REVISED
WATER RESOURCES
MANAGEMENT PLAN 2019

December 2022

Jim Barker
Head of Water Resources
Portsmouth Water Limited
PO Box 8
West Street
Havant
Hants
PO9 1LG

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Glossary of acronyms

	Term	Meaning
A	ADO	Average deployable output
	ADPW	Average day peak week
	ALC	Active Leakage Control
	AMP	Asset Management Plan period
	AMP7	The Asset Management Planning period, running from 2020/21 to 2024/25
B	BL	Baseline (Plan) (The WRMP excluding all future options)
D	Defra	Department for Environment, Food and Rural Affairs
	DI	Distribution Input
	DO	Deployable output
	DYAA	Dry year annual average planning scenario
	DYCP	Dry year critical period planning scenario
	DYMDO	Dry year minimum deployable output planning scenario
E	EA	Environment Agency
F	FP	Final (Plan) i.e. The plan including all options
	fWRMP	Final Water Resources Management Plan
	Revised WRMP	Revised Water Resources Management Plan
H	HH	Household customers
L	l/h/d	Litres per head per day
	l/prop/d	Litres per property per day
	LoS	Levels of Service
	LTA	Long Term Average
M	mAOD	Meters Above Ordinance Datum
	MDO	Minimum deployable output
	Ml/d	Megalitres per day
N	NEUB	Non-Essential Use Ban

	Term	Meaning
	NHH	Non-household – i.e. commercial and industrial customers
	NYAA	Normal Year Annual Average planning scenario
P	PCC	Per capita consumption
	PDO	Peak deployable output
	PET	Potential evapotranspiration
	PHC	Per household consumption
	PR19	Periodic Review 2019
	PRT	Portsmouth Water
S	SDB	Supply demand balance
	SPORT	Storage and Production Optimisation in Real Time
T	TLL	Time Limited Licences
	TUB	Temporary Use Ban
U	UKWIR	UK Water Industry Research Ltd
	USPL	Underground supply pipe leakage
W	WAFU	Water available for use
	WFD	Water Framework Directive
	WRMP	Water Resources Management Plan
	WRPG	Water Resource Planning Guidelines, produced and published by the EA
	WRSE	Water Resources in the South East
	WRZ	Water Resource Zone

Note

This Revised WRMP19 is subject to further external assurance, and we will continue to develop our approaches as we progress forwards through AMP7. We will regularly provide any updates to key regulators and key stakeholders as required.

1 Executive Summary

1.1 Background

Portsmouth Water is a water supply only company with a long tradition of serving Portsmouth and the surrounding area. On average, we distribute around 175 million litres of water each day to over 740,000 customers in around 320,000 properties. We are facing a number of challenges over the next 25 years, characterised by anticipated growth in population and property numbers in our supply area, coupled with the effects of climate change and other pressures on our sources such as the need to protect the environment.

The Final WRMP19 presents the supply-demand balance throughout the 25-year planning period (2020/21 to 2044/45). It demonstrates the need for investment to maintain the balance between supply and demand over the planning period. It shows the programme of actions we plan to undertake to ensure our resilience to a 1 in 200 year drought and support other water companies in the region. Our Final WRMP19 was prepared in accordance with the statutory guidance and policies issued by the Environment Agency and Defra. It was approved for publication by Defra on 4 November 2019.

The Final WRMP19 makes a major contribution to long-term resilient water resources in the South East by providing additional bulk supplies to Southern Water. It is planned that this will be enabled by a twin-track approach to reduce leakage and lower Per Capita Consumption (PCC), and the development of Havant Thicket Winter Storage Reservoir (HTWSR). We are building the reservoir in close collaboration with Southern Water.

1.2 Revised WRMP19

As part of the WRMP process, it is a statutory requirement to annually review progress against the Plan and report it to the Secretary of State in an Annual Review.

Our Final WRMP19 sets out how we plan to maintain our supply demand balance up to a 1 in 200 year drought scenario throughout AMP7 and beyond. Our previous Annual Reviews for 2020 and 2021 highlighted that the outturn values of certain elements of our plan were not following their expected trajectories. Whilst we outperformed on some elements such as leakage, other elements have put pressure on our supply demand balance, such as PCC. In addition, our proposed AMP7 supply schemes have been undergoing environmental assessment and final design which has resulted in a change to the delivery profile of these schemes and a better understanding of the yields these schemes will deliver.

Following the receipt of feedback from Ofwat, Defra and the Environment Agency, we decided that a Revised WRMP19, along with a set of full planning tables was the most appropriate way to investigate if there were significant changes to our supply-demand balance. This would enable us to understand if there was a security of supply risk to our own customers, and to the bulk supplies to Southern Water in each drought scenario and identify mitigation measures if necessary.

Our Revised WRMP19 (rWRMP19) makes use of our most recent data and knowledge. It uses our new forecasts which have recently been developed following Water Resources South East (WRSE) agreed process and reflecting industry best practice, as we produce our WRMP24. We believe this to be the most appropriate information to give us an accurate view of our current position.

We submitted our first view of the rWRMP19 in June 2021, including details of further work we needed to reach a greater understanding of risk. This report serves as an update to the previously submitted rWRMP19.

1.3 Key Components of the Revised WRMP19

For both the Final and Revised WRMP19 we have planned on the basis of a single Water Resource Zone (WRZ) that covers our entire supply area. We have produced forecasts for annual average and critical period planning scenarios for a range of drought scenarios, although our focus is on the challenging 1 in 200 year drought event.

The levels of service and the nature of the supply options selected for the Final WRMP19 are the same as those within this Revised WRMP19, although the detail of the supply options has been updated to reflect our latest investigations. Our demand side options have also been updated to reflect new WRSE Group methodologies that have been implemented in the development of our draft WRMP24.

We have continued to engage with the Environment Agency and Southern Water for this Revised WRMP19 and have provided regular updates as the work has progressed, including via our 2022 annual review.

Our engagement with stakeholders on our future plans has now broadened with the consultation stage of our draft WRMP24. The draft WRMP24 sets out the preferred programme of options/interventions to maintain the balance of supply and demand between 2025 and 2075 and can be accessed here:

https://www.portsmouthwater.co.uk/news/publications/water-resources-planning/

The draft WRMP24 identifies that there is currently a slightly higher risk we'd need to introduce emergency restrictions in a very severe drought, which reflects the findings of this Revised WRMP19.

1.4 Baseline Supply

A reassessment of the deployable output (DO) of our 22 sources was undertaken for the Final WRMP19, providing the basis for the baseline supply forecasts. The source DO assessment, along with the assessment of climate change impacts and treatment process losses, has been retained for this Revised WRMP19. However we have now updated the WRZ DO assessment using our new Pywr system simulator.

We do not have any bulk supply import agreements. Current and potential future bulk supply export agreements with Southern Water were included in our baseline supply forecast for the Final WRMP19 and they are also retained for this Revised WRMP19. The existing bulk supply agreements which are available throughout the planning period (April 2020 – March 2045) comprise:

- Southern Water – Sussex North (15 Ml/d)
- Southern Water – Hampshire Southampton East (15 Ml/d)

A future bulk supply has been agreed with Southern Water predicated on the construction of the new reservoir:

- Southern Water – Hampshire Southampton East (additional 21 Ml/d from 2029/30)

And a further future bulk supply is under discussion with Southern Water, predicated on the successful commissioning of a new groundwater source:

- Southern Water – Hampshire Southampton East (additional 9 Ml/d from 2024/25)

For the Final WRMP19, we also considered the impact of any short-term loss of production referred to as 'outage'. Our outage assessment has been updated to reflect a consistent methodology developed by the WRSE Group for the Regional Plan. The updated outage values and WRZ DO assessment have been used for this Revised WRMP19 and they are the only change from the Final WRMP19 with respect to Baseline Supply.

Please note the Revised WRMP19 does not include potential sustainability reductions (abstraction licence reductions) to meet 'licence capping' and 'environmental destination' requirements. These are new future requirements, and they are only considered within our draft WRMP24.

1.5 Baseline Demand

1.5.1 Final WRMP19

Our Final WRMP19 assessment was that non-household demand will continue to fall over the planning period, with the long-term trend being reinforced by retailers in the Non-Household Retail Market who are working with their customers to reduce usage further.

Leakage is of significant concern to our customers and a keen area of focus for us; therefore, it was reviewed in detail for the Final WRMP19. We set an initial leakage reduction target of 7.1Ml/d, reducing leakage from 35 Ml/d down to 27.9 Ml/d by 2025.

