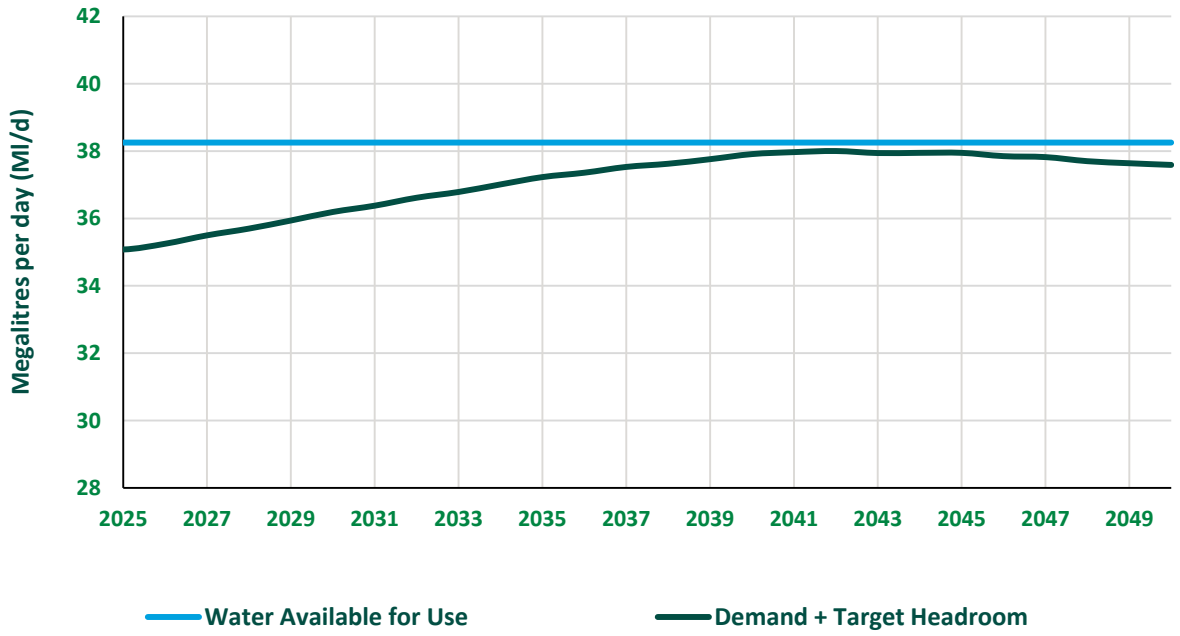
Table 13 presents a summary of the baseline dry year peak week supply-demand balance, for the first year of forecasts 2025/26 and at five-yearly intervals to 2049/50. See also Figure 24.

Table 13 Summary of baseline dry year peak week supply-demand balance by resource zone

	Dry Year Peak Week Supply-Demand Balance (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Carlisle	3.0	1.9	0.9	0.3	0.4	0.7

As shown in Figure 24, for the dry year critical period (peak week) planning scenario, our Carlisle Resource Zone is forecast to remain in surplus throughout the statutory planning period to 2050, although the magnitude of the surplus decreases over time.

Figure 24 Carlisle Resource Zone – Dry Year Critical Period Supply-Demand Balance



7. Strategic choices

i Key Points

- **Our baseline position shows that we must respond to a deficit forecast in our Strategic Resource Zone from 2025 (this will be resolved by our demand management strategy).**
- **We also consider the opportunity to make some 'strategic choices' to protect and, where possible, benefit customers and the environment.**
- **The strategic choices have been developed principally in response to the views of customers, regulators and other stakeholders. They include:**
    - **Meeting ambitious government targets to halve the level of leakage and reduce the use of water to 110 litres per person per day by 2050;**
    - **Improving levels of service for the frequency of water use restrictions and drought permits; and**
    - **Supporting national and regional water resources needs through water transfers.**

In this Water Resources Management Plan, we have forecast available supply and future demand for the 25-year period to 2050 and beyond. Our analysis has demonstrated that we have a supply-demand surplus for all years across our planning period for Barepot, Carlisle and North Eden Resource Zones, however our final plan must meet a deficit identified in our Strategic Resource Zone from 2025 onwards. Beyond the supply-demand balance we have also taken the opportunity to consider a number of 'strategic choices' in order to help protect and, where possible, benefit customers and the environment. The strategic choices are related to:

- Leakage reduction and demand management;
- Customer preferences relating to levels of service; and
- Supporting regional and national water resource needs through water transfer.

The strategic choices have been developed principally in response to the views of customers, regulators and other stakeholders. In the remainder of this section, we set out the rationale behind each choice and explain how it has been defined. The strategic choices are then fed into our options appraisal process to determine which interventions are required and the necessary level of investment (Sections 8 and 9).

7.1 Leakage reduction and demand management

Since the 1990s, leakage management activities have played a key role in reducing leakage and therefore the overall demand across our region. In our previous plan, we set out our strategy to achieve further leakage reductions of 190 Ml/d over the 25-year planning horizon, a reduction of over 40 per cent below the baseline position, with 67 Ml/d reductions (15 per cent) taking place from 2020–2025.

In the National Framework for Water Resources (2020) the government set out ambitious targets for the industry to reduce water consumption to 110 litres of water per person per day and halve rates of leakage by 2050. This strategic choice is effectively, therefore, a regulatory expectation, albeit there are choices around the pace of delivery. These targets are very challenging, but we are stretching our capabilities through increased focus and innovation to embrace these ambitions within our plan. Such significant demand reductions also require actions by others, for example customers reducing their usage and the government implementing new regulations, so adaptive planning is critical to delivering overall national ambition (Section 9.5). An overview of the demand-side options we have considered in order to achieve these targets is provided in Section 8.4.

7.2 Customer preferences relating to levels of service

All companies have stated levels of service, which stipulate the frequency at which they expect to apply water use restrictions or apply for drought permits and orders during dry weather. Our current levels of service are set out in Table 14, along with our proposals for future improvements.

Our previous plan improved our minimum stated level of service for drought permits and orders to augment supplies from five per cent annual average chance (no more than once every 20 years) to 2.5 per cent annual average chance (once every 40 years) by 2025, enabled by the leakage reductions proposed by the plan. It also improved the level of service for non-essential use bans (NEUBs) from 2.9 per cent annual chance (1 in 35 years) to 1.25 per cent annual chance (1 in 80 years).

Moving forward to our 2024 Water Resources Management Plan, the North West has one of the lowest levels of resilience to temporary use bans, previously known as hosepipe bans. This is due to the nature of our supply area where we have the highest proportion of surface water and therefore the lowest proportion of groundwater sources. This means we can experience sharp decreases in supplies, but also rapid refill. Therefore, our system is vulnerable to 'short-term shocks' when reservoir storage drops rapidly in response to periods of low rainfall, and the point at which temporary use bans may be required is reached more often.

Having listened to customer and stakeholder views, and conducted new customer research for our 2024 Water Resources Management Plan (see Section 3.3 and our *Draft Technical Report – Customer and stakeholder engagement* for further details), there is strong support for improving our level of service for temporary use bans from a five per cent annual average chance (1 in 20 year frequency) to 2.5 per cent annual average chance (1 in 40 years). In this plan, we are again putting customers at the heart of our decision making. Our ongoing efforts to reduce leakage and demand will facilitate these improvements in future, however the earliest this is likely to occur is 14 years into the planning period, in 2039. We have therefore sought to identify other potential strategic opportunities to deliver these improvements to customers (see Section 7.3).

The improvement of temporary use bans level of service will bring a secondary benefit to drought permits, as shown in the table. Drought permits can only be applied for after temporary use bans have been implemented and therefore have a lower expected frequency of occurrence (because sometimes the situation will recover in this window of time).

Table 14 Summary of our current and proposed minimum stated levels of service

		Average frequency of occurrence in period:		
Event	**Current**	**2025–2031**	**2031–2040**	**2040–2050**
Temporary use bans	Once every 20 years on average (5 per cent annual average chance)	Once every 20 years on average (five per cent annual average chance)	Once every 40 years on average (2.5 per cent annual average chance)	Once every 40 years on average (2.5 per cent annual average chance)
Drought permits and drought orders to augment supply	Once every 40 years on average (2.5 per cent annual average chance)	Once every 40 years on average (2.5 per cent annual average chance)	Once every 50 years on average (2 per cent annual average chance)	Once every 50 years on average (2 per cent annual average chance)
Drought orders to ban non-essential water use	Once every 80 years on average (1.25 per cent annual average chance)	Once every 80 years on average (1.25 per cent annual average chance)	Once every 80 years on average (1.25 per cent annual average chance)	Once every 80 years on average (1.25 per cent annual average chance)

		Average frequency of occurrence in period:		
Event	**Current**	**2025–2031**	**2031–2040**	**2040–2050**
Emergency drought orders (e.g. rota cuts and standpipes)	Once every 200 years on average (0.5 per cent annual average chance)	Once every 200 years on average (0.5 per cent annual average chance)	Once every 200 years on average (0.5 per cent annual average chance)	Once every 500 years on average (0.2 per cent annual average chance)

7.3 Water transfer to support national water resource needs

Through our leading role in Water Resources West (WRW) and regional planning, we are actively helping to solve some of the largest water supply risks in the country. In particular, we sponsor the North West Transfer (NWT) Strategic Resource Option (SRO), which is the United Utilities Water component of the Severn to Thames Transfer (STT) SRO. The STT scheme is being developed collaboratively by Severn Trent Water, United Utilities Water and Thames Water as one of a number of SROs assessed through the Regulators' Alliance for Progressing Infrastructure Development (RAPID) to address regional and national water resources planning needs.

The STT scheme involves transferring water from the River Severn to the River Thames where it can be abstracted by Thames Water, and potentially other companies in the South East. When there is insufficient flow in the River Severn, support is provided by Severn Trent Water SROs and the NWT SRO. The NWT SRO involves transferring up to 180 Ml/d of raw water from Lake Vyrnwy into the River Severn, and 25 Ml/d of potable water into Severn Trent Water's area (which indirectly supports flow in the River Severn by reducing their abstraction). Therefore, the current total available tradable amount for NWT is 205 Ml/d. In order to mitigate the impact on customers and the environment, the NWT SRO also involves developing 'sub-options' in the North West. The term sub-option reflects that the options form part of the larger NWT SRO which itself is viewed as an option by our potential trading partners. The whole STT scheme is shown in Figure 25. Support from NWT would only be required at times when water resources in the South East are under stress. At other times the sub-options will help to improve resilience in our area.

We also developed over 20 'non-SRO' export options transferring water to other regions, water companies and organisations. Several of these options have been selected in other companies' Water Resources Management Plan preferred plans (Section 9.2). In terms of imports, we considered over 20 options and the most promising appear to be the Northumbrian Water Kielder and Cow Green transfers, both of which could potentially support the NWT SRO.

The first proposed water trade starts in 2031; more details about the plan for water trading are provided in Section 9.2. Water trading is a key issue of concern for some customers and stakeholders. We conducted extensive research and specifically designed our approach to address their concerns (Section 3.3), by developing a set of key water trading principles, as set out in Table 15, which will apply to any future water transfer.

Figure 25 The Seven Thames Transfer strategic resource option

Table 15 Our water trading principles

Principle	Criteria
Drinking Water Quality	United Utilities Water customers will receive drinking water that is fully compliant with all regulatory standards.
Customer Acceptability	Customers must continue to have confidence in their water supply and acceptance in terms of taste, odour, appearance (discolouration) and pressure.
Resilience	The transfer must not have a net detrimental impact – and should ideally improve – the resilience of the water resource and assets used to provide services to customers.
Environment	The projects must not have a significant adverse effect on the environment, must be approved through regulatory oversight and must support, or at least not have a detrimental impact on, the company's overall environmental performance.
Customer Bills	The scheme should provide demonstrable value for money for customers in the North West, as reflected in customer bills, and customers in the region must receive a fair proportion of the national benefits which arise from the scheme.

8. Deciding on future options

i Key Points

- **In line with industry guidance, we have considered all possible options.**
- **We are putting customers at the heart of our decision making, using the outcomes of our latest customer research to shape our plan to their preferences.**
- **We developed an extensive engagement strategy to encourage third parties to collaborate on identifying potential supply and demand options.**
- **Our options screening and assessment process takes account of our commitment to delivering carbon net zero by 2050.**
- **We collaborated with Water Resources West to develop a set of 'best value metrics' to quantify and maximise the benefits of our plan. We also developed a best value optimisation tool, named ValueStream, to use as part of our decision-making methodology to create a best value plan.**

This section outlines the process by which we identify and assess a wide range of supply and demand options for potential inclusion in our plan. An overview of the options screening process is shown in Figure 26. The decision-making framework adopted to select the options which comprise our best value plan is summarised in Section 8.6.