We anticipated significant improvements in leakage detection and repair efficiency through innovation over the next 40 years and took this into account when forecasting the baseline level of leakage, as well as expected growth in properties and increased customer metering.

Reducing household demand is an important element of our Final WRMP19. Using a combination of measures we were seeking to influence the consumption patterns of our customers to reduce the amount of water per person they consumed. Our strategy to influence customers identified in the plan was for consistent and persistent water efficiency messaging, the provision of free water efficiency devices, home audits and through increasing our metering penetration.

We have made significant progress in our water efficiency offer to customers and have introduced Change of Occupier metering and maintained Optant metering. We are also undertaking a number of trials in using smart meter technology to track consumption and meaningfully engage with customers around how they use water.

Bearing in mind the effectiveness of metering in reducing PCC, we have taken legal advice and written to both the EA and the Secretary of State to request the authority to introduce universal metering before the adoption of the draft WRMP24 and gain PCC reduction benefits early. We are not confident we can overcome the barriers that currently prevent that course of action but will continue to explore the possibility.

1.5.2 Revised WRMP19

Since the publication of our Final WRMP19 we have been working to produce updated demand side forecasts to input into the WRSE regional model for the development of the regional plan. We have followed the most recent methodologies and used the latest data and water efficiency and leakage strategies. The forecasts have included our latest outturn values to produce forecasts starting prior to 2020. It is therefore appropriate to use this data as the basis for our Revised WRMP19.

It is widely acknowledged within the industry that there has been an impact of Covid-19 on PCC, and that there are likely to be long-term impacts of this on water demand. For our draft WRMP24, and this Revised WRMP19, we have included the risk from Covid-19 impacts in the headroom assessment. However it should be noted that the current approach may be updated for the final WRMP24.

1.6 Baseline Supply-Demand Balance

The Final WRMP19 baseline supply-demand deficit was reported as 27.9 Ml/d in 2019/20 increasing to 80 Ml/d by 2044/45 under the 1 in 200 year annual average scenario, and 27.3 Ml/d in 2019/20 increasing to 84.6 Ml/d by 2044/45 under the 1 in 200 year critical period

scenario. This indicated that options needed to be developed to meet both our customer requirements and bulk supply commitments to Southern Water. We followed an 'options appraisal' process to identify the options that should be implemented to eliminate the deficits.

This Revised WRMP19 provides updated baseline supply and demand forecasts and target headroom. Our Revised WRMP19 baseline supply-demand balance also shows a deficit at both annual average and critical period throughout the planning period. The deficit was 21.0 Ml/d in 2019/20 increasing to 74.9 Ml/d by 2044/45 under the 1 in 200 year annual average scenario, and 17.2 Ml/d in 2019/20 increasing to 78.3 Ml/d by 2044/45 under the 1 in 200 year critical period scenario.

The baseline deficits for the Revised WRMP19 are smaller than for the Final WRMP19, despite a higher outturn demand, largely as a result of a smaller outage allowance and lower leakage.

1.7 Final Supply-Demand Balance

Our preferred Final WRMP19 plan contained options that we considered at the time most appropriate to deliver over the twenty-five year planning period to maintain the balance between water supply and demand.

Both the Final WRMP19 and the Revised WRMP19 analysis has indicated that the 1 in 200 year event represents the most challenging scenario. The revised analysis indicates that the types of options originally selected under the preferred plan are still required, but that the benefits of those options might not be the same as they were understood to be at the time.

Table 1 sets out the options within our preferred WRMP19 Final Plan and their planned start dates along with key updates for the Revised WRMP19.

Option code	Preferred Final Plan Option name	AMP7 (2020/21-2024/25)	AMP8 (2025/26-2029/30)	Revised WRMP 2019 adjustment
CO46	Household water efficiency programme (partnering approach, home visit)	2020–21		New basket of demand side options and benefits to reflect latest WRSE Group related work streams. Including; • Revised water efficiency programme • Virtual home visits • Change of Occupier metering • Further fixed network noise loggers to reduce leakage • The targeted provision of water saving devices
CO46b	Waterwise programme	2020–21		
CO26	Subsidy to customers that purchase water efficient appliances (washing machines and dishwashers, showers and WCs)	2020–21		
CO34	Water saving devices – Retrofitting existing toilets	2020–21		
CO06a	Metering on change of occupancy – existing meter pits	2020–21		
DO04a	Fixed network of permanent noise loggers connected to telemetry - Tranche 1	2020–21		
CO40	Water saving devices – spray taps	2020–21		
CO84	Voids metering	2020–21		
CO78	Voluntary restraint and leakage action	2020–21		
CO79	Mandatory restraint	2020–21		New view on the effectiveness of mandatory restraint from Pywr modelling
CO80	Imposition of Drought Direction Restrictions (mandatory commercial restraint)	2020–21		
RO68	Source S – Drought Permit	2020–21		Completed analysis and environmental reports. Revised yield benefit following Pywr modelling.
RO21a	Source O – Maximising DO	2020–21		Delivery now expected to be 2024-25 with a revised yield benefit following a feasibility review and Pywr modelling.
RO23a	Source H – Maximising DO	2020–21		Delivered and in place for 2022-23.
RO24a	Source C – Maximising DO	2020–21		Delivery now expected to be 2024-25 with a revised yield benefit following feasibility review and Pywr modelling.
RO22a	Source J – Maximising DO	2024–25		Updated assumptions regarding yield benefit and operation following a feasibility review and Pywr modelling. No change to implementation date.
DO04b	Fixed network of permanent noise loggers connected to telemetry - Tranche 2		2025–26	New basket of demand side options and benefits to reflect latest WRSE Group related work streams. This includes universal metering from 2025-26.
CO06	Metering on Change of Occupancy - all properties		2025–26	
RO13	Havant Thicket Winter Storage Reservoir		2029–30	Revised DO based on updated designs and further Pywr modelling

Table 1 Preferred Final and Revised Planning Programme

The Revised WRMP19 final planning supply-demand balance for the 1 in 200 year annual average scenario is represented in Figure 1 and the critical period scenario is presented in Figure 2. These balances demonstrate that with the adjustments we have made due to advances in methodologies and knowledge, we are no longer meeting our target headroom in 2022-23 and 2023-24 for a 1 in 200 year annual average drought scenario i.e. our risk and uncertainty allowance for the supply demand balance is almost fully used. It means there is a slightly higher risk we'd need to introduce emergency restrictions in a very severe drought. This reflects a reduced benefit and increased delay in implementing our supply side options and also revisions to the baseline demand forecast to reflect outturn values and new WRSE methodologies.

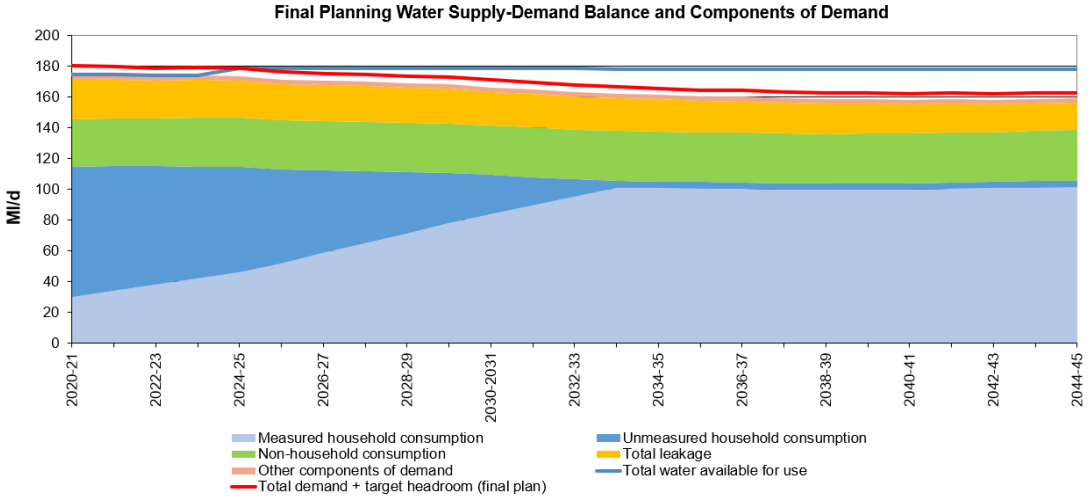

Figure 1 Revised Final Planning Supply-Demand Balance Graph - Annual Average

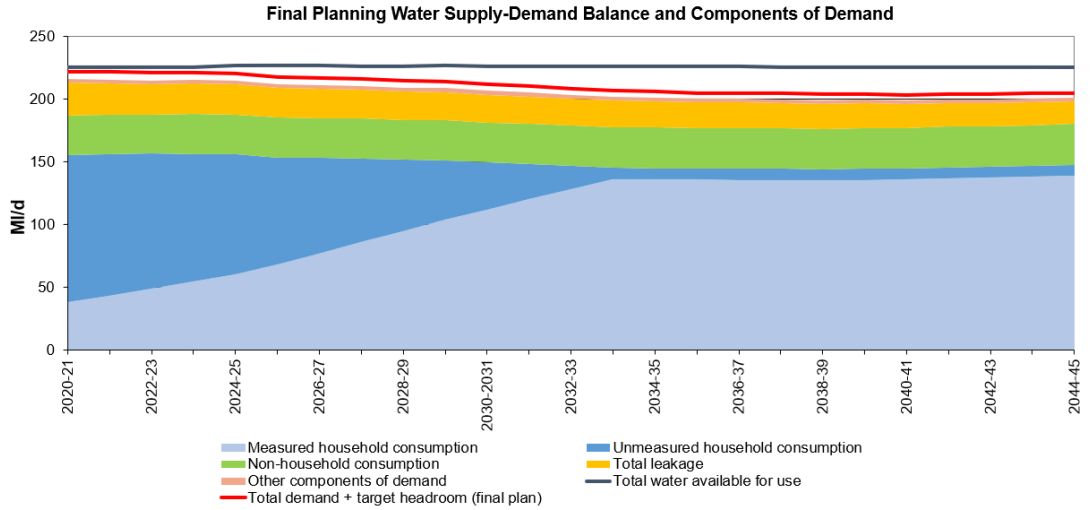

Figure 2 Revised Final Planning Supply-Demand Balance Graph - Critical Period

1.8 Conclusions and next steps

Planning for a 1 in 200 year drought event provides future resilience and, as we have committed to providing a bulk supply to Southern Water with water available up to a 1 in 200 year event, it is appropriate to undertake planning based on this event.

Whilst the risk of a 1 in 200 year event occurring within the next few years is relatively low as they take multiple dry winters to evolve to such a severity, we are continuing to explore a range of mitigation measures with the Environment Agency and Southern Water to maintain our supply demand balance.

In addition to implementing our PCC recovery plan, we will investigate the following mitigation options over the coming months:

- Acceleration of the metering programme, including preparations for universal smart metering.
- Moving one of our AMP7 supply schemes to a new location to provide additional water.

Our Draft WRMP24 will be updated in 2023 and this is expected to lead to revisions in methodologies and data (e.g. new base year for the baseline demand forecast). Therefore, we will review the need to update this Revised WRMP19 with our regulators in early May 2023.

In addition to mitigating the AMP7 situation, these activities will ensure that our statutory WRMP24 is robust and has a realistic starting point as we look forward into AMP8.

2 Overview

2.1 Introduction

Long-term planning for the provision of public water supplies is a vital aspect of maintaining the security of supply to customers whilst respecting the needs of the environment. Water resource planning has been a regular activity for water companies for many decades, and the Government has introduced legislation that requires us to prepare Water Resources Management Plans (WRMPs) and carry out public consultation. Our Final WRMP 2019 (WRMP19) was prepared in accordance with the statutory guidance and policies issued by the Environment Agency and Defra. It was approved for publication by Defra on 4 November 2019.

Please refer to the published Final WRMP19 on our website for an overview of the Water Resources Management Plan Process.

2.2 Background

Part of the WRMP process is a statutory requirement to review progress against the Plan, reported to the Secretary of State in an Annual Review.

Our Final WRMP19 sets out how we plan to maintain our supply demand balance up to a 1 in 200 year drought scenario throughout AMP7 and beyond. Our previous Annual Reviews for 2020 and 2021 highlighted that the outturn values of certain elements of our plan were not following their expected trajectories. Whilst we outperformed on some such as leakage others put pressure on our supply demand balance, such as PCC. In addition, our proposed AMP7 supply schemes have been undergoing environmental assessment and final design which has resulted in a change to the delivery profile of these schemes and a better understanding of the yields these schemes will deliver.

Feedback from Defra, Ofwat and the Environment Agency on the Annual Reviews for 2020 and 2021 was centred around concerns that the risks from delays and the relatively high PCC affecting our proposed bulk supply commitment of an additional 9 Ml/d to Southern Water in 2024, mean that we may not be fully resilient up to a 1 in 200 drought event.

Our recommended action from Defra, Ofwat and the Environment Agency was to:

"keep track of the water available for bulk supplies to the region as a whole, and focus on demand management activities to minimise the risks to these proposed transfers."

Furthermore, the Environment Agency specifically stated that:

"The company should review the water available for the bulk supplies to Southern Water as given the multiple issues identified there is a risk to bulk transfer and potentially to security of supply that Portsmouth Water need to recognise, investigate and address. The company need to report progress through quarterly meetings and AR2021."

Following this feedback, we decided that a Revised WRMP19, along with a set of full planning tables was the most appropriate way to illustrate where significant changes have been made to our supply-demand balance. This would enable us to understand our security of supply risk to our own customers, and to the bulk supplies to Southern Water in each drought scenario, and ensure mitigation measures are in place where necessary until WRMP24 is implemented in 2025.

Our Revised WRMP19 makes use of our most recent data and knowledge and uses our new forecasts which have recently been developed as we produce our WRMP24. We believe this to be the most appropriate information to use to give us an accurate view of our current position.

We submitted our first view of the rWRMP19 in June 2021, including details of further work we needed to complete to reach a greater understanding of risk. This report serves as an update to the previously submitted rWRMP19.

The sections below set out the characteristics of the Water Company supply area, together with the key components of this Revised WRMP19.

2.3 Characteristics of Portsmouth Water

Portsmouth Water is a water supply only company with a long tradition of serving Portsmouth and the surrounding area since the Company was established in 1857. Through amalgamation, our supply area has expanded beyond Portsmouth to supply the towns and cities of Gosport, Fareham, Havant, Chichester and Bognor Regis in the south east of Hampshire and West Sussex. On average, we distribute around 175 million litres of water each day to over 740,000 customers in around 320,000 properties. We are facing a number of challenges over the next 25 years, characterised by anticipated growth in population and property numbers in our supply area, coupled with the effects of climate change and other pressures on our sources such as the need to protect the environment.

We supply an area of 868 square kilometres with a population of around 740,000 across West Sussex and Hampshire. The area of supply includes a large expanse of coastline with numerous important habitats that have been designated under European Directives (including the South Downs National Park). As a statutory undertaker, we have due regard to the purposes of the national park. We abstract an average of around 175 Ml/d from boreholes, natural springs and one river. We have no significant raw water storage and consequently are reliant on the recharge of groundwater over the winter period.

Within our supply area there are a series of ephemeral and perennial chalk streams and rivers. In addition to their global rarity, chalk streams are diverse ecosystems which support a wide range of native wildlife. Their special status has been recognised by the European Commission's Habitats Directive.

The map below (Figure 3) gives an overview of the sources we abstract from.

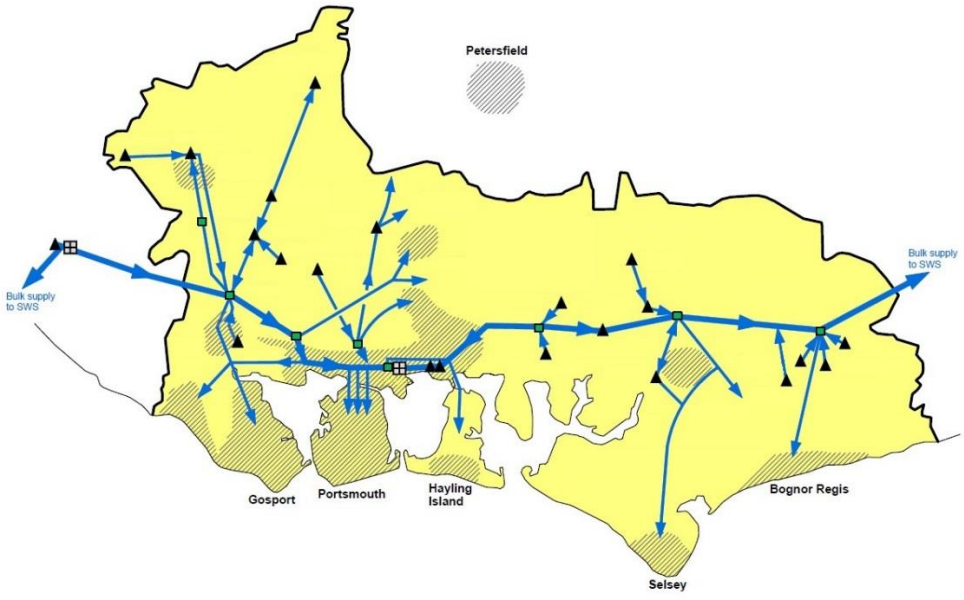

Figure 3 Map of Portsmouth Water Area of Supply

A number of sources are subject to 'group licences' where the licence conditions are limited between sources. The group sources are listed below.