8.1 Identifying possible options

Identification of the options was carried out in accordance with current regulatory and industry guidelines, which include:

- Defra guiding principles;
- Environment Agency and Natural Resources Wales guidelines;
- UKWIR *Water Resources Planning Tools* report; and
- Drinking Water Inspectorate Guidance Note: Long-term planning for the quality of drinking water supplies.

We have explored a full range of options, including those that seek to reduce the demand for water as well as options for new water supplies, to ensure that our final list is comprehensive and includes options from all of the four categories listed in the UKWIR report:

- Resource management: New supply options, including both groundwater and surface water, and abstraction licence trading and imports;
- Production management: Reducing losses on our raw water systems and at our treatment works;
- Customer management: Metering, water efficiency activities and changes to levels of service; and
- Distribution management: Leakage prevention, detection and reduction.

We have further enriched this list with bespoke types of options that are not explicitly detailed in the UKWIR report, for example capture and use of urban surface water interceptor sewers and trade effluent reuse.

In our initial list of options, we included all 'unconstrained options' which were assessed for our previous (2019) Water Resources Management Plan. This list was augmented with new options from within the company, third-party options, options identified from bilateral discussions with other water companies, and national and regional options identified in a 2020 report commissioned by RAPID (the Regulators' Alliance for Progressing Infrastructure Development). Key considerations in assembling our list of unconstrained options for this draft plan included:

- Resilience: ensuring that our options offer benefit to customers and demonstrate reduced susceptibility to drought;
- Environmental objectives: ensuring that our options do not compromise our legislative and wider climate change objectives; and
- Range of options: ensuring that we have considered options in all four categories as listed above.

We developed an engagement strategy to encourage third-party organisations to provide potential supply and demand options for our plan. We delivered this strategy through a range of communication channels, including a bespoke online collaboration portal, a brochure and letter sent to 200 stakeholders, media distribution to industry publications, LinkedIn posts and a webinar. This has resulted in several options being taken forward for engineering assessment and has generated a number of licence trade options and around 40 demand options for further consideration.

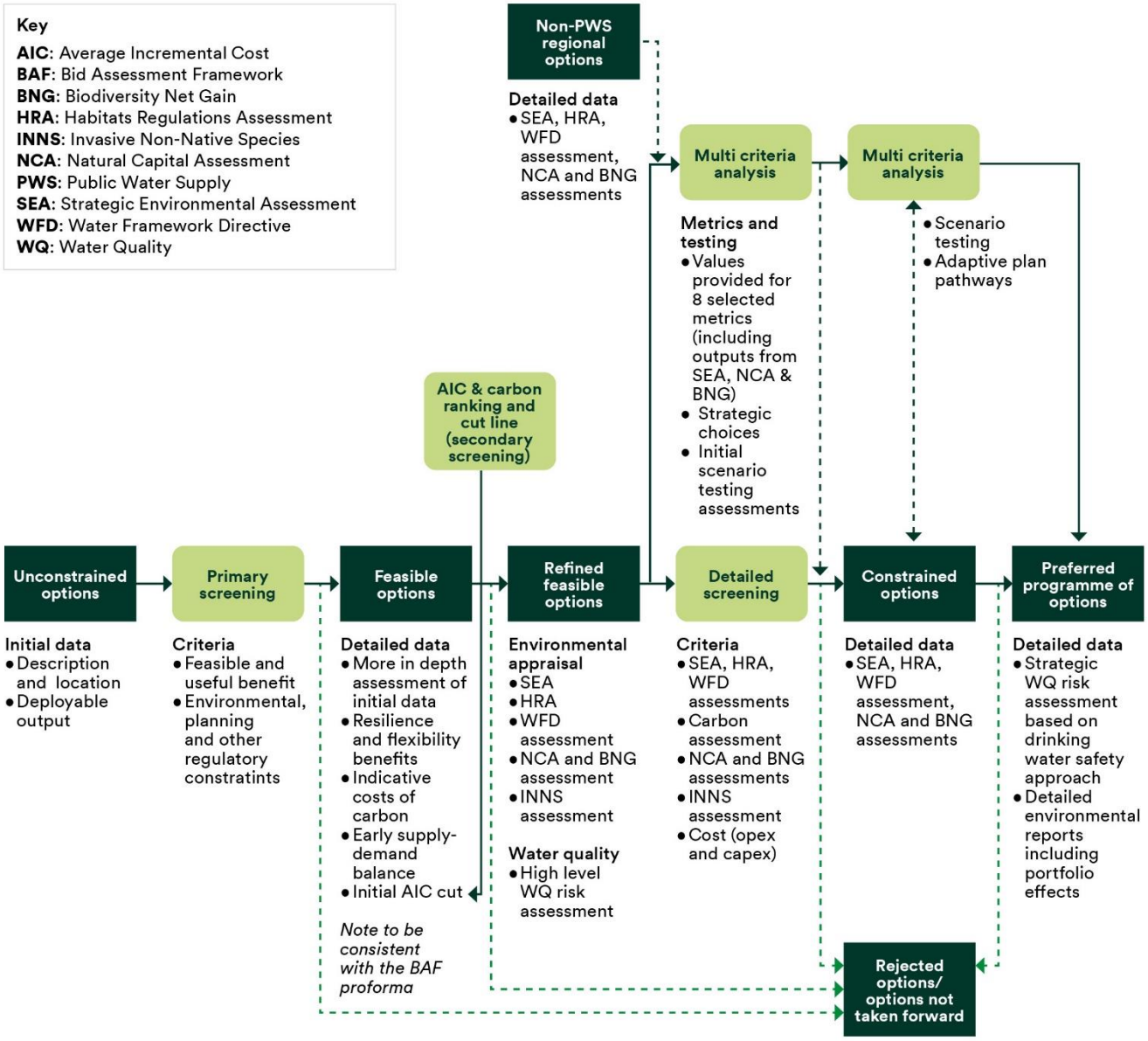
Our list of potential options includes the North West Transfer strategic resource option, which is being progressed to address national resource needs, as outlined above in Section 7.3, along with a number of demand management options (see Section 8.4) and supply options (see Section 8.5). Further details of the options we have considered are provided in our *Draft Technical Report – Options identification*.

8.2 Options screening

We carried out primary screening of 163 potential options (90 supply options and 73 demand options), including some considered in our previous plans and some new options. We developed a common approach to primary screening within our regional group, Water Resources West, which we have applied to all options including any third-party options for consistency. Our primary screening process included 11 criteria covering the four key areas of option benefit, engineering risk and delivery feasibility, environmental, planning and other regulatory constraints and political and customer acceptability. Any options which were identified as infeasible, or with environmental risks which cannot be mitigated, were screened out at this stage and the reasons for rejection were recorded.

In our secondary screening stage, we undertook further detailed assessment including the calculation of monetary and carbon costs for each feasible option, in parallel with environmental appraisal, to develop a list of constrained options to take forward into our decision-making analysis. This included a more detailed assessment of those criteria considered in the primary screening stage, as well as an assessment of cost, carbon and natural capital for use in the decision-making stage. A high-level water quality risk assessment of each option was also included at this stage. An overview of the screening process is provided in Figure 26.

Figure 26 Overview of options screening process



8.3 Our commitment to net zero

Our approach to carbon accounting within our options screening and assessment process is detailed within our *Draft Technical Report – Options identification*. Our demand-side options (see Section 8.4 below) will contribute to our commitment to reduce carbon emissions by reducing the amount of water we need to produce. Our supply-side options were evaluated according to a set of weighted best value metrics, which include carbon cost (see Section 8.6 and Figure 28), to minimise carbon emissions subject to trade-offs with other metrics.

A stable climate is fundamental to the sustainability of water and wastewater services. We therefore strive to lead by example, and lead others to join us, to reduce carbon emissions in line with global goals to curb the extent of future climate change.

Our carbon footprint is calculated by estimating the individual greenhouse gases that result from all United Utilities Water's activities, converted into a carbon dioxide equivalent (tCO_2e). We report Scope 1, 2 and all relevant Scope 3 emissions of the Greenhouse Gas Protocol, as summarised below:

- Scope 1: direct emissions (from activities which we own or control);
- Scope 2: energy indirect emissions (from purchased electricity); and

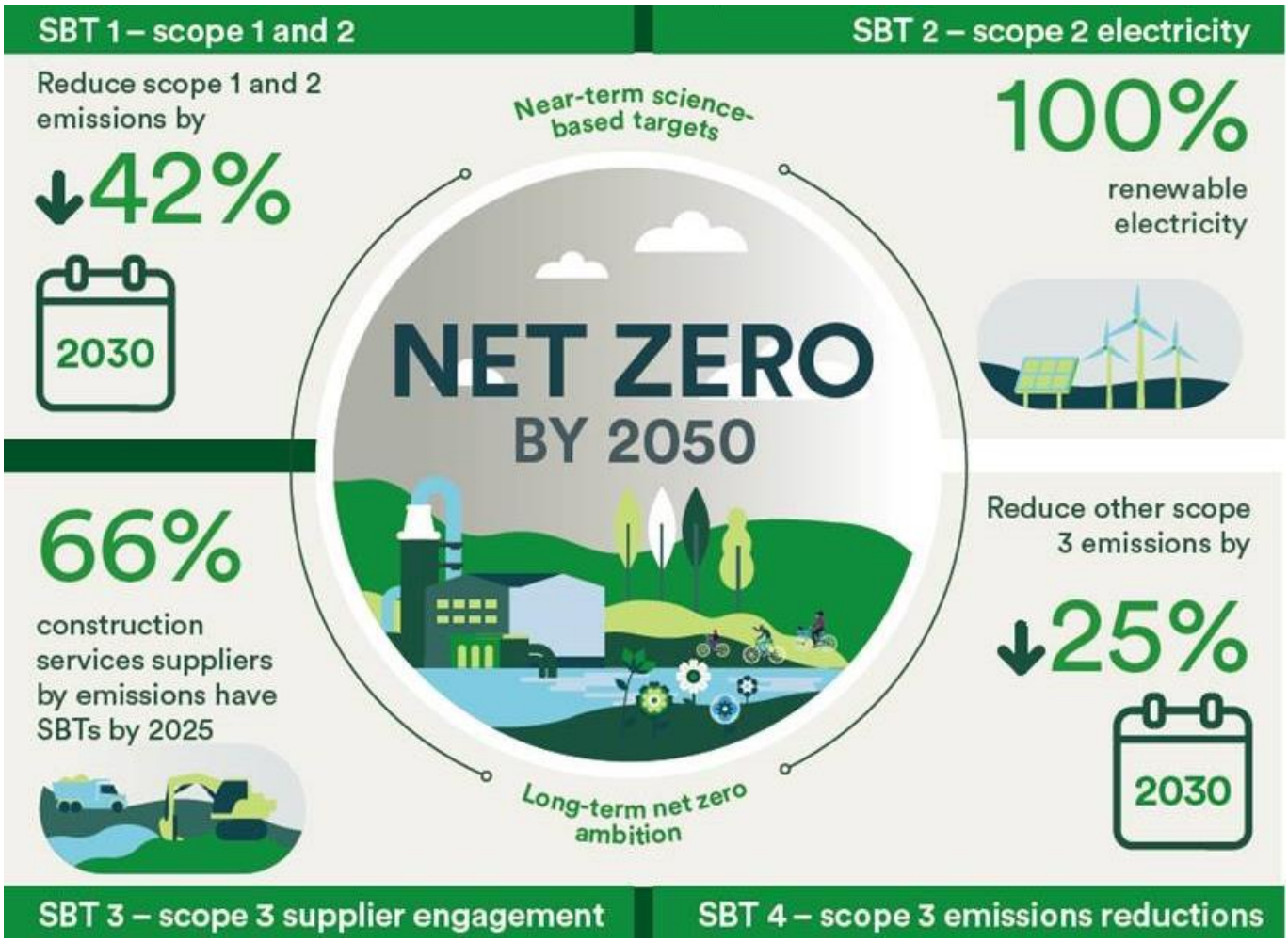
- Scope 3: other indirect emissions (e.g. from sludge disposal, business travel, purchased goods and services etc.).

To support our goals, we have made six pledges:

- Pledge 1: Reduce Scope 1 and 2 emissions by 42 per cent by 2030 from a 2019/20 baseline;
- Pledge 2: 100 per cent of electricity used from renewable sources (achieved from October 2021);
- Pledge 3: 100 per cent green fleet by 2028 (27 fully electric vehicles now deployed in our fleet with plans for 200 low carbon vehicles by 31 March 2025);
- Pledge 4: 1,000 hectares of peatland restoration by 2030;
- Pledge 5: Create 550 hectares of woodland by 2030; and
- Pledge 6: Set Scope 3 science-based target by the end of 2021.

We were the first company in the water industry to independently verify our end emissions targets with the best practice Science-Based Targets initiative (SBTi), covering Scopes 1, 2 and 3 to ensure a holistic approach across all elements of our carbon footprint: both operations and supply chain. Our four near-term science-based targets are summarised in Figure 27. The SBTi Net Zero Standard was launched in late 2021 and we have committed to validate our 2050 ambition to this standard when we revise and revalidate our near-term targets in advance of 2025.

Figure 27 Our science-based targets



8.4 Demand-side options

Our demand-side options are focused on reducing demand through both leakage reductions and activities to reduce customer consumption (both household and non-household). Demand options are considered first to meet government policy targets before supply options are considered.

In developing the list of unconstrained demand-side options we sought to identify options that pushed internal and external boundaries. We incorporated new technologies and offered differing delivery mechanisms and programmes, which in turn could enable the inclusion of options that were currently being researched but had not yet had tangible and scalable option development with confidence in costs and benefits. We took account of industry guidance[9], and considered political, environmental and regulatory reasons for promoting demand management measures. We also benchmarked our options against those considered by other water companies.

Key considerations in developing our demand management strategy include:

- Affordability challenges;
- Customer preferences (see Section 3);
- Rapid technology changes;
- Adapting to changes in water use patterns following the COVID-19 pandemic;
- Requirement for government support (for example through water labelling schemes); and
- Balancing uncertain innovations with certainty/confidence.

The following sections provide an overview of our approach to developing our demand management strategy through leakage reduction, metering and water efficiency options. Further details can be found in our *Draft Technical report – Options identification*.

8.4.1 Leakage reduction

Our leakage reduction strategy considers the need to enable efficiency in the longer term; smart metering will enable more efficient leakage reduction, as we will know whether we are targeting leaks on the distribution-side or customer-side. Network sensors work well in the short term but require replacement approximately every five years, which is a factor that needs to be taken into consideration.

Our proposed approach to leakage reduction is a continuation and refinement of our strategy for 2020–2025, aimed at the proactive 'Prevent' and 'Aware' aspects of PALM (Prevent, Aware, Locate and Mend). With a strong focus on the need to **Prevent** leakage, we are promoting options which:

- Ensure that our networks are effectively optimised and managed via 'calm networks'[10], live valve status and remote control;
- Apply intelligent maintenance to water network assets; and
- Stop deterioration in water network asset health, ensuring that we have already applied appropriate operational mitigation and that any new network is leak-free.

This approach is reflected in our asset rehabilitation, replacement and Dynamic Network Management (DNM) options. DNM involves installing monitoring technology to enable us to proactively pinpoint and prevent leaks or reduce leak run times.

Our approach to ensuring that we are **Aware** of leaks so that we can efficiently repair them, is to:

- Prioritise targeted enhanced monitoring; and
- Use the latest data analytics and prediction techniques to shift the balance from customer reported leaks to proactively found leaks.

To **Locate** leaks, we will work with our suppliers to develop and implement automatic correlation for pinpointing leaks to reduce leak runtimes. Finally, our demand-side options will enable us to **Mend** leaks, by implementing a robust repair prioritisation, using customer impact and size of leak, and reducing disruption by continuing to seek out and implement 'no dig' and 'in pipe' repair techniques, as well as utilising temporary repairs for leak mitigation.

[9] UKWIR (2012) Water Resources Planning Tools 2012. Report Ref. No. 12/WR/27/6 and UKWIR (2002) Economics of Balancing Supply and Demand Report.

[10] 'Calm networks' aim to minimise the risk of inducing surge pressures and flow as a result of the way hydrants, valves and pumps are operated. This is primarily achieved through effective training of operatives, including United Utilities Water employees and third parties who interact with the water network (e.g. fire service and large industrial users).

We are also conducting trials of innovative technologies, which can help to reduce leakage, as part of our Innovation Lab programme. This has included a trial of an app that manages and monitors valve operations and reduces transient pressure waves on a potable water network. The intuitive tool enables the following:

- Valve operations to be carried out in-line with our calm network procedures, ensuring we minimise the water quality and transient pressure risk, particularly in the first and last 10-20 per cent of the valve operation; and
- Update live valve information and provide additional data such as photos/notes to assist in ensuring the correct valves are operated. This will also assist with calculating and targeting leakage.

Further details of our approach to our leakage reduction strategy can be found in our *Draft Technical report – Options identification*.

8.4.2 Metering

Meter penetration within our company supply area is currently around 47 per cent for households and 91 per cent for non-households. This is lower than for many other UK water companies, however unlike many companies in the East and South of England we are not located in an 'area of serious water stress', meaning that we are legally unable to implement compulsory metering. Billing can only occur on a meter where customers opt for this, or where a customer has moved into a property with a meter installed. Our metering options are based on proactive metering, which then allows us to bill on meters when customers move house. The water efficiency benefit of these options therefore takes time to grow, while the leakage benefit is immediate.

Achieving 100% meter penetration is challenging for other reasons too, the most significant being that 22% of properties in the North West are supplied through common supply pipes, making individual meters difficult and more expensive to implement. Common supply pipes are where flats, apartments and other large shared buildings are supplied through one main supply pipe, and there is no area in which to place an individual meter upstream of a property's supply. Occupants may opt for a meter to be installed inside their home, however we've assumed that some customers who haven't already opted for a meter are unlikely to do so in the future during a proactive metering programme. Our full metering options currently assume relaying common supply pipes after 2030 to achieve full metering. This is not considered cost-effective, however the benefits of this approach are key to achieving our per capita consumption targets. In future, there may be a different, more cost-effective, approach to full metering but we have built our current options on a present-day view of the world.

Some other minor reasons which make 100% meter penetration challenging to achieve are voids and bulk meters, which introduce further complexity to metering programmes.

Key considerations in developing an initial list of metering options for screening include potential delivery mechanisms and ability to increase meter penetration levels, what meter types to install (dumb, automated meter reading or AMR with advice, or smart metering), impacts on costs, programme and meter coverage and how the overall metering strategy may impact our ability to deliver water efficiency and leakage targets. Our metering options all involve the installation of smart meters and are split into three types:

a. WR601: Enhanced metering of households (smart meters);
b. WR603: Enhanced metering of households on single supplies (smart meters); and
c. WR619: Upgrade existing household meters to smart meters.

Options have been created for each water resource zone and for the Strategic Resource Zone a number of options have been developed with varying programme length. The longer the programme length and the more benefit an option provides, the more it costs - as it relies on more meter installations. In particular, there is a large increase in cost between metering options WR603 to WR601, as WR601 includes households on common supply pipes.

Our WR619 options (upgrading existing household meters to smart) are designed to replace meters at a rate of 50,000 meters per year. This aligns with the current asset life of the meters we have installed in recent years, and allows us to be cost-effective rather than prematurely replacing meters. The smart metering roll-out will provide data and insight on leakage performance (awareness and location) within District Meter Areas, contributing to

our leakage reduction options as outlined in Section 8.4.1. Further details of our metering options are provided in our *Draft Technical Report – Deciding on future options*.

We have a number of methods by which we aim to protect vulnerable customers who have a meter installed. An example of this is our 'lowest bill guarantee', which allows customers who have opted for a meter to revert back to their previous billing technique in the two years following meter installation. We also have tariffs such as 'Watersure'[11], for customers who need to use lots of water and might struggle to afford bills while on a meter. This tariff puts a cap on how much these customers are charged. Customers can also apply for financial support with their bills online[12]. Increasing our metering penetration also allows customers to influence their own bill, potentially reducing their bill where other billing practices might have resulted in a larger amount.

In areas where meter penetration is high, the use of tariffs may provide a potential tool for managing demand in households. The two main types of tariffs identified for consideration are 'rising block tariffs', comprising additional charges for volumes above a threshold or multiple thresholds and 'seasonal tariffs', comprising increased charges during specific periods. However, customer feedback has consistently indicated that tariffs are unpopular, and in all cases there is a need for the tariff to be: fair, easy to quantify, not overly complex, considerate of occupancy/household size and not lead to 'water debt'.

We have developed an integrated approach to our demand management strategy that seeks to enable smart metering, reduce 'all losses' (catchment to customer) and drive water efficiency (see Section 8.4.3). We are building this strategy on a foundation of data-driven insights provided via options that deliver a large smart (Advanced Metering Infrastructure or AMI) metering programme and targeted enhanced operation of our water system as part of our Systems Thinking approach.

8.4.3 Water efficiency

Our water efficiency options were developed in collaboration with the industry through Water UK and the Waterwise strategic communications programme. We engaged with customers and stakeholders, including non-household customers via retailers, and specifically targeted the education and tourism sectors where we believe significant savings can be made. Many of our options utilise data-driven insights to target our activities, for example water efficiency audits. Options to reduce consumption focus on:

- Customer communications (community and direct messaging);
- Smart metering;
- Water efficiency home audits; and
- Water efficiency audits for non-households (likely to focus on education and health).

We already have a number of programmes promoting free or subsidised water efficiency devices that customers can order from our website, or which can be fitted during home audit visits. Existing programmes delivered by water companies have provided benefits in reducing demand, however the benefits of particular devices are variable and not easily quantifiable. The demand savings realised depend on a range of factors including:

- Customer behaviour;
- Existing plumbing arrangements;
- Existing connection pressures;
- The particular suite of devices installed;
- Whether devices are self-fitted or fitted by water companies as part of audit visits; and
- Whether measured benefits are also due to finding and resolving supply pipe leakage or internal plumbing losses as part of the audits.

Other approaches to reducing household demand include water labelling schemes, rainwater harvesting and greywater recycling schemes.

[11] https://www.unitedutilities.com/watersure

[12] https://www.unitedutilities.com/my-account/your-bill/difficulty-paying-your-bill/how-we-can-help/

Currently, it is difficult for customers to make informed choices about the water efficiency of water-using appliances, devices and products they buy. Introducing a mandatory water label linked to fittings standards has the potential to provide sustainable benefits, and research carried out by the Energy Saving Trust, based mainly on experiences in Australia, has shown that this can be effective. However, in the UK currently water labelling schemes are voluntary and limited to kitchen and bathroom fittings only, and do not cover white goods or external use. Changes to building regulations and legislative support for water labelling are required if we are to meet the government's policy target for per capita consumption, and our plan assumes that these will be delivered (Section 9.1). It is also important that we work with organisations such as Waterwise to help improve communication and support our efforts.

Based on our commitments to reduce demand for water, to support water resources resilience and reduce our impact on the environment, we are requesting that all local authorities in our supply area adopt the optional minimum building standard of 110 litres per person per day (lppd) in all new builds. We already incentivise water efficiency in new builds, by offering a 90% reduction in water charges to developers building water efficient homes which include measures to reduce water use to 100 lppd. This scheme was launched in 2018 and initially targeted a standard of 110 lppd, but due to the success of the scheme and to encourage further improvements in water efficiency, we reduced the threshold to 100 lppd in 2021. To date, more than 86,000 plots have been registered with many of these already built, creating savings of £25m for developers. A similar reduction on wastewater charges is available for properties featuring sustainable drainage, and both schemes are still available to developers building homes in the North West.

In recent years, there have been several small trials and case studies of greywater and rain harvesting systems in the UK, with potential demand savings of between 25–50 per cent identified. The main concerns around the implementation of these types of systems are related to cost, maintenance and the scalability and sustainability of benefits. Any greywater installation would need to ensure there is no contamination to the potable drinking water supply, this would require consumer education and engagement. However, a recent report by Waterwise[13] showed a high level of positivity towards water harvesting and reuse systems within the home. Therefore, we plan to continue investigating these systems and how best to influence and support regulators and developers to install them.

Through place-based planning pilots (see Section 2.6) we will explore the synergies between wastewater and water needs including, for example, the dual benefit on wastewater flow and water demand of surface water interventions like water butts.

8.5 Supply-side options

We considered 90 potential supply-side options for this draft Water Resources Management Plan, which have been screened and assessed in line with the process outlined in Section 8.2. Types of options included in the unconstrained list include:

- Existing and new groundwater sources, surface water sources (e.g. river abstractions) and impounding reservoirs;
- Urban surface water: capturing and utilising surface water run-off, particularly from urban areas during and following rainfall events;
- Aquifer storage and recovery including managed aquifer recharge;
- Infiltration galleries: not commonly used in the UK, these comprise horizontal drains made of perforated pipes that are laid below the water table in certain aquifers to collect sub-surface flows;
- Desalination options;
- Raw water transfers (either between resource zones or external transfers);
- Rain cloud seeding;
- Tidal barrages;

[13] Waterwise (2019) How do people feel about domestic water recycling systems: Public perception of rainwater harvesting and greywater recycling for domestic use.