- Source B Springs
- Source C and Source D
- Source F and Source G
- QRST Group (Source Q, Source R, Source S and Source T)
- LMNOP Group (Source L, Source M, Source N, Source O and Source P)

There are also a further six sites that have individual licences.

Over the last five years we have undertaken a number of infrastructure reinforcement projects which have resulted in improved connectivity between sources. As a result, our supply area is considered to be a single Water Resource Zone at this point. However, we are continuing to undertake Pywr modelling to understand our connectivity even further.

2.4 Key Components of the Revised WRMP19

For both the Final and Revised WRMP19 we have planned on the basis of a single Water Resource Zone (WRZ) that covers our entire supply area. We have produced forecasts for annual average and critical period planning scenarios for a range of drought scenarios, although our focus is on the challenging 1 in 200 year drought event.

For our Final WRMP19 we worked with our customers to set levels of service, and these are consistent between the WRMP and the Drought Plan. Our planned level of service over the planning period is set out below:

- Temporary Use Bans to be implemented no more frequently than in a 1 in 20 year drought event, representing an annual risk of 5%.
- Non-Essential Use Bans to be implemented no more frequently than in a 1 in 80 year drought event, representing an annual risk of 1.25%.
- Emergency Drought Orders to be implemented no more frequently than in a 1 in 200 year drought event, representing an annual risk of 0.5%.

In developing the Final WRMP19, we also worked closely with the Water Resources in the South East (WRSE) Group, which is a sector-wide partnership that selects the best options to solve deficits across the region. The modelling undertaken by the WRSE Group indicated that there is both the scope (through options available to us) and the need for us to provide additional bulk supplies to Southern Water, to assist our neighbour in meeting the deficits it faces during the planning period.

Our involvement with the WRSE Group was central in the development of the Final WRMP19, the Havant Thicket Winter Storage Reservoir being considered a significant option to help deliver resilience in South East England.

The levels of service and the nature of the supply options selected for the Final WRMP19 are the same as those within this Revised WRMP19, although the detail of the supply options has been updated to reflect our latest investigations. Our demand side options have also been updated to reflect new WRSE Group methodologies that have been implemented in the development of our draft WRMP24.

It is recognised that as a result of this work there have been updates compared to our Final WRMP19, and the reasons for these updates are outlined throughout this report where appropriate. Following the Environment Agency Annual Review guidance (Environment Agency, May 2019), such changes to components of the water balance and/or supply-demand balance as a result of better understanding are not routinely considered a ‘material’ change of the WRMP. Therefore we do not consider that we are required to re-consult on our WRMP.

3 Stakeholder and Customer Engagement

In preparing the Final WRMP19, we engaged extensively with customers and stakeholders both prior to publishing our Draft WRMP19 and during the public consultation period following its publication. We take the views of our customers and stakeholders very seriously and we demonstrated the influence that the engagement process had on shaping the Final WRMP19. In parallel, the plan is closely aligned to the Government's expectations for ensuring resilient water supplies in the long-term enabled by reductions in demand and regional resource sharing through the use of greater bulk supplies to neighbouring companies.

Further information on Stakeholder and Customer Engagement during the development of our Final WRMP19 is provided within the published November WRMP19, which is available on our website.

We have continued to engage with the Environment Agency and Southern Water for this Revised WRMP19 and have provided regular updates as the work has progressed, including via our 2022 annual review.

Our engagement with stakeholders on our future plans has now broadened with the consultation stage of our draft WRMP 2024 (WRMP24). The draft WRMP24 sets out the preferred programme of options/interventions to maintain the balance of supply and demand between 2025 and 2075 and can be accessed here:

https://www.portsmouthwater.co.uk/news/publications/water-resources-planning/

The draft WRMP24 identifies that there is currently a slightly higher risk we'd need to introduce emergency restrictions in a very severe drought, which reflects the findings of this Revised WRMP19.

4 Supply

4.1 Introduction

The majority (89%) of the water we supply to customers is derived from the local Chalk aquifer. It is either taken directly from the Chalk aquifer from boreholes and wells or captured as it emerges from the Chalk aquifer via springs. In addition, we have one surface water abstraction.

Our Final WRMP19 described how much water is available for supply and the factors that could influence this availability, covering the following:

- Deployable Output (DO) Assessment
- Sustainability Reductions
- Climate Change
- Outage Assessment
- Process Losses
- Bulk Supply Imports

Of these, the Water Resource Zone DO assessment and outage assessment have been updated for our Revised WRMP19. The Water Resource Zone DO has been updated to reflect the output of our new Pywr system simulator. The outage assessment has also been fully updated and audited by the WRSE Group for the draft regional plan.

For additional information on our climate assessment, process losses, bulk supply imports and sustainability reductions, please refer to the published Final WRMP19 on our website. The revised DO and outage assessment is described in more detail in the remainder of this section.

Please note the Revised WRMP19 does not include potential sustainability reductions (abstraction licence reductions) to meet 'licence capping' and 'environmental destination' requirements. These are new future requirements, and they are only considered within our draft WRMP24.

4.2 Outage Assessment

Outage is defined as a temporary loss of DO at a source works. It can relate to planned or unplanned events and covers a wide range of influences from power failure to short term pollution incidents.

4.2.1 Assessment Timescales

For the Final WRMP19, data was analysed for the period 2007–2016. For the Revised WRMP19 we based our assessment on data from 2013-2020. This period was selected to provide a good balance between data quality and length of data set.

4.2.2 Current Guidance

Mott Macdonald consultancy developed a consistent approach to outage assessment for the WRSE Group which has been used by each member water company for the development of the regional plan. The same consultant has completed our outage assessment for the Revised WRMP19 taking into account the following guidance:

- Draft 'Water Resources Planning Guideline' (July 2020)
- UKWIR 'Outage allowances for water resources planning' (1995)
- UKWIR 'WRMP19 methods – risk-based planning' (2016)

4.2.3 Methodology

Historic data have been split into outage categories with magnitudes and durations recorded. A Monte Carlo simulation using a Python based model has then been used to simulate outage in the future, having justified which events are 'legitimate'.

All Monte Carlo simulations undertaken for this outage assessment have been run for 5000 iterations for the Dry Year Annual Average (DYAA) scenario and 2000 iterations for the Dry Year Critical Period (DYCP) scenario, which in practice gives consistent results.

Outage has been calculated to include the AMP7 DO recovery schemes, detailed in section 7.2, and the future Havant Thicket Reservoir option.

4.2.4 Analysis of Recorded Data

Since 2007 our operational staff have been maintaining a new record system for actual outage. The outage register is in the form of a spreadsheet which records:

- Start and end date and time
- Site reference
- Percentage of deployable output lost
- Planned or unplanned events
- Short term or long-term shutdown
- Classification and fault code

Since 2012 we have also been recording outages of less than one day. This is one of the drivers for calculating our new outage allowance based on data for 2013 to 2020.