- Reuse of treated effluent from wastewater treatment works;
- Catchment management schemes;
- Drought permits and drought orders;
- Options to reduce losses within our supply network, for example by improved reservoir compensation release control;
- Options to reduce outage; and
- Increases to treatment works capacities.

Some of the above option types are not currently used in our existing supply network and, in some cases, there are technical constraints and/or potential water quality risks which need to be taken into account in assessing the feasibility of these options. Further information is provided in our *Draft Technical Report – Options identification*.

We have also considered separate supply options for improving resilience to temporary use ban risk; however, as discussed in Section 9, we have created an intelligent, best value and adaptive plan, which uses a portfolio of options, lowering the cost to customers in the North West and those in other companies.

8.6 Decision-making framework

The role of the decision-making framework is to select supply and demand options to address the needs identified by our baseline position (Section 6) and strategic choices (Section 7). Together these options form our 'best value' plan (Section 9). A best value plan delivers added value to customers and the environment. Financially, it may cost more than a 'least cost' plan, but this cost is outweighed by the additional value created. The key components of a best value plan are:

1. Metrics – measurable criteria that affect the value of the plan (Section 8.6.1); and
2. Weightings – the level of importance we place on each metric (Section 8.6.2).

The specific methods used in the framework were aligned to our 'problem characterisation' exercise, which is introduced in Section 2.9. Working with the other companies in Water Resources West, we developed a sophisticated decision support tool called 'ValueStream' to help with the calculation of value for each option, and to optimise the overall solution (Section 8.6.3).

8.6.1 Best value metrics

Best value metrics allow us to quantify how well each option performs against a number of criteria, across a range of economic, environmental and social wellbeing aspects. By summing together the values for each option selected we can also measure best value at plan level. In all cases, our metrics are either derived as, or translated into, monetary values, which further enhances our understanding of best value (see *Draft Technical report – Deciding on future options* for more details).

Rather than measure and create value for the Water Resources Management Plan in isolation, we collaborated with Water Resources West to adopt regional-level best value metrics (Figure 28). This was necessary to support the development of the regional plan, for example allowing us to jointly assess the value of transfer options within our region and with other regions (Section 9.2). More widely in United Utilities Water we are embedding the concept of the 'Six capitals' into our long-term business planning, to help us ensure the affordability and resilience of our essential public services for current and future generations. In creating our best value metrics, we carefully considered those capitals relating to water resources planning and the links are shown in Figure 28.

Figure 28 United Utilities Water/Water Resources West best value metrics, also showing alignment with our six capitals thinking

8.6.2 Weightings

We have placed customers at the heart of our decision making. Using weightings allowed us to shape our best value plan to their views, by prioritising certain metrics over others. Working with our consultancy providers and eminent industry economists we developed a sophisticated customer choice experiment, which allowed us to weight our best value metrics according to their preferences. The results are shown against each metric in Figure 28 as a value below the metric title. We also developed a separate set of weightings based on stakeholder feedback and explored trade-offs between the different metrics by varying the weightings. All of this information and analysis was used to inform our best value plan; more information is provided in the *Draft Technical Report – Deciding on future options*.

8.6.3 ValueStream

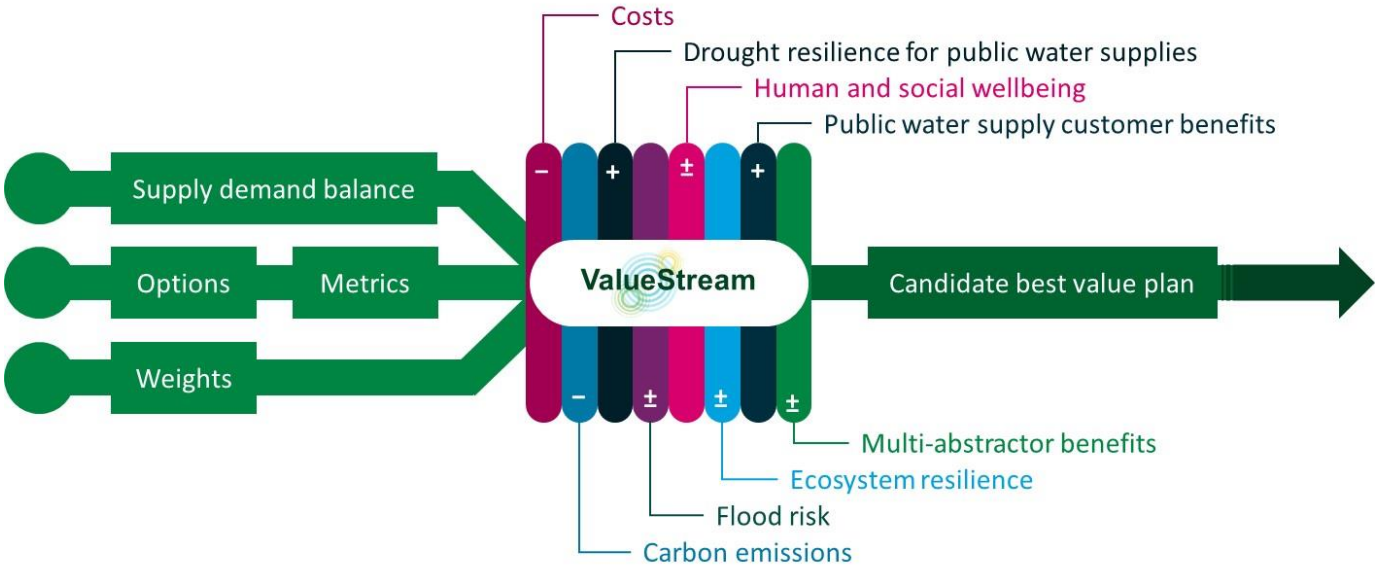
As part of Water Resources West, we have worked with expert consultants in economics and decision making to develop a best value optimisation tool, named ValueStream, to use as part of our decision-making methodology. We developed the methodology in collaboration with our regional group to ensure consistency with regional planning.

ValueStream provides equivalent monetised costs for best value metric scores, enabling us to compare options on a like-for-like basis with regard to environmental and wellbeing metrics, and cost and monetised carbon cost metrics. The tool uses data inputs from monetised and non-monetised (Strategic Environmental Assessment and Natural Capital Assessment) assessments to produce scores for each option across the eight best value metrics,

normalised to -100 to +100 scale. It uses solving algorithms to minimise overall costs, including environmental and social costs, while generating a scheduled plan, which meets our supply-demand balance. Best-value scores are multiplied by weightings taking into account customer preferences, and the resulting scores are used in the optimisation. We also use the tool to evaluate the best value performance of programmes generated by system simulation and UKWIR's Economics of Balancing Supply and Demand (EBSD) approaches.

An overview of our ValueStream tool is shown in Figure 29, and more details are provided in the *Draft Technical Report – Deciding on future options*.

Figure 29 Our decision support tool ValueStream



Source: Water Resources West

9. Our best value plan

i Key Points

- **We are acutely aware of the ongoing cost of living challenge. We have identified effective ways to deliver our strategic choices to minimise the impact on customer bills. For example, we have dual-purposed options to meet different needs at different times.**
- **We have created a low regrets adaptive plan to ensure that our plan is robust to future uncertainties.**
- **Our proposed best value plan is focused on delivering our three strategic choices:**
    1. **Achieve government targets to halve leakage and reduce customer consumption to 110 litres per person per day by 2050.**
    2. **Support national planning by developing large-scale water transfers. Critically, create solutions that can adapt to the changing needs of others.**
    3. **In line with customer preferences, improve our level of service for temporary use bans, halving the expected frequency of occurrence to 1 in 40 years (2.5 per cent annual chance). At the same time, we will improve the frequency of implementing drought orders and drought permits to 1 in 50 years (two per cent annual chance).**
- **Our plan protects the environment by assuming reductions in certain abstractions by 2050. This is our environmental destination scenario, which will take shape over time in response to ongoing investigations.**

As outlined in Section 6, in three of our resource zones we forecast a supply-demand surplus throughout the planning period. However, if we do not take action in the Strategic Resource Zone we are likely to be in deficit from the start of the planning period. This is caused mainly by rising population, climate change and the need to reduce abstraction to protect the environment.

When we implement the first of our strategic choices, to meet government policy targets on leakage and per capita consumption, the predicted reduction in demand leads to a surplus throughout the planning period in the Strategic Resource Zone. At this point, our plan switches focus towards delivering our other two strategic choices to: (a) take a lead role in national water resources planning by delivering large-scale water transfers; and (b) deliver on customers' strong preference to improve our level of service for temporary use bans. The rationale behind our strategic choices is set out in Section 7. Reflecting the ongoing cost of living challenge, we will deliver these strategic choices as intelligently as possible, minimising the impact on customer bills. In particular, we will deliver multiple objectives with the same options, in some cases repurposing them during the planning period.

We carefully assessed the future uncertainties we will face and created a plan which is both robust and flexible to change. Having played an integral part in the regional planning process and witnessed first-hand the level of future risk and uncertainty faced by some other regions, we ensured that our trading solutions can deliver the stated benefits on time, and can adapt to changes in recipients' plans which will inevitably occur over the coming months and years.

Working closely with our partners in Water Resources West, we fully embraced the industry move towards 'best value planning' to ensure that our solutions deliver value to customers and environment. In particular, we monetised all of our resilience and environmental metrics to facilitate a full optimisation of our plans (Section 8.6.1). The following sections summarise our proposed best value plan by strategic choice, explain how we addressed future uncertainties, and provide the resultant 'final planning' supply-demand balance views across each resource zone.

9.1 Leakage and demand management plan

Our approach to the development of our demand management strategy is outlined in Section 8.4 of this report and further details can be found in our *Draft Technical Report – Options identification.* Table 16 provides a summary of the demand-side options, which have been selected through our best value decision-making process to meet our targets for the reduction of leakage and per capita consumption (customer use per person) by 2050. As explained in Section 8.4.1, our leakage strategy is proactive and includes significant investment in mains renewal and network sensors to prevent and detect leaks. Our plan to reduce per capita consumption centres on smart metering and water audits. However, we are also heavily dependent on the government's water labelling policies to achieve the required 110 litres per person per day level by 2050.

Table 16 Summary of selected demand options

Option ID	Name	Resource Zone	Demand reduction (Ml/d)	Year of selection
WR510	WR510_In-pipe repairs and lining technologies	Strategic	4.5	2026
WR524c	WR524c_Upstream tile optimisation	Strategic	3.0	2026
WR619d	WR619d_Upgrade existing household meters to smart	Strategic	16.2	2026
WR661c	WR661c_Free water efficiency audits (households)	Strategic	13.0	2026
WR677c	WR677c_Non-household water efficiency programme	Strategic	7.1	2026
WR516h1	WR516h1_Mains renewal	Strategic	45.9	2026
WR601e	WR601e_Enhanced metering of households (smart meters)	Strategic	58.2	2026
WR694f	WR694f_Water Labelling	Strategic	35.6	2030
WR516h2	WR516h2_Mains renewal	Strategic	54.0	2036
WR658c	WR658c_Free water efficiency devices (inside/internal)	Strategic	4.6	2038
WR669a	WR669a_Flow regulators	Strategic	7.4	2038
WR659c	WR659c_Free water efficiency devices (outside/external)	Strategic	4.0	2038
WR502c	WR502c_Permanent network sensors	Strategic	20.0	2046
WR685c	WR685c_Rainwater harvesting and water reuse (new builds)	Strategic	5.8	2046
WR601a	WR601a_Enhanced metering of households (smart meters)	Carlisle	1.2	2026
WR658a	WR658a_Free water efficiency devices (inside/internal)	Carlisle	0.1	2026
WR677a	WR677a_Non-household water efficiency programme	Carlisle	0.7	2026
WR669b	WR669b_Flow regulators	Carlisle	0.1	2026
WR685a	WR685a_Rainwater harvesting and water reuse (new builds)	Carlisle	0.1	2027

Option ID	Name	Resource Zone	Demand reduction (Ml/d)	Year of selection
WR516a1	WR516a1_Mains rehabilitation/renewal/replacement	Carlisle	1.2	2028
WR694d	WR694d_Water labelling (government intervention)	Carlisle	0.6	2030
WR502a	WR502a_Permanent network sensors	Carlisle	0.5	2037
WR619a	WR619a_Upgrade existing household meters to smart	Carlisle	0.2	2041
WR520a	WR520a_DMA optimisation	Carlisle	0.2	2042
WR661a	WR661a_Free water efficiency audits (households)	Carlisle	0.3	2043
WR511c	WR511c_Pressure management	Carlisle	0.5	2046
WR659a	WR659a_Free water efficiency devices (outside/external)	Carlisle	0.1	2048
WR694e	WR694e_Water labelling (government intervention)	North Eden	0.1	2030
WR603b	WR603b_Enhanced metering of households on single supplies (smart meters)	North Eden	0.2	2040

In line with regulatory and government expectations, our Water Resources Management Plan assumes that by 2050 we will be able to achieve a 50 per cent reduction in leakage and reduce customer water use to 110 litres per person per day. This is an ambitious target and needs significant investment to achieve, alongside action by the government and others. Even with significant investment there is therefore uncertainty around whether these reduction targets are achievable. We have therefore developed an adaptive plan, which takes this uncertainty into account (see Sections 9.4 and 9.5).

9.2 Water trading

Section 7.3 outlines the rationale behind our water trading strategic choice and summarises the development of our principal trading option, the North West Transfer (NWT) Strategic Resource Option (SRO). In terms of national planning, trading options were appraised and selected by companies through the regional planning reconciliation process. The United Utilities Water transfer options that form part of the final agreed reconciliation position are shown in Table 17.

Table 17 United Utilities Water transfer options selected in the regional planning reconciliation process

Recipient	Date	Capacity (Ml/d)	Cumulative (Ml/d)	Option
Severn Trent	2031	75	75	Vyrnwy (handed to WRSE in 2060)
Severn Trent	2041	25	100	Llanforda aka Shrewsbury aka Shelton
Severn Trent	2051	6.5		Peckforton (Vyrnwy)
Severn Trent	2051	1	107.5	Bearstone Borehole
WRSE	2060	135	167.5	Vyrnwy (Severn Trent hand over 75 Ml/d trading option)
Severn Trent	2061	1	168.5	Kinsall (Vyrnwy)

Over the full course of the regional planning process, we experienced a high degree of variability in the trading volumes and timing requested by recipients. Some of this was due to improvements in their understanding of future uncertainties, for example relating to demand, climate change and environmental destination. There was also significant uncertainty around the reliability or acceptability of other large-scale options. Some regional groups and companies, for example West Country Water Resources and South Staffs Water (also part of Water Resources West) considered our options, but ultimately did not select them as part of their draft Water Resources Management Plan preferred plan. We received change control requests from both WRSE and Severn Trent Water to refine trade volumes and timing very late in the process, after our decision-making work was complete. Unfortunately, there was insufficient time to accommodate these changes in our preferred pathway; instead we included an additional pathway in our water trading adaptive plan (Plan A2 in Figure 32). This again underlines the level of uncertainty that still exists with regards to water trading at this stage.

Taking all of this uncertainty on board, which relates to factors external to United Utilities Water, we felt that developing a trading solution that sticks rigidly to the reconciliation position would present unacceptable risks to customers and the environment. Therefore, we focused on a flexible solution and explored the implications of further changes in volumes and timing through adaptive planning. We created an alternative view of water trading drawing from the scenarios tested in regional planning, for example assuming the South East Strategic Reservoir Option (SESRO) is not granted planning permission. The details are shown in Table 18 and incorporated into our plan as an adaptive planning pathway (Section 9.5). Additional investment required to provide the required flexibility has been considered within our low regrets solution.

Table 18 Summary of water trading adaptive planning pathway

Recipient	Date	Capacity (Ml/d)	Cumulative (Ml/d)	Option
Severn Trent	2031	75	75	Vyrnwy (handed to WRSE in 2050)
Severn Trent	2041	25	100	Llanforda aka Shrewsbury aka Shelton
Severn Trent	2051	6.5	106.5	Peckforton (Vyrnwy)
WRSE	2048	25	131.5	Vyrnwy
WRSE	2050	73.5	205	Vyrnwy (maximum reached)

As detailed in our *Draft Technical Report – Deciding on future options,* we used a sophisticated, industry-leading approach to select options for water trading and help ensure that customers and the environment would be fully protected. A continuation of the water trading assessment approach used for our 2019 Water Resources Management Plan, the methodology incorporates the 'system simulation' and 'Robust Decision Making' techniques. In summary, it involves the following steps:

1. Select a range of resilience and environment performance metrics, which represent the key features we need to protect.
2. Use a water resources model to simulate the future performance of the system without water trading.
3. Measure the drop in performance due to water trading without any supply options in place.
4. Build sub-options into the model to recover the drop in performance, specifically optimised to minimise cost.

We created several candidate solutions and then calculated the best value scores using the decision-making framework developed with Water Resources West (Section 8.6). The solution was initially developed to fulfil a 205 Ml/d trade, and then re-optimised to different trade volumes using our ValueStream tool (Section 8.6.3). The trading options that we would use to specially deliver the final reconciliation position are shown in Table 19. However, we also developed the solution to incorporate the improvement in the temporary use ban level of service, as explained in the next section.

Table 19 Summary of 'sub-options' selected for water trading (regional reconciliation view)

Option ID	Name	Capacity (Ml/d)	Resource Zone	Year of selection
WR015	SWN_RIVER IRWELL	40	Strategic	2031
WR111	GWE_WOODFORD	9	Strategic	2031
WR113	GWE_TYTHERINGTON	3	Strategic	2031
WR149	ITC_WIGAN	13	Strategic	2031
WR076	SWN_RIVER BOLLIN	25	Strategic	2041
WR049d	SWN_RIVER RIBBLE 49d	40	Strategic	2060
WR107a2	GWE_AUGHTON PARK a2	10	Strategic	2060

9.3 Improving our levels of service for temporary use bans and drought permits

As explained in Section 7.2, our level of service for temporary use bans (TUBs), at 1 in 20 years or a five per cent annual chance, is amongst the highest (most frequent) nationally. Our customer research outputs indicated a strong preference to halve the frequency to 1 in 40 years (2.5 per cent annual chance). Our initial aim was to provide this improvement by the end of our next business plan period, in 2030. While the customer 'willingness to pay' produced by our research would support developing options solely to improve TUBs within this timeframe (see our *Draft Technical Report – Deciding on future options* for more information), we have combined this need with our other two strategic choices to minimise the impact on customer bills. There are two mechanisms that facilitate this:

1. Over time the planned reductions in leakage and per capita consumption progressively deliver a decrease in the frequency of TUBs. However, by these means alone we would not achieve the required 1 in 40-year level until 2039, 14 years after the start of the planning period.
2. We need to develop supply options for water trading from 2031. Based on our current understanding of utilisation patterns from potential transfer recipients, the options can provide additional resilience to the North West outside of trading periods, helping to reduce the frequency of TUBs.

Our *Draft Technical Report – Deciding on future options* sets out in detail how the trading options can provide this additional benefit for a relatively minor impact on customer bills in the North West, compared to developing separate options. As the first water trading request is currently for 2031, we delayed our original target for achieving 1 in 40 years TUBs by one year. The report also outlines the analysis we did to determine the correct timing of implementation.

The options that will deliver early phases of water trading and the improvement to TUBs level of service are shown in Table 20. Irrespective of exactly how trading pans out, we believe these options should be developed as part of our low regrets solution. In order to be delivered on time their implementation must commence soon. As such, all four options are included in the North West Transfer (NWT) Strategic Resource Option (SRO) ongoing RAPID process.

Table 20 Summary of supply options selected in 2031 both for water trading (regional reconciliation view) and 1 in 40-year temporary use ban resilience

Option ID	Name	Capacity (Ml/d)	Resource Zone	Year of selection
WR015	SWN_RIVER IRWELL	40	Strategic	2031
WR111	GWE_WOODFORD	9	Strategic	2031
WR113	GWE_TYTHERINGTON	3	Strategic	2031
WR149	ITC_WIGAN	13	Strategic	2031

Figure 30 shows the locations of the new sources most likely to be developed to support water trading and/or the proposed improvements to our levels of service. Of these options, seven have been included in our preferred plan (Table 19).

Figure 30 Supply options being considered to support water trading and improved levels of service

9.4 Scenario testing

We assessed seventeen scenarios relating to alternative futures covering some of the key uncertainties in our supply-demand balance:

- Impacts of climate change on supply;
- Potential variations in our future demand forecasts;
- Impacts of deteriorating raw water quality on supply;
- A different pace of delivery of our demand management programme, to that included in our preferred plan;
- Alternative timing for the requirement for a water transfer from our region;
- Changes to the environmental destination, which we need to deliver; and
- The pace of technological development, for example smart meters.

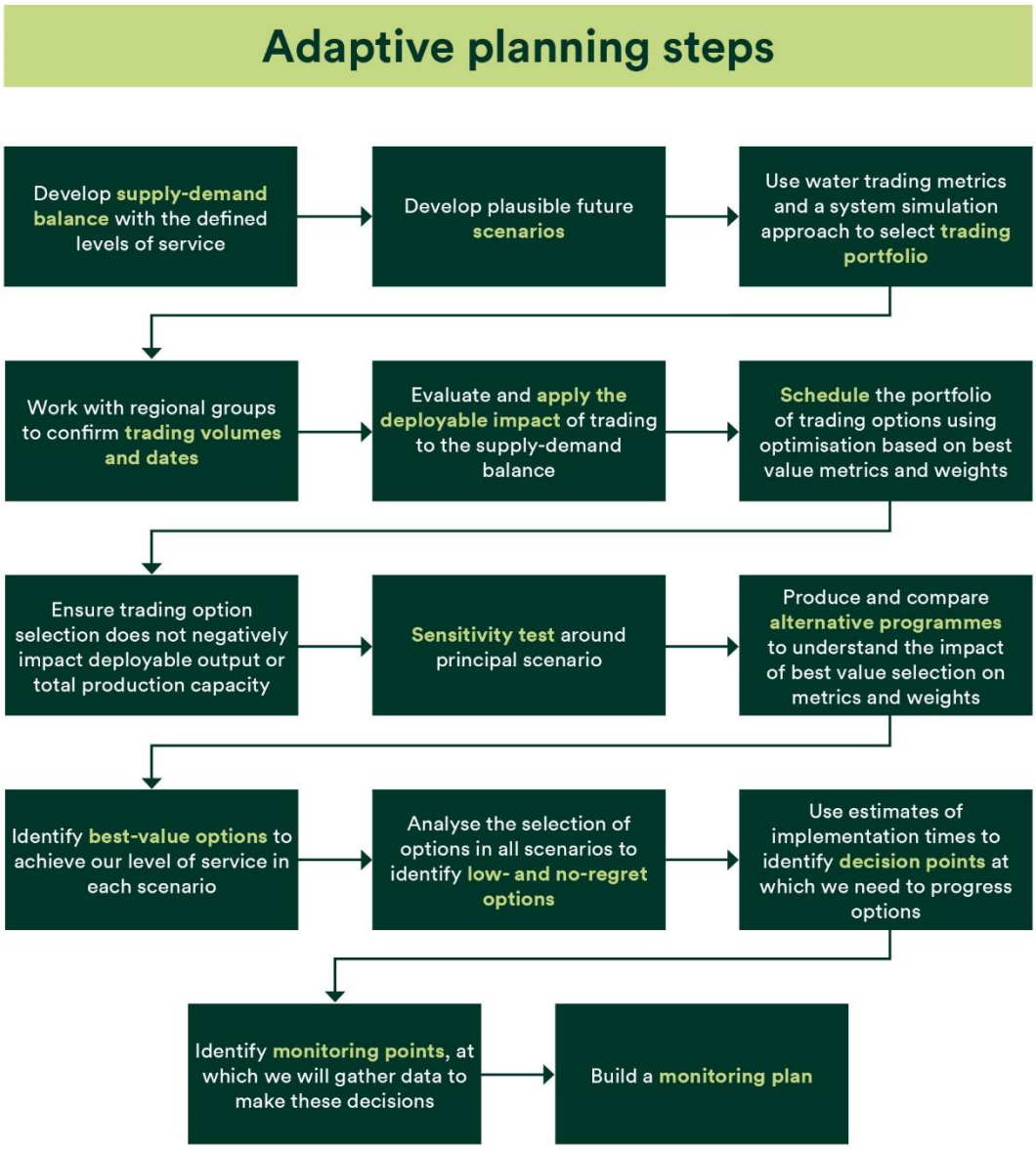
For each scenario we developed an alternative pathway for inclusion in our adaptive planning assessment (Section 9.5). Full details of the scenarios are provided in our *Draft Technical Report – Deciding on future options.* The report also outlines our extensive programme appraisal and sensitivity testing, as well as portfolio testing we completed at the end of the process using our water resources models.