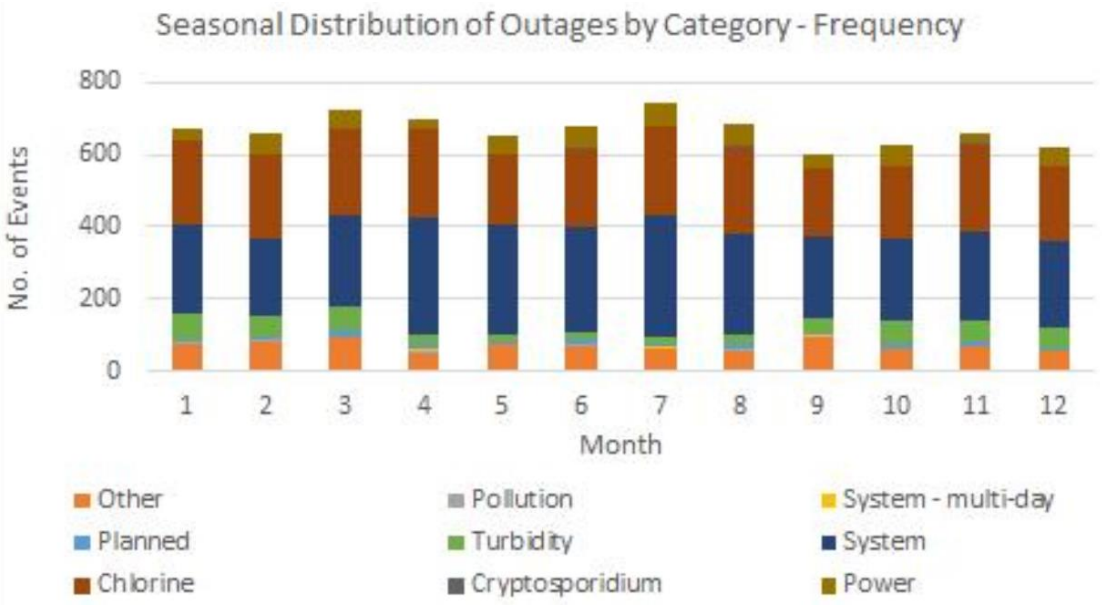

Figure 4 Seasonal Distribution of Recorded Outage Events, 2013-2020

Figure 4 indicates that there are no significant patterns and the number of outage events (including the categories) seem to be evenly spread throughout the year. It is important to note that the outage events do not result in interruptions to service to our customers in normal years because of the resilience of the works and networks and two to three days storage at the service reservoirs. A number of the recorded events cause a reduction in capacity rather than a loss of works.

4.2.5 Outage Assumptions

The analysis of future outage is based on events that are considered to be 'legitimate' according to UKWIR guidance and expert judgement. Many of our recorded outage events are not legitimate outage events to assess a suitable outage allowance for our supply/demand balance. The reason for this is that either they did not result in a loss of DO or because the DO lost was not required to meet demand at the time of the shutdown. These events are not considered as outage events within the assessment. They are instead classed as strategic operational decisions.

All planned events in excess of 90 days were excluded from the outage assessment. Where appropriate these have been considered within the company DO and headroom assessments. This is in line with the UKWIR guidance Outage allowances for water resources planning (1995).

Unplanned events in excess of 90 days have been included within the assessment, but capped at 90 days, in line with the outage assessment guidelines.

Other adjustments to event durations were made to reflect more realistic response times during drought conditions and/or periods of high demand or any other time when the supply-demand balance is critical. Durations of events caused by faulty hatch alarms were reduced to zero.

To ensure that outage is not overestimated the data were also sorted to remove double counted events.

4.2.6 Summary of Legitimate Outage Events

Raw data from the outage registers was processed as follows:

- Data from the outage registers was compiled into a single table.
- Duplicated events were removed.
- Event start date and time was determined by subtracting the duration from date and time restored.
- Outage event magnitude was determined as "Corrected Deployable Loss" / "Corrected (duration)".
- "Planned" was added as an outage classification, based on the planned/unplanned column in the register.

The processed event start/end dates, corrected durations, event magnitudes and event classifications were then input to a WRSE outage model template (version 5.3).

Events in the system category were categorised by duration as short term (<2 days) or long term, to enable short-term and long-term events to be represented by separate distributions in the outage allowance probability simulation. This avoids artificially increasing the outage allowance for these events.

The groundwater springs associated with Source B feed the same water treatment works. Legitimate outage is recorded at the treatment works, where events impact DO. Outage events for Source B that are not associated with the water treatment works have been removed for the assessment as they do not represent a loss of DO.

Nitrate events at Source K will be mitigated by a network improvement scheme and have therefore been removed.

With respect to the Source F Unit No.1 fault, the works includes 3 filtration units, so losing one would not result in a loss of DO. These events were therefore excluded.

4.2.7 Accounting for Action to Reduce Outage

During AMP6 and in support of our Business Plan, a number of studies and initiatives have been undertaken, including modelling and testing where required, to consider resilience and additional requirement both in the short and long-term.

One study concentrated on potential high impact and single point failures given that one treatment works contributes 45% of supply to customers. A major threat to our treatment works is from oil spills and so the purpose of the study was to explore the most effective solution to ensure resilience to this risk, and the projects include expenditure to deal with this. The study included extensive modelling and evaluation of our supply system and distribution systems to consider short and long-term resilience to outages. Over 440 scenarios were tested with failure scenarios ranging from single to 6-point failure. The overall conclusion was that no properties were at risk on an average day, however at peak demand some 100,000 customers would be at risk of low pressure for up to 3 hours. A range of options were considered, and our 2020-25 Business Plan includes four projects that are addressing the risk and improving resilience at peak demand in a normal year at a cost of £2.4m. Whilst these options will increase resilience at peak demand in a normal year, they have not been tested in 1 in 200-year drought.

We have considered a range of Catchment Management options to reduce outage in our AMP7 Business Plan (Portsmouth Water, 2018). Catchment Management is a key tool in controlling pollution incidents and we are involved in three Catchment Partnerships. These have included initiatives to reduce domestic oil pollution for example through the offer of subsidised surveys of old oil tanks and/or subsidised replacement of oil tanks with plastic double bunded tanks. We have also recently installed VOC monitors at all sites at risk from pollution, in order to be able to better monitor the pollution plume and make an informed decision on when the site can be started up again. This is likely to reduce the outage durations of any future pollution events related to oil spills.

In addition, we are implementing a new system for Storage and Production Optimisation in Real Time (SPORT). The SPORT system will continuously analyse and select the optimum pump combinations from the multiple inter-connected sources to balance reservoirs and meet customer demand. Where outage occurs, the SPORT system will allow automated reset to restart works, and where this is not possible, SPORT will analyse and modify the optimum pump combinations on available pumps. Only where reservoirs cannot be balanced within defined limits will out of hours responses be required.

4.2.8 Results

Outage allowances have been calculated for two scenarios:

- Dry Year Annual Average (DYAA).
- Dry Year Critical Period (DYCP).

The benefits of Final WRMP19 preferred options specified for delivery before 2029 were also included in the outage allowance. The selected outage allowance values are shown in Table 2 and they are for a probability of 90%, or exceedance probability of 10%.

Period	Final WRMP19		Revised WRMP19	
	Value in Ml/d	As % of DO	Value in Ml/d	As % of DO
DYAA	12.2	5.4	6.7	3.5
DYCP	11.6	4.1	6.4	2.7

Table 2 Outage allowance for the Final and Revised WRMP19 (Ml/d)

The revised outage allowance is lower than the published Final WRMP19 allowance for the following reasons:

- All long duration events were capped at 90 days.
- Events were separated into long and short duration events, with specific probability distributions for both. This prevented the skewing of duration distributions, which artificially increases the outage allowance.
- The choice of distributions used were reviewed for all site/hazard combinations with a contribution to outage >0.2 Ml/d.
- Length of data record used in the assessment was also reviewed. In order to balance data quality with capturing a sufficient period of data, the record from 2013 to 2020 has been used for the revised assessment to determine the outage allowance

Outage has been calculated for each works. The figures are not cumulative as outage events will not occur at all sites at the same time. The main contributory factors to our outage allowance are those of chlorine failures and pollution events.

Event durations of chlorine failures were historically longer on average, when compared to other companies, as we did not have a remote or automatic restart following system shutdown events. A physical site visit was required to inspect and verify failure reasons before restarting supply. In the past 12 months we have implemented a new control room system that allows remote start-up, leading to a reduction in outages related to chlorine failures. Although this may help reduce our outage allowance in the future, the impact cannot be quantified until more data has been collected.

Pollution events have also had a significant impact on the outage allowance. In the past our sites were shut down for longer durations as a precaution. Newly installed VOC monitors are likely to reduce the outage durations of any future pollution events related to oil spills, although similar to chlorine failures, the impact cannot be quantified until further data is collected.

4.3 Deployable Output Assessment

We are required to submit DO values to the Environment Agency and Ofwat every five years as part of our WRMP submission. DO is defined by UKWIR's Handbook of source yield methodologies (2014) as:

"the output of a commissioned source of group of sources or of bulk supply as constrained by licence (if applicable), pumping plant and/or well/aquifer properties, raw water mains and/or aqueducts transfer and/or output main, treatment and water quality, for specified conditions and appropriate demand profiles to capture variations in demand over the year"

We appointed AECOM to carry out a reassessment of our DO for WRMP19. As part of this work, the following activities were carried out:

- Source models were developed to calculate individual source DO values for the Worst historic drought on record
- A Water Resource Zone assessment of Deployable Output was undertaken to determine DO values for group licences for the worst historic drought and a range of stochastic droughts.

The source models have not been updated for our Revised WRMP19. However we appointed Atkins to develop a sophisticated Pywr system simulator, which includes a representation of our supply network and key demand centres. Furthermore we subsequently appointed AECOM and Atkins to review and improve the Pywr model for the purpose of Water Resource Zone DO assessment. The reassessment of DO is outlined below.