9.5 Adaptive planning

We have undertaken adaptive planning assessments to take into account key uncertainties, which may influence our Water Resources Management Plan: the future effects of climate change, changes in demand, environmental destination, water quality influences and the timing and magnitude of water trading. Our adaptive plan consists of a core pathway plus alternative pathways where the future may deviate from the expectations assumed for our preferred best value plan.

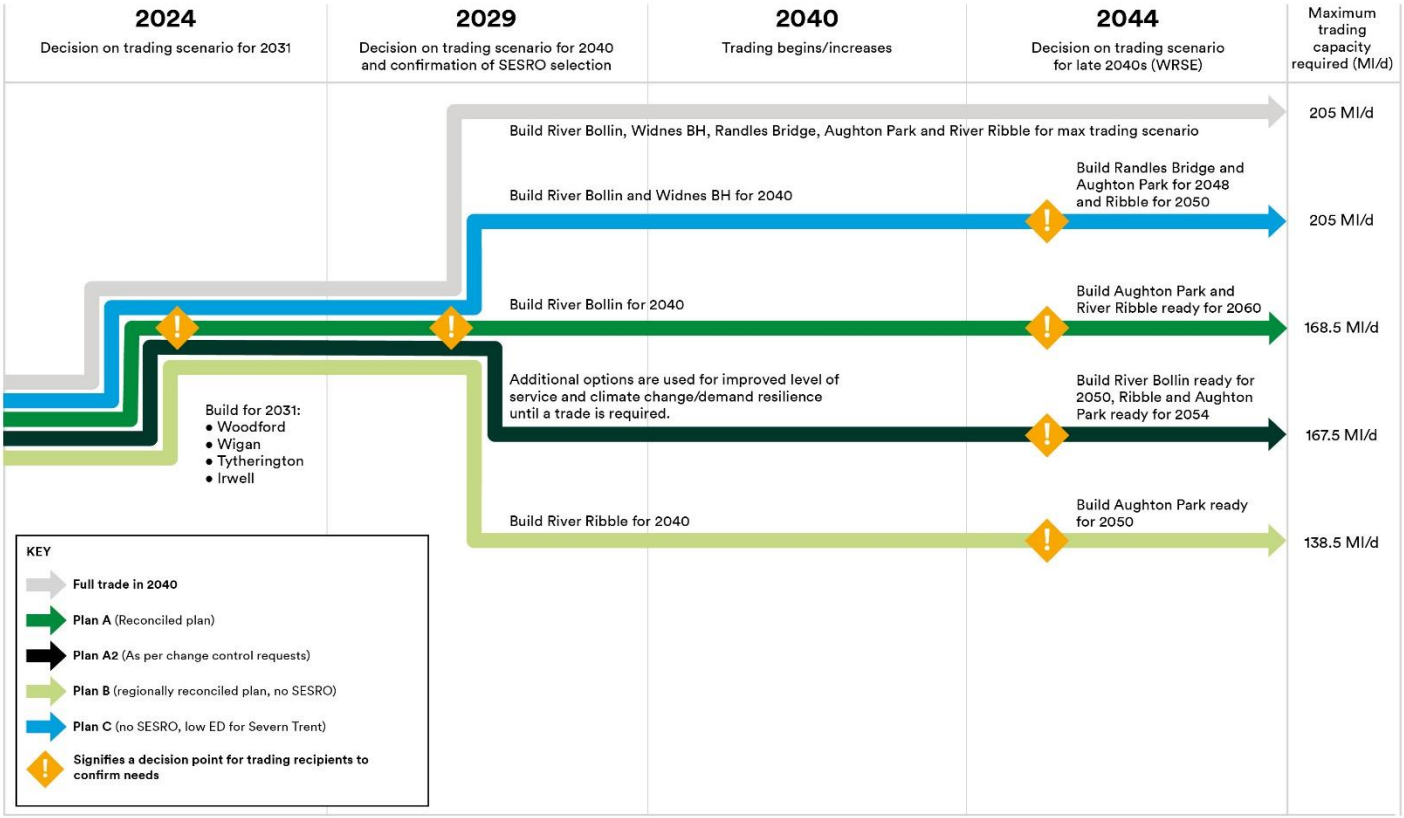
Figure 31 shows a summary of the key steps undertaken in our adaptive planning assessment. Note that some of these steps do not apply to all of our resource zones; the steps relating to the timing, volume and impacts of water trading only apply to our Strategic Resource Zone as water trading is not expected to affect our other resource zones. More detail on how we have applied each of these steps is provided in our *Draft Technical Report – Deciding on future options*.

Figure 31 Adaptive planning steps



Our *Draft Technical Report – Deciding on future options* presents adaptive plans for climate change, water trading and demand & technology. The water trading adaptive plan is shown in Figure 32 as an example.

Figure 32 Water trading adaptive plan



9.6 Final supply-demand balances

Table 21 presents a summary of the final planning dry year annual average supply-demand balance, for the first year of forecasts 2025/26 and at five-yearly intervals to 2049/50 taking into account all of the options we have selected. Table 22 presents the same view for our dry year critical period scenario, which is only applicable to the Carlisle Resource Zone (Section 2.8).

Table 21 Summary of final planning dry year annual average supply-demand balance by resource zone

	Dry Year Annual Average Supply-Demand Balance (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Strategic	6.6	0.0	26.4	96.6	155.2	199.7
Carlisle	4.4	4.7	4.9	3.9	5.4	6.5
North Eden	5.3	5.3	5.3	5.5	5.6	5.7
Barepot	0.0	0.0	0.0	0.0	0.0	0.0

Table 22 Summary of final planning dry year critical period supply-demand balance by resource zone

	Dry Year Peak Week Supply-Demand Balance (Ml/d) for year:					
Resource Zone	**2025/26**	**2030/31**	**2035/36**	**2040/41**	**2045/46**	**2049/50**
Carlisle	3.8	3.8	3.9	3.8	5.3	6.5

9.7 Environmental assessment

Environmental assessment is crucial to the Water Resources Management Plan (WRMP) process, both in terms of choosing the right options and ensuring that our proposed overall preferred plan protects, and where possible improves, the environment. Four key assessments were completed as part of the WRMP process:

- Strategic Environmental Assessment (SEA);
- Habitats Regulations Assessment (HRA);
- Water Framework Directive (WFD) assessment; and
- Invasive Non-Native Species (INNS) assessment.

Full reports are published for the SEA, HRA and WFD assessments alongside our WRMP. We have also provided detailed summaries in Section 8 of our *Draft Technical Report – Deciding on future options*. It is important to note that these assessments form part of an ongoing process and the draft WRMP is just a step along the way. Preferred option scopes are refined over time to eliminate or mitigate potential risks. It is therefore normal for risks to be present at this stage, and where this is the case we need to ensure the necessary steps are in place to resolve them. We have also identified alternative options should the development of certain options become infeasible.

Provisionally, no adverse effects of the proposed preferred plan, alone or in combination, on internationally designated biodiversity features, sites or assets were identified by the SEA. Whilst there are some residual uncertainties at the draft WRMP 2024 stage (principally associated with aquifer response that will be resolved with the development of the Manchester and East Cheshire groundwater model), the HRA assessment of currently available data indicates that none of the options will adversely affect the integrity of any European sites, alone or in combination. One option (River Ribble, WR049d) was considered to present medium risk of INNS transfer but this can likely be mitigated within the design and operation of the scheme. The WFD assessment found that three groundwater options have a medium risk of non-compliance:

- Aughton Park and Moss End Boreholes (WR107a2)
- Woodford Borehole (WR111)
- Wigan (WR149)

Further investigation is required to ensure that these schemes will be WFD compliant. Updating the relevant groundwater models will be a key step towards resolving uncertainties associated with the quantitative assessment of impacts. This includes the Lower Mersey Basin and North Merseyside groundwater model and the East Cheshire groundwater model, both of which we have now commenced work on, with outputs expected to be available next year.

If any of these options is deemed to be non-compliant we have a wide range of alternative options including:

- Two further options already fully assessed as part of the reasonable alternative plan: Widnes boreholes (WR102b) and Randles Bridge, Knowsley, Primrose Hill (WR107b). Both of these options were assessed to have a low risk of WFD non-compliance;
- Several reserve options being developed as part of the NWT SRO, in parallel to the preferred plan; and
- A large number of other WRMP feasible supply options.

We have also taken into account Biodiversity Net Gain in our approach, and more detail on this can be found in Section 2.2.4 of our *Draft Technical Report – Deciding on future options* and the Biodiversity Net Gain and Natural Capital Assessment, carried out by our environmental consultants (Wood)[14].

9.8 What do customers think of our preferred plan?

As introduced in Section 3.3, and detailed in our *Draft Technical Report - Customer and stakeholder engagement*, working with industry experts DJS we conducted innovative customer research to test the acceptability of our preferred plan. A screenshot of the tool we developed with DJS is shown in Figure 33.

Figure 33 Screenshot of customer preference research tool

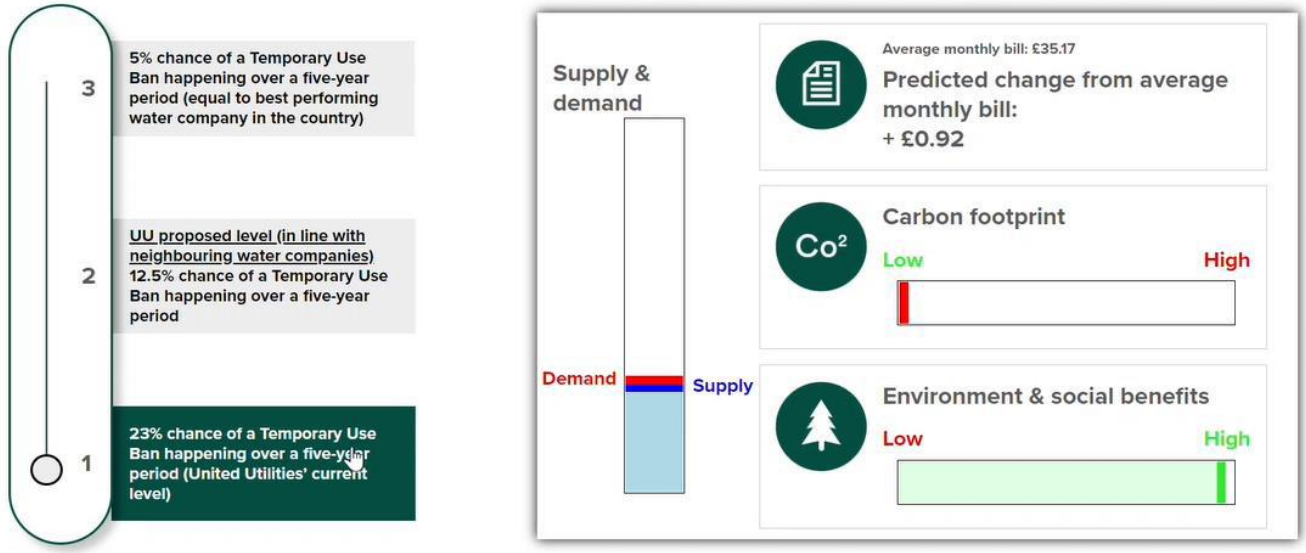


Figure 34 presents customer preferences for preferred plan activities required to deliver our strategic choices. This is based on selections customers made for different levels of activities, for example frequency of water restrictions, when presented with information on environmental and societal impacts, plus the associated impact on bills. The figure shows the preferences of household customers; the customer and stakeholder engagement technical report also provides results for non-household customers and future bill payers, but their preferences are broadly similar.

Where the bars are green, this represents the percentage of customers that selected our preferred plan. Pink or purple bars represent customers that would prefer us to do less activity than in our preferred plan, for example install fewer smart meters, with an associated lower impact on bills. Blue bars indicate customers who would prefer us to do more.

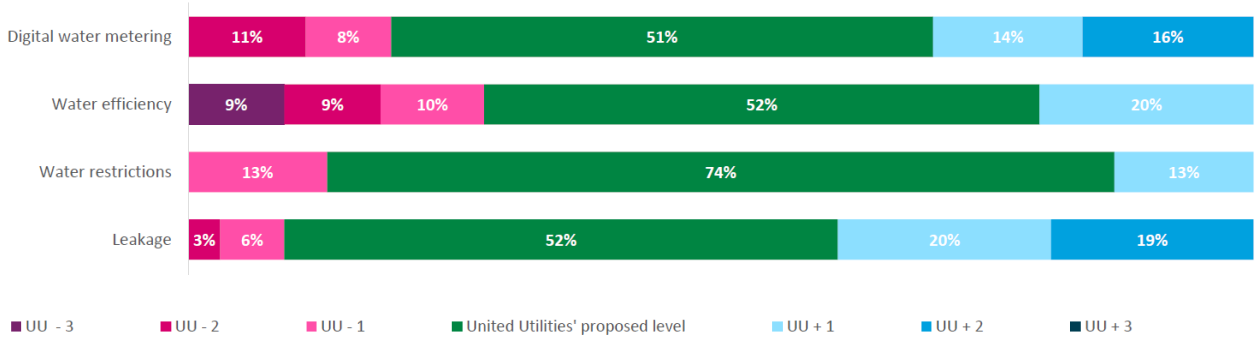
At 74%, the highest level of support was for our strategic choice to improve the level of service for water restrictions, or more specifically to halve the frequency of temporary use bans from five per cent annual chance (1 in 20 years) to 2.5 per cent annual chance (1 in 40 years). Preferences related to the activities required to deliver the government's leakage and per capita consumption (PCC) targets showed a lower level of support, but still with a majority in favour. In relation to the measures required to reduce PCC, the remaining customers were fairly evenly distributed around our preferred plan, with some wanting us to do more and some less. For leakage, 39% wanted us to do more, however the majority of customers still selected the level of reduction in our preferred plan.

Due to the high level of support for our preferred plan we have not made any alterations. By shaping our plan to the outcomes of previous engagement we have built a plan for customers; this has been confirmed by this piece of research. We will continue to engage with customers and stakeholders on our plan, in particular with regards to leakage reduction. This will happen both as part of our 2024 Water Resources Management Plan and our PR24

[14] Biodiversity Net Gain and Natural Capital Assessment, Wood and Ricardo, September 2022.

(2025–2030) business plan submission. As part of PR24 we will examine customer preferences, acceptability and affordability in the context of the full range of services we provide including relating to wastewater.

Figure 34 Overview of final customer preferences (household customers)



From this piece of customer research we were also able to determine 'willingness to pay' for our proposed preferred plan. If willingness to pay exceeds the cost of the plan it indicates that customers believe it represents good value for money.

Table 23 provides the willingness to pay value for household customers. The customer and stakeholder engagement technical report provides results for non-household customers and future bill payers, as well as a comprehensive breakdown of different social groups and geographical areas. The customer research was conducted reflecting the proposed preferred plan in 2030, but we have presented the bill impact for 2050 too. Costs related to water trading are not included in bill impacts as they will not be funded by customers in our area.

The results show that household customers view our proposed preferred plan as good value for money. As presented in the customer and stakeholder technical report, this conclusion in fact extends to all 30 sub-groups for which results were generated; the lowest willingness to pay value was £18.00 for the under 35 age group.

Table 23 Customer willingness to pay versus estimated bill impacts

Plan	Estimated average annual bill impact	Household customer willingness to pay
Proposed preferred plan in 2030	£16.59	£23.05
Proposed preferred plan in 2050	£38.55	Not tested

10. Conclusions

This document provides a summary of our draft Water Resources Management Plan 2024. Further details are provided in the accompanying technical reports (listed in Appendix A).

Our draft Water Resources Management Plan 2024 provides the following key benefits:

- We plan to achieve ambitious government targets to halve the level of leaks and reduce water use per person per day to 110 litres by 2050; the reduction in demand for water will contribute to our commitment to reduce carbon emissions.

- Our plan supports national planning by developing a wide range of options (including a new supplier) which would allow us to transfer large volumes of water outside our region, making us a net exporter of water to address imminent water needs elsewhere in the country.

- Building these options will also help us to deliver improved levels of service for temporary use bans and drought permits by 2031, benefitting customers and the environment.

- In the longer term, progressive savings from reducing leaks and lowering water use by customers will mean we can deliver water transfers, while maintaining our improved levels of service.

- Our plan protects the environment by assuming reductions in certain abstractions by 2050. This is our 'environmental destination' scenario, which will take shape over time in response to ongoing investigations.

- We have tested a range of scenarios and pathways to ensure that our plan can adapt to future uncertainty in the face of climate change, population growth and environmental changes.

In summary our proposed best value plan offers a flexible, low regrets solution, which provides environmental improvements and benefits customers in the North West as well as supporting national water resource needs.

An overview of the key elements of our best value plan is shown in Figure 35.

Figure 35 Overview of our best value plan

Appendix A List of supporting documents

Table A1 List of supporting documents providing further technical details on the topics in this report

Document reference	Title	Purpose
Technical Report 1	Assurance and governance	Provides details of our internal governance, audit and assurance processes supporting the plan development and final Board assurance
Technical Report 2	Customer and stakeholder engagement	Provides details of the customer research and customer and stakeholder consultation, which has supported the development of our draft plan and will play a key part in finalising our plan
Technical Report 3	Demand for water	Provides technical details of the assumptions and methodology adopted in preparing our demand forecasts
Technical Report 4	Supply forecast	Provides technical details of the assumptions and methodology adopted in preparing our supply forecasts
Technical Report 5	Environmental destination	Provides details of our long-term ambitions for more sustainable water resources management and the actions required to achieve these
Technical Report 6	Allowing for uncertainty	Provides technical details of how we have allowed for uncertainty in the supply-demand balance through our target headroom assessment
Technical Report 7	Options identification	Provides full details of all supply-side and demand-side options assessed in the preparation of the plan, along with details of the screening and detailed appraisal processes
Technical Report 8	Deciding on future options	Provides details of our decision-making processes i.e. how we have selected the options which comprise our best value plan for each of our resource zones
Technical Report 9	Strategic Environmental Assessment	Reports on the Strategic Environmental Assessment, which we have undertaken as a statutory requirement for our Water Resources Management Plan
Technical Report 10	Habitats Regulation Assessment	Sets out the findings of the Habitats Regulation Assessment, which has been used to inform the assessment of options as part of the Strategic Environmental Assessment
Technical Report 11	Water Framework Directive Assessment	Sets out the findings of the Water Framework Directive Assessment, which has been used to inform the assessment of options as part of the Strategic Environmental Assessment

Appendix B References

Meeting our future water needs: a national framework for water resources (Environment Agency, March 2020).

Water Resources Planning Guideline (Environment Agency, Ofwat and Natural Resources Wales, December 2021).

An Improved Methodology for Assessing Headroom (UKWIR, 2002).

Demand forecasting methodology WR-01/A and Forecasting Water Demand Components: Best Practice Manual 97/WR/07/1.

Outage allowances for water resources planning (UKWIR, 1995).

Risk-based planning methods (UKWIR, 2016).

Uncertainty and Risk in Supply and Demand Forecasting (UKWIR, 2002).

Impact of Climate Change on Water Demand (UKWIR, 2013).

Meeting regional and national water resources needs: Gap analysis of the current strategic infrastructure scheme portfolio (Jacobs on behalf of RAPID, July 2020).

Preparing for a drier future – England's water infrastructure needs (National Infrastructure Commission, April 2018).

Long-term planning for the quality of drinking water supplies (Drinking Water Inspectorate, 2020).

Resilience of water supplies in water resource planning (a supplementary note to long term planning for the quality of drinking water supplies) (Drinking Water Inspectorate, 2021).

PR24 and beyond: Final guidance on long-term delivery strategies (Ofwat, April 2022).

PR24 and beyond: Long-term delivery strategies and common reference scenarios (Ofwat, November 2021).

Draft Regional Plan for consultation (Water Resources West, Autumn 2022).

Appendix C Glossary

Table C1 Glossary

Term	Definition
Abstraction	The removal of water from any source, either permanently or temporarily.
Abstraction Licence	The authorisation granted by the Environment Agency to allow the removal of water from a source.
AMP	Asset Management Plan: AMP6 covers the period April 2015 to March 2020, AMP7 covers the period April 2020 to March 2025, etc.
AMR	Automated Meter Reading.
Aqueduct	An artificial channel for conveying raw or partially treated water.
Average Incremental Social Cost (AISC)	The ratio of present Social Costs over Present Net Value of additional water delivered or reduced demand.
Barepot	A small resource zone in the West Cumbria area serving non-potable water to commercial customers only.
Base Year	The first year of the planning period/horizon, forming the basis for the water demand and supply forecasting of subsequent years.
Baseline Demand Forecast	A demand forecast, which reflects a company's current demand management policy, but which assumes the achievement of the current agreed target for leakage during the forecast duration, as well as the implementation of the current company water efficiency plans, irrespective of any surplus.
Best value plan	A plan, which considers factors alongside economic cost and seeks to achieve an outcome that increases the overall benefit to customers, the wider environment and overall society.
Bristol Water	The licensed water only company for Bristol.
Canal and River Trust	A charitable organisation playing a protective role for waterways in England and Wales.
Catchment	The area from which precipitation (rainfall) and groundwater would naturally collect and contribute to the flow of a river.
Carlisle Resource Zone	The resource zone covering the Carlisle area (see resource zone).
Consumer Council for Water	The Consumer Council for Water (Northern), which represents the interests of water customers.
Compensation flow/release	Stored water released from a reservoir to ensure a continuous flow in the downstream watercourse.
Competition/Competitive Markets	A concept introducing customer choice of supplier into a formerly regionally monopolised industry.
Critical Period	The length of time between a reservoir being full and the reservoir reaching minimum storage during the worst drought on record.
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs.
Demand Management	The implementation of policies or measures, which serve to control or influence the consumption or waste of water. (This definition can be applied at any point along the chain of supply).
Deployable Output	The output of a commissioned source or group of sources or of a bulk supply as constrained by the environment, abstraction licences, water quality, existing water treatment and supply system capacities.
DETR	Department of the Environment, Transport and the Regions (which no longer exists and many of its functions are now completed by the new department Defra).

Term	Definition
Distribution Input	The amount of water entering the distribution system at the point of treated water production.
Distribution Losses	Comprises water lost from trunk mains, service reservoirs, distribution mains and communication pipes. Distribution losses = distribution input less water taken.
DMA	District Meter Area – an area (of up to 3,000 properties) where the supply to it is continuously monitored, and there is a defined and permanent boundary. DMAs were set up for leak detection prioritisation. Guidance states that DMAs should typically have, under normal operation, a single supply inlet.
DMZ	Demand Monitoring Zone. There are currently 33 DMZs in our region, which are areas used to monitor demand and losses. All supply inputs and outputs are metered around the boundary of a DMZ. A DMZ is built up of a number of smaller units; however, these are predominantly for water quality and leakage detection purposes.
Dead Water	The part of a reservoir's total storage volume that is not usable for water supply purposes. Often the dead storage of a reservoir is required to store sediment accumulation during the life of the reservoir. In some cases, a portion of the dead storage may be recoverable through engineering works.
Dry Year	In water resources modelling, a period of low rainfall from which future demand is forecast.
Dry Year Annual Average Daily Demand	The level of demand, which is just equal to the maximum annual average, which can be met without the introduction of demand restrictions at any time during the year. This should be based on a continuation of current policies regarding demand management. The dry year demand should be expressed as the total demand in the year divided by the number of days in the year.
Droughts (severe, extreme)	A prolonged dry period potentially leading to scarcity of water. Severe and extreme droughts are defined by Defra return periods of 1:200 years and 1:500/1,000 respectively.
Drought Order	The Water Resources Act 1991 gives the Secretary of State or the National Assembly for Wales the power to grant ordinary and emergency drought orders to water undertakers or the EA. Ordinary drought orders can include the same powers to abstract water as drought permits, but they can also authorise water undertakers to take other actions. In this plan, the term 'drought permit/order' is used to differentiate these from drought orders for non-essential use. An emergency drought order gives water companies complete discretion on the uses of water that may be prohibited or limited, and they can authorise supply of water by standpipes or water tanks or impose rota cuts.
Drought Permit	Schedule 22 of the Environment Act 1995 amended the Water Resources Act 1991 to give the Environment Agency the power to grant drought permits. Drought permits can only authorise a water undertaker to 'take water' from specified sources or modify or suspend restrictions or obligations relating to a water undertaker's existing powers to 'take water' from a source. In this plan, the term 'drought permit/order' is used to differentiate these from drought orders for non-essential use.
Drought Plan	A statutory document written every five years, detailing company strategy to maintaining water supplies during periods of drought.
DWI	Drinking Water Inspectorate.
Dŵr Cymru Welsh Water	The licensed water and sewerage company for Wales.
Emergency Storage	A reserve water storage capacity aimed at accommodating the operational uncertainty for the duration of a particular drought. The value of the reserve store should be agreed with the regulators and should be reflected in the level of risk a water company is taking across the planning period.