4.3.1 Critical Periods and Planning Scenarios

We are a peak driven company because of our groundwater supplies and a lack of raw water storage. The critical period is associated with peak summer demand. For this reason, a critical

period scenario (peak summer demand), in addition to the annual average scenario, has been included within our Final and Revised WRMP19 DO assessments.

4.3.2 Level of Service and Drought Plan Links

When drought conditions begin, we will implement our Drought Plan. This results in a steady escalation of restrictions on the demand for water, from Temporary Use Bans (TUBs) such as bans on the use of hosepipes to Non-Essential Use Bans (NEUBs, also referred to as ordinary drought orders) that may start to impact businesses in the local area.

As a last resort, we may also ask for emergency drought orders (e.g. use of standpipes and rota cuts to reduce the demand for water), although these are part of the Emergency Plan and not the Drought Plan. We have agreed with our customers the frequency at which demand restrictions might need to be implemented. The agreed Levels of Service (LoS) are as follows:

- Temporary Use Bans > 1 in 20 years
- Ordinary Drought Orders > 1 in 80 years
- Emergency Drought Orders > 1 in 200 years

The DO assessments undertaken for the Final and Revised WRMP19 investigate DO for a range of plausible droughts that are more severe than those experienced in the past. The introduction of a demand profile (considering the critical period) enables the results from the DO assessment to be mapped relative to the Company's planned LoS. This provides a link between the WRMP and the Drought Plan.

The DO assessment results themselves are used within the WRMP process to understand the impact of drought conditions on the supply-demand balance and the required investment costs, with or without demand restrictions and drought permits in place.

4.3.3 Source Deployable Output Assessment

The Source DO assessment completed by AECOM for our Final WRMP19 calculated the individual DO for Portsmouth Water's sources, based on the worst historic drought on record. The work examined observed groundwater level and flow data, source operational data and source constraints in order to develop individual source DO assessments. Further details are provided in our published Final WRMP19, which is available on our website.

The Source DO assessment has not been updated for our Revised WRMP19.

4.3.4 Resource Zone Assessment

AECOM and Atkins have updated our Water Resource Zone DO assessment, building on the individual source DO work (outlined above). The Pywr model estimates WRZ DO for a range of plausible droughts that are more severe than those experienced in the past.

New WRSE baseline stochastics timeseries have been used to generate groundwater levels using the Final WRMP19 lumped parameter model. The stochastic groundwater levels and the flow at the River Itchen are represented by the same sequences utilised in Pywr modelling for the WRSE group.

The Average demand Deployable Output (ADO) has been calculated by increasing a demand profile in the Pywr model to generate failures. The ADO and corresponding Peak summer demand Deployable Output (PDO) results are provided in Table 3.

Return Period	PDO (Ml/d)	ADO (Ml/d)
10	288	232
20	287	230
80	261	213
125	250	204
200	239	194
500	241	192

Table 3 Pywr WRZ DO values for selected return periods

The reassessment of Water Resource Zone DO for the Revised WRMP19 has resulted in a marginal increase in DO across a range of drought conditions, relative to the Final WRMP19. Whilst the improved representation of our supply network within Pywr might be expected to constrain DO, the Pywr model ensures that abstraction is weighted towards our spring and surface water sources.

Building on preliminary work within our Final WRMP19 DO assessment, we used the Environment Agency's regional groundwater model to further understand the impact of differing levels of abstraction on the Chalk aquifer. This understanding was then translated into the Pywr model, such that resting groundwater sources to preserve storage in the Chalk aquifer leads to a higher overall DO in drought.

5 Demand

5.1 Introduction

This section details our current and forecast demand for water. It defines and explains the basis of the different demand scenarios used in water resources planning and considers base year and forecast household demand, water efficiency, non-household demand and leakage. The impact of climate change on demand is also considered.

5.2 Final WRMP19

For the Final WRMP19, Experian was appointed by a group of water companies in the South East to develop detailed property and population forecasts for the planning period 2020-45. In response to representations received during the public consultation, we adopted a plan-based forecast for our Final WRMP19. The population and property forecasts were applied to estimates of base year and forecast per capita consumption for different customer segments.

Our metering policy is to continue to encourage household customers to change to a water meter voluntarily (optants), but also to use our ability to meter households as ownership changes (change of occupier). In combination, our final WRMP19 made provision to deliver 27,500 meters by these means by 2025. Unfortunately access to resources and the interruption of the covid pandemic means we are currently behind programme. However a recovery plan is in place and given no change in circumstances we will deliver the metering aspiration by the end of 2025.

We currently also undertake a number of water efficiency activities with the aim of working with our customers to help them reduce their consumption, which they have consistently said they want, the savings from which contribute to base year levels of Per Capita Consumption (PCC) and are therefore incorporated in the baseline PCC forecasts.

Our Final WRMP19 assessment was that non-household demand will continue to fall over the planning period, with the long-term trend being reinforced by retailers in the Non-Household Retail Market who are working with their customers to reduce usage further.

Leakage is of significant concern to us and our customers; therefore, it was reviewed in detail for the Final WRMP19. We commissioned a consultant to undertake a Sustainable Economic Level of Leakage (SELL) assessment to establish the base year and forecast leakage levels that we should be targeting as part of our baseline demand forecast. As a result of the full SELL appraisal, we decided to set an initial leakage reduction target of 7.1Ml/d, reducing leakage from 35 Ml/d down to 27.90 Ml/d by 2025. This results in a leakage target at SELL by 2025.

We anticipated significant improvements in leakage detection and repair efficiency through innovation over the next 40 years and took this into account when forecasting the baseline level of leakage, as well as expected growth in properties and increased customer metering. We believed that it was reasonable to expect that the increase in leakage from growth in the distribution network will be less than savings made through gains in efficiency. Additionally, it was reasonable to expect that the savings resulting in supply pipe leakage from the metering of customers should be reflected in the leakage forecast. We allowed for these benefits in our baseline leakage forecast which resulted in a falling leakage forecast over the planning period.

Reducing household demand is an important element of our final WRMP19. Using a combination of measures we were seeking to influence the consumption patterns of our customers to reduce the amount of water per person they consumed. We planned to influence customers through water efficiency messaging, the provision of free water efficiency devices, home audits and through increasing our metering penetration.

We have made significant progress in our water efficiency offer to customers and have introduced Change of Occupier metering and maintained Optant metering. We are also undertaking a number of trials in using smart meter technology to track consumption and meaningfully engage with customers around how they use water.

5.3 Revised WRMP19

Since the publication of our Final WRMP19 we have been working hard to produce updated demand side forecasts to input into the WRSE regional model for the development of the regional plan. We have followed the most recent methodologies and used the latest data and water efficiency and leakage strategies. The data has been audited both internally and externally by WRSE. The forecasts have included our latest outturn values to produce forecasts starting prior to 2020. It is therefore appropriate to use this data as the basis for our Revised WRMP19.

It is widely acknowledged within the industry that there has been an impact of Covid-19, and that there are likely to be long-term impacts of this on water demand. For our draft WRMP24, and this Revised WRMP19, we have included the risk from Covid-19 impacts in the headroom assessment. However it is noted that the approach may be updated for the final WRMP24.

5.4 Base Year Calculation

The base year for the demand forecast in this Revised WRMP19 is 2019/20. We have used updated methodologies for calculating Per Capita Consumption (PCC) and leakage.

We have adjusted the outturn leakage of 24.36 Ml/d to the three-year average of 28.36 Ml/d. This 4 Ml/d adjustment has been made to recognise the mild conditions of the preceding winter. Without the adjustment we would be underestimating leakage and total Distribution Input (DI).

In order to adjust the outturn base year sub-components of demand to the various climatic scenarios, provided at a DI level, adjustments have also been made to the measured and unmeasured household customer volumes using uplift factors, derived by the 'Water demand insights from summer 2018' club project, produced by Artesia consultants.

5.5 Demand Scenarios

The Water Resources Planning Guideline (Environment Agency and Natural Resources Wales, 2018) required demand forecasts to be produced for two planning scenarios, namely, dry year annual average (DYAA) and critical period (DYCP). For our Final WRMP19 we also developed a forecast for the normal year annual average (NYAA) scenario, which allows us to demonstrate our demand management strategy under typical climatic conditions. These scenarios are defined below.