Term	Definition
Environment Agency (EA)	One of our regulators. The Environment Agency (EA) is a non-departmental public body, established in 1995 and sponsored by the United Kingdom Government's Department for Environment, Food and Rural Affairs (Defra), with responsibilities relating to the protection and enhancement of the environment in England (and until 2013 also Wales).
EBSD	Economics of Balancing Supply and Demand – a key methodology document published by UKWIR in 2002.
ELL	Economic level of leakage, which is being superseded by the concept of 'sustainable economic level of leakage' (SELL).
Final Planning Demand Forecast	A demand forecast that reflects a company's preferred policy for managing demand and resources through the planning period, after taking account of all options through economic analysis.
Freeze-thaw	Freeze-thaw events relate to peak demands caused by rapidly increasing leakage levels. These normally occur during the winter months, when changes in temperature can cause the ground to freeze and then thaw relatively quickly. This can result in pipes or mains cracking or bursting.
Habitats Directive	The European Union Habitats Directive (92/43/EC) is the instrument through which Member States must identify and protect as 'Special Areas of Conservation' (SAC) certain sites that are representative of specified habitats for specific species, which are of European importance. It also covers 'Special Protection Areas' (SPA) but none are identified as being affected by United Utilities Water abstractions
Habitats Regulation Assessment (HRA)	Habitats Regulations Assessment is a process for identifying the implications of the drought plan options for European designated sites (SAC, SPA, and Ramsar). If likely significant adverse impacts are predicted, then a detailed Appropriate Assessment of the option is required.
Hands-off flow	A hands-off flow (also known as a prescribed flow) is normally associated with a river abstraction and is the flow above which abstraction can occur. The purpose of a hands-off flow is to ensure a given flow of water continues in the river prior to abstraction.
Headroom	Available headroom is the difference (in Ml/d or %) between WAFU (including imported water) and demand at any given point in time. See also Target Headroom.
Hosepipe Ban/Temporary Use Bans	Section 36 of The Flood and Water Management Act 2010 replaced the original Section 76 of the Water Industry Act 1991. The original legislation only allowed water undertakers to prohibit or restrict the use of hosepipes (or similar apparatus) for the purposes of watering private gardens and the washing of private motor cars, commonly known as a hosepipe ban. The new legislation gives water companies further powers to restrict water use by customers. Therefore, this plan refers to 'water use restrictions' rather than hosepipe bans.
Household	A property used as a single domestic dwelling as defined by Ofwat.
Hydro-Logic® Aquator	The name of a water resources computer modelling system used by United Utilities Water.
Impounding Reservoir	A man-made store of water featuring a dam wall, often the result of damming a river or stream.
Initial Supply-Demand Balance	The difference between WAFU and baseline demand forecast (including target headroom) before any additional demand management measures or source enhancements.

Term	Definition
Inset Appointee	The inset appointment process is the route by which one company replaces the incumbent (i.e. United Utilities Water for the North West) as the appointed water and/or sewerage company for a specified area. As such, the replacement appointed water company will have all of the same duties and responsibilities as the previous statutory water company for the specified area. United Utilities Water's only inset appointment is for Leep Water Networks Ltd. who supply water to Media City, Salford and Liverpool International Business Park. Leep are not a licensed supplier as they do not hold a Water Supply Licence.
Integrated Resource Zone	A term used in our Water Resources Management Plan 2015 to describe our largest resource zone covering most of North West England. For this plan we now refer to the Strategic Resource Zone.
Integrated Asset Planning (IAP)	An internal process used to identify future investment needs at our treatment works and network assets.
l/hd/d (also lppd)	Litres per person per day.
l/prop/d	Litres per property per day.
LeakLine	A free telephone number for the public to report leaks to United Utilities Water.
Level of Service	Reliability of water supply to customers expressed as the average frequency of the imposition of water use restrictions.
Met Office	The United Kingdom's national weather service.
MISER	A water network management advisory tool for operational resource planning, widely used in the UK water industry.
Ml/d	Megalitres per day (million litres per day).
Natural England (NE)	A non-departmental public body in the United Kingdom sponsored by the Department for Environment, Food and Rural Affairs. It is responsible for ensuring that England's natural environment, including its land, flora and fauna, freshwater and marine environments, geology and soils, are protected and improved.
Natural Resources Wales (NRW)	Natural Resources Wales is a Welsh Government-sponsored public body established in 2013, with responsibilities relating to the protection and enhancement of the environment in Wales. Its functions were previously carried out by the Countryside Council for Wales, Environment Agency Wales and the Forestry Commission Wales.
Net Present Value (NPV)	Net Present Value of a schedule of costs for a programme. NPV is a very widely used method to combine various costs occurring over a period of time into a single value for comparison with the NPV of an alternative programme.
Non-essential Use Ban	Also known as a prescribed uses order. The Drought Direction 2011 sets out the 'non-essential' uses of water that can be prohibited or limited by an ordinary drought order. It is more restrictive than Section 76 of the Water Industry Act 1991 (as replaced by Section 36 of The Flood and Water Management Act 2010) and can impact particularly on car washing businesses, building cleaning businesses and those businesses with private swimming pools.
Non-household	Properties receiving potable supplies, but which are not occupied as domestic premises, i.e. factories, offices, commercial properties, and cattle troughs. They also include properties containing multiple households, which receive a single bill (e.g. block of flats).
Normal Year Annual Daily Demand	The total demand in a year with normal or average weather patterns, divided by the number of days in the year.
North Eden Resource Zone	The water resource zone covering the North Eden area, comprised mainly of borehole sources.
Northumbrian Water	The licensed water and sewerage company for Northumbria.

Term	Definition
NRA	National Rivers Authority, which was replaced by the Environment Agency (EA) in 1996.
ODPM	Office of the Deputy Prime Minister.
Ofwat	The public name of the Water Services Regulatory Authority, previously called Office of Water Services (the economic regulator of the water industry in England and Wales).
ONS	Office for National Statistics.
Outage	A temporary loss of deployable output due to planned or unplanned events. An outage is temporary in the sense that it is retrievable, and therefore deployable output can be recovered.
PCC	Per capita consumption (in litres per person per day).
Peak Demand	In water resource modelling, the time at which demand for water is at its highest.
Leep Water Networks Limited	A water supply and wastewater drainage service provider owned by The Peel Group.
Price Control	A method of separating out the regulation of prices charged by water companies.
Price Review or Periodic Review	A review (normally every five years) conducted by Ofwat of water tariffs, price limits, water company investment plans and service levels to customers.
PR19	Price review in 2019 to determine water prices, water company investment plans and service levels for the period 2020–25.
PR24	Price review in 2024 to determine water prices, water company investment plans and service levels for the period 2025–30.
Point of Production	The point where treated water enters the distribution system. Defined as raw water into treatment less treatment works operational use and treatment works losses.
Potable/Non-Potable	Drinking water/non-drinking water
Pywr	The name of a water resources computer modelling system used by United Utilities Water.
Ramsar	Ramsar sites are wetlands of international importance designated under the Ramsar Convention. More formally known as 'The Convention on Wetlands of International Importance especially as Waterfowl Habitat' it is an intergovernmental treaty signed in Ramsar, Iran, in 1971.
RAPID	Regulators' Alliance for Progressing Infrastructure Development.
Raw Water	Water direct from the source, which has yet to be treated.
Rateable Value	A value ascribed to a domestic or commercial building based on its size, location, and other factors, used to determine the rates payable by its owner.
Reservoir	An impoundment with natural or pumped inflows.
Resource Zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers should experience the same risk of supply failure from a resource shortfall.
Review of Consents	The Environment Agency process by which abstraction licences (and other consents such as discharge consents) that have the potential to adversely affect SAC and SPA sites are being reviewed by the Environment Agency to determine if they need to be altered. This process will result in changes such as increases to compensation or prescribed flow requirements and reductions to the volume of water that can be abstracted.
RDM (Robust Decision Making)	A planning framework that helps in making decisions when dealing with a very uncertain future, sometimes referred to as 'deep' uncertainty, where the probabilities of future events are unknown or cannot be agreed upon. Solutions from RDM are considered to be robust as they perform well over a wide range of future conditions, rather than optimally in a few.
RSPB	The Royal Society for the Protection of Birds.

Term	Definition
SAC	Special Area of Conservation designated under the EU Habitats Directive.
SEA	Strategic environmental assessment – see Section 9.8.
SELL	Sustainable economic level of leakage, a concept introduced by Ofwat in 2007.
SELWE	Sustainable economic level of water efficiency, a concept introduced by Ofwat in 2010.
Secretary of State	The Secretary of State for Defra (Department for Environment, Food and Rural Affairs).
Service Reservoir	A holding tank for treated water prior to distribution into the network.
Severn Trent Water	The licensed water and sewerage company serving the majority of the Midlands (England).
South Staffordshire Water	The licensed water only company serving parts of Staffordshire and the West Midlands.
SPA	Special Protection Area, as designated under the EU Directive on the conservation of wild birds (also known as the Birds Directive). Together with SAC's these form the Natura 2000 network of protected sites.
SSSI	Site of Special Scientific Interest.
Statutory Water Use Restrictions	Statutory Water Use Restrictions would be implemented approximately 28 days following the introduction of Voluntary Water Use Restrictions. The Statutory Water Use Restrictions are as set out in Section 76 of the Water Industry Act 1991 (as replaced by Section 36 of The Flood and Water Management Act 2010).
Stochastic	A process incorporating an element of randomness, the evolution of which can only be predicted within a range of values of the uncertain variables.
Strategic Resource Zone	The largest water resource zone, covering the majority of the North-West of England. Formerly the Integrated Resource Zone but including West Cumbria also.
Supply-demand balance	The difference between total water available for use (as supply) and forecast distribution input (as water demand) at any given point in time over the Water Resources Management Plan's planning period/horizon.
Supply Pipe Losses	Losses that occur from pipes that are the responsibility of the customer.
Sustainability Reduction	Reduction in deployable output of a water source, or group of water sources, due to change in abstraction licence conditions imposed by the Environment Agency to ensure more environmentally sustainable water abstraction.
Target Headroom	Target headroom is the threshold of minimum acceptable headroom, which would trigger the need for total water management options to increase WAFU or decrease demand.
Telemetry	Telemetry is an automated communications process by which measurements and other data are collected at remote or inaccessible points and transmitted to receiving equipment for monitoring.
Thirlmere transfer scheme	A large-scale capital project to enable transfers of water from Thirlmere reservoir into the demand area fed by the former West Cumbria Resource Zone. This was defined in our 2015 Water Resources Management Plan and implemented in 2022.
Total Leakage	The sum of distribution losses and customer supply pipe losses.
Total Water Management	All water management activities from source to end use (i.e. resource management, production management, distribution management and customer-side management).
Tripartite Report	The short name often given to the Ofwat, Environment Agency and Defra (2002) report: Future Approaches to Leakage Target Setting for Water Companies in England and Wales.
UKCIP	United Kingdom Climate Impacts Programme.
UKCP	United Kingdom Climate Projections.
UKWIR	United Kingdom Water Industry Research Limited.

Term	Definition
United Utilities Water	United Utilities Water Limited, the licensed water and sewerage company for North West England.
Wastewater	The commercial and domestic sewage that is collected and treated by United Utilities Water.
Waterbody	A body of fresh or salt water e.g. a lake or a river.
Water Resources North group	A multi-company forum for discussing water resources activities in the North of England.
Water Resources West group	A multi-company forum for discussing water resources activities in the West of England (see Section 2.1).
Water Available for Use (WAFU)	The value of Ml/d calculated by the deduction from deployable output of an allowance for outage and an allowance for raw and treated water losses in a resource zone.
Water Framework Directive	The European Union Water Framework Directive (2000/60/EC) establishes a strategic 'river basin planning' approach to managing the water environment, including achievement of good ecological status in water bodies by 2015. It provides a consistent approach for ensuring compliance with standards and objectives set for protected areas, and implementation of programmes of measures to meet those objectives.
Water Network Plus	An internal term to describe the business area responsible for water treatment and treated water distribution.
Water Resource Zone	See Resource Zone.
Water Taken Unbilled	Water supplied to customers for legitimate purposes, which is unbilled, and water taken illegally.
Water Trading	The concept of transferring water between the incumbent areas of water companies.
Water UK	An organisation, which represents and works with the major water and wastewater service providers in England, Scotland, Wales and Northern Ireland.
West Cumbria Resource Zone	A term used in our Water Resources Management Plan 2015 to describe the water resource zone covering West Cumbria. For this plan West Cumbria is now part of the Strategic Resource Zone.
WINEP	Water Industry National Environment Programme.
WRC	Water Research Centre.
WRMP	Water Resources Management Plan.
Yield	A general term for the reliable supply of water from a source. More specific, defined terms are used in this document – see Water Available for Use and Deployable Output.

United Utilities Water Limited
Haweswater House
Lingley Mere Business Park
Lingley Green Avenue
Great Sankey
Warrington
WA5 3LP

unitedutilities.com

United Utilities

Water for the North West