- *Normal Year Annual Average Demand (NYAA):* The annual average daily value of demand under 'normal' weather conditions. The base year must be assessed as to whether it is a normal year, and if it is found not to be, its demand must be normalised to take account of factors such as weather.
- *Dry Year Annual Average Demand (DYAA):* The annual average value of demand under dry conditions without any drought demand restrictions in place. This demand is presented against the Average Demand Deployable Output (ADO) supply forecast.
- *Dry Year Critical Period Demand (DYCP):* The rolling 7-day average peak week that occurs during the dry year. This demand scenario is presented against the Peak Deployable Output (PDO) supply forecast.

The method by which demands for these different scenarios have been derived for our Revised WRMP19 is set out in the sections below.

5.6 Climatic scenarios

Six climatic scenarios in total were developed for the WRSE Group: NYAA, NYCP, DYAA, DYCP, 200D (AA) and 500D (AA), where '200D (AA)' and '500D (AA)' are 1 in 200 year and 1 in 500 year demands for the Annual Average scenario.

For this Revised WRMP19 we have also derived demands for 1 in 20 year AA and CP scenarios so that our Revised WRMP19 definition of Dry Year is comparable to that of our Final WRMP19 (1 in 20 year). It is 1 in 20 year AA and CP demands that are used within the supply and demand balance calculations for both the Revised and Final WRMP19.

To derive demand at the different return periods, we have utilised both outturn data and stochastically generated DI data. The outturn data was used to produce an estimate of the Normal Year (NY), which is the same approach as for our Final WRMP19. However the stochastic data was then used to characterise rarer events for which there is limited or no experience in our 20 year historic record. This is a key difference between the Final and Revised WRMP19 demand forecasts.

The starting point was to generate the best view of what the NYAA and NYCP was in 2019/20. To do this, the historic outturn data was de-trended, annualised and ranked, such that the median value of the series provided the normal year estimation. The estimated NYAA DI was 173.8 Ml/d, which is close to our 2019/20 outturn figure of 174.0 Ml/d (post-leakage adjustment).

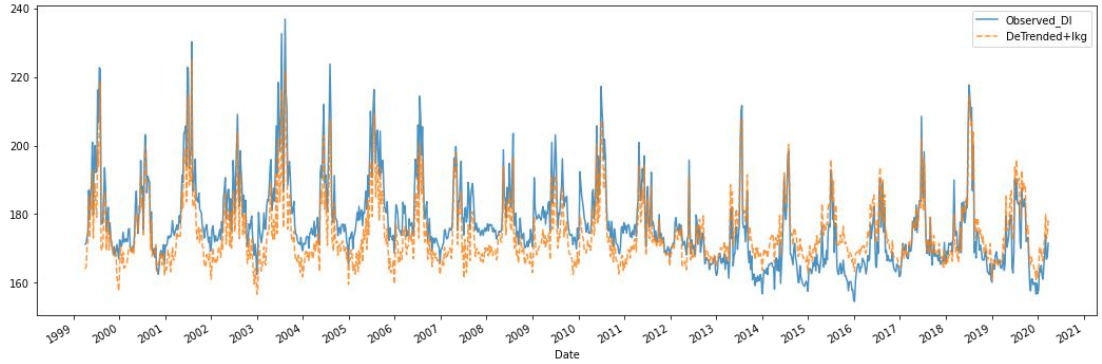

Figure 5 Calculating the NYAA by detrending the historic series. The NYAA is the medial annual average and annual maximum week.

In order to develop the climatic scenarios we have made use of the daily stochastic DI outputs produced by WRc and Artesia consultants for the WRSE Group. Factors have been applied to the NYAA and NYCP to generate annual DIs annual averages (AA) and annual weekly maximums (CP). The 'nth' percentile has then been used to represent DI for a given climatic scenario. For example, the 1 in 10 year DYAA is the 90th percentile of the annualised stochastic DI data.

5.7 Properties and population

Six property and population scenarios were developed for the WRSE Group model: BL_H_Plan, Compl_5Y, H_Need, Max, Median, Min (formerly Min_10%). We have used the 'WRSE & OxCam Forecasts – 13.05.2020' source data provided by Edge Analytics.

We have derived the forecasts using the Edge Analytics Bottom-Up (BU) forecasts which allocate local plan growth according to potential housing development sites – rather than Top-Down, which allocates growth according to existing levels of growth. This approach is particularly valuable where a local authority is shared between neighbouring water companies.

As with the Final WRMP19 plan, the local authority Plan based scenario (BL_H_Plan) is used as the core scenario and to populate the baseline demand tables. The Max, Median and Min scenarios are specific to each water company in the WRSE Group. As our household demand model is driven by both population and property growth, these scenarios have been selected based on an analysis of the impact (Ml/d) in 2099. Table 4 provides the mapping between the WRSE scenario and the Edge Analytics forecast. For the Revised WRMP19, the Min and Max scenarios are used in the headroom modelling to provide variation around the Plan based scenario – though up to 2020, the Max and Plan based scenarios are very similar.

WRSE Scenario	Edge Analytics Forecast
Max	Housing-Need-H
Median	Completions-5Y-P
Min	ONS-18-Low-L

Table 4 Selected forecasts for 'Max', 'Median' and 'Min' scenarios

The Edge Analytics base year estimates varied between scenarios and with our outturn reported figures. Therefore all of our forecasts have been adjusted to outturn reported base year. We achieved this by taking the growth associated with each forecast and applying the net increase in each year.

All household property growth occurs in the measured household group because all new properties have meters installed.

Household population growth was not directly allocated to our measured customer base as this type of growth can occur across the unmeasured and measured household population. Instead, the household population is assigned according to a controlled logic in our population and property model. Each new property was always assumed to be occupied with the estimated new property occupancy for a given year in the forecast. If in any given year the new properties could not be filled with the new population as there is an excess of housing, the population was taken from the unmeasured and existing measured household groups proportionally. Likewise, if there was an excess of the population beyond that met by new housing, then the surplus population was allocated proportionally.

All new Non-Household growth was assumed to occur to the measured Non-household group only. We have applied this approach as the unmeasured Non-household group is small and has remained stable for many years.

5.8 Household Demand

For our Final WRMP19 we moved away from the micro-component modelling that was previously used in our Final WRMP14, in favour of the 'Variable Flow' (VF) method proposed in the 'WRMP19 Methods – Household Consumption Forecasting' guidance. This decision was taken as the assumptions underpinning the micro-component model were deemed to be outdated. The VF method allows a more explicit exploration of the factors impacting demand and the uncertainty surrounding the model assumptions. Like micro-components, the method is deemed to be suitable for Water Resource Zones (WRZs) with moderate-low levels of concern. For this Revised WRMP19 the method is applied again with updated assumptions.

The household demand splits the household customer base into three groups. Unmeasured Properties, New Properties and Meter Optants. New Properties are those customers with properties built after 2004 while Meter Optants are properties that have historically opted for a meter.

Typically in water resource planning, new volumes associated with growth are assigned to either new properties or new persons. One weakness of this approach is that it does not fully recognise the impact of occupancy on consumption i.e. if average occupancy increases, then homes become more efficient and vice versa. Our VF model attempts to capture occupancy impacts by assigning volumes to both properties and persons. Customer movements can then drive volume factors according to the outputs of the properties and population model.

In order to derive the volume factors, a linear regression model was developed using company-specific data. The model uses customer type and occupancy to predict PHC volumes. The result is coefficients that split the PHC volume impacts for persons and households. The coefficients are presented below in Table 5.

Pop & Prop	Properties (l/prop/d)	Population (per person)
New Property	91.2	72.4
Measured (Meter Optant)	N/A	85.9
Unmeasured	N/A	94.4

Table 5 Aggregated coefficients for population and property movements in litres

Our climate change impact is based on the outputs of the UKWIR 'Impact of Climate Change on Water Demand Project' (2012). The factors from this cover a range of scenarios from the 10th percentile to the 90th percentile, with the 50th percentile figures used as our central scenario. The raw factors extend to 2040, therefore the remaining years have been extrapolated. The raw factors also use a 2012 base and therefore these were adjusted to the new base year. In order to convert the factors to Ml/d impacts, we multiplied the factors by the base year total household consumption, which also varies according to the relevant climatic scenario. The total Ml/d impact of climate change in each year was then split between the Unmeasured and Measured household groups proportionally, according to the split of households for a given year.

We do not assume any new metering in the baseline scenario, and therefore the number of unmeasured customers is flat. Instead, all metering, including optants, are including as options and presented in the final plan scenario. This differs from the Final WRMP19 where meter optants were included in the baseline. We believe this new presentation is more transparent, presenting a scenario with no company intervention.

In theory, a fall in per customer demand would be expected without company intervention, driven by replacement of old, less efficient, water-using devices. In practice, we have seen a continual increase in PCC for several years. This may suggest that this impact is being offset by other factors, for example, changes in customer behaviour. As these impacts cannot be robustly estimated, no reduction for water efficiency is assumed for the central scenario. Instead, ranges have been explored as part of the uncertainty analysis.

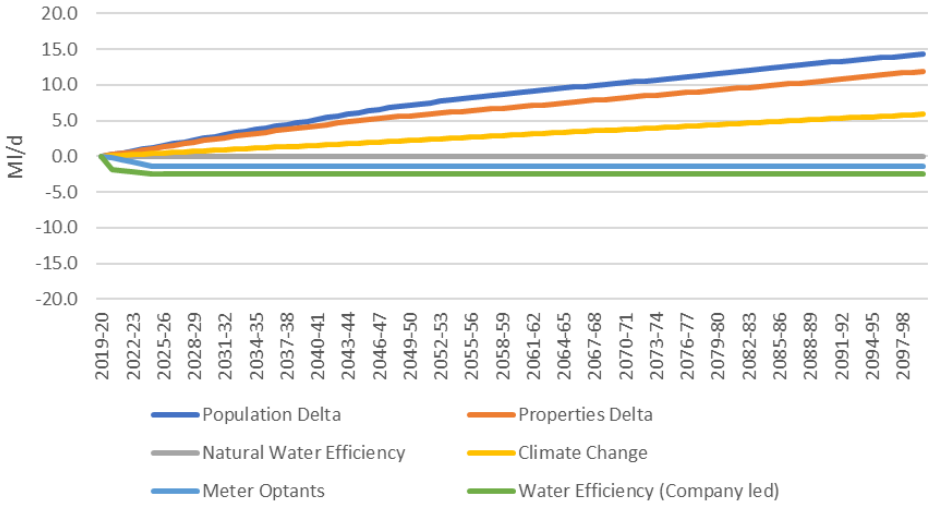

Figure 6 Example VF cumulative impacts for NYAA (Ml/d)

5.9 Non-Household Demand

For the Final WRMP19 plan, the Non-household forecast was produced internally by us. The new forecast has been updated by Artesia consultants for WRSE, which provides alignment with the other WRSE member companies.

Artesia created four core forecasts with associated uncertainty scenarios: Baseline, Low, Central and High. Though initially the 'Baseline' was intended to be used as the main scenario for the new WRSE investment model, the demand is higher than that in the 'High' scenario for the initial years of the plan. Therefore we have adopted the Central scenario as the main scenario for this Revised WRMP19. The Low and High scenarios then form inputs to our headroom analysis.

As each of the scenarios has different starting points in the base year, all the forecasts have been adjusted to the 2019/20 outturn. We achieved this by taking the cumulative change from the base of each forecast and applying it to the 2019/20 actuals.

5.10 Leakage

The latest Environment Agency guidance for WRMP24 suggests that leakage in the baseline forecast should be flat with the following assumption applied: "leakage remaining static from the first year of your plan (2025/26) throughout your whole planning period (unless otherwise agreed by regulators)".

In practice, given no additional company effort, the baseline leakage might be expected to rise as the length of the network and the number of supply pipe connections increase with growth. In alignment with the guidance, however, we have kept all leakage flat over the entirety of the planning horizon.

5.11 Baseline Demand Forecast

The approach to the calculation of the baseline demand forecast described above has resulted in the profiles shown in Figure 7 and Figure 8.

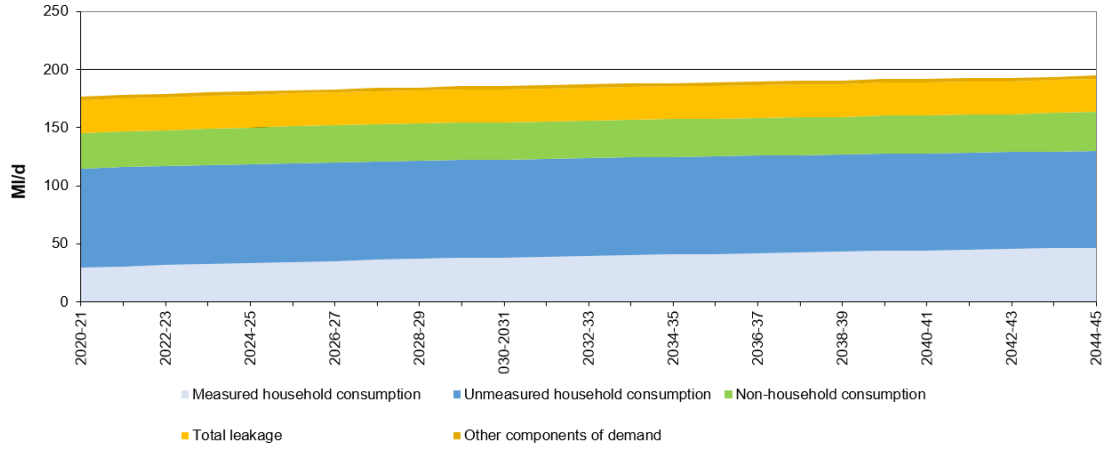

Figure 7 Baseline components of demand for the 1 in 200 year AA scenario

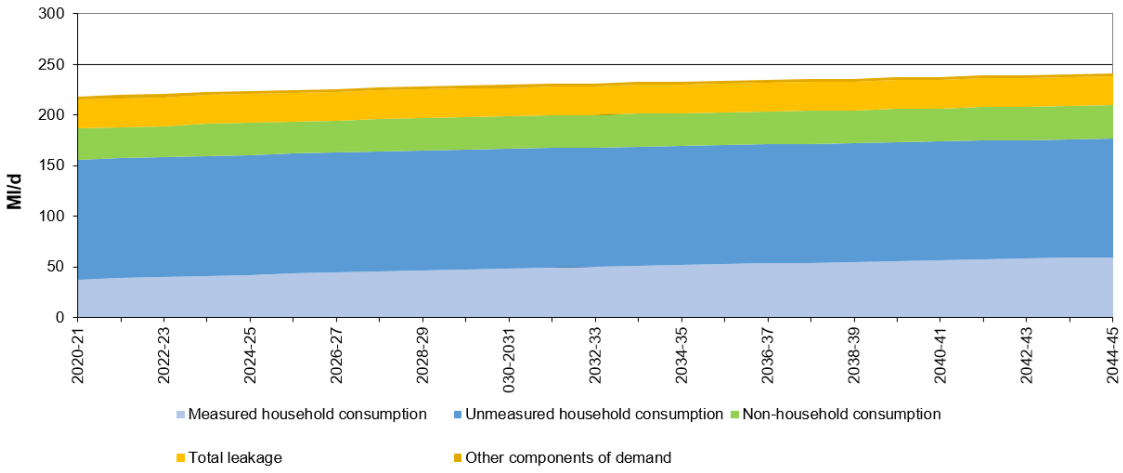

Figure 8 Baseline components of demand for the 1 in 200 year CP scenario

6 Baseline Supply/Demand Balance

6.1 Introduction

This section takes forward the information from previous sections which have determined how much water is available for supply and the demand for water. Headroom is now considered to give an indication of whether a company has sufficient resources to meet demand.

The baseline supply, demand and headroom information is then drawn together and presented as a series of baseline supply-demand balance graphs under different WRMP planning scenarios. These plot demand and demand plus target headroom against Water Available For Use (WAFU).

The sections below present the revised headroom assessment and the updated baseline supply-demand balance graphs for this Revised WRMP19.

6.2 Headroom Assessment

6.2.1 Introduction

In accordance with the WRPG and industry standard practice, the supply-demand balance includes a margin between supply and demand to allow for uncertainties inherent within the supply and demand forecasts. This margin is known as 'headroom'. The headroom value determined for each year across the planning horizon is termed the target headroom allowance. The aim of calculating a target headroom allowance is to provide a reasonable margin to cover the combined impact of factors leading to uncertainty on the supply-demand balance at a defined level of risk.

We have updated the target headroom allowance for this Revised WRMP19 to take into account the new baseline demand forecast and WRSE methodologies. This has been achieved using our new Python based headroom model.

6.2.2 Methodology

The industry standard method for the calculation of target headroom allowance has been followed. This is a probabilistic approach based on the 2002 UKWIR report and the guidance published by the Environment Agency. The Monte Carlo simulations were carried out using Python with 10,000 iterations. A high number of iterations were used to improve repeatability of results.

The standard methodology used for the Final WRMP19 includes 13 uncertainty factors. The factors used for this Revised WRMP19 are shown in Table 6, mirroring those applied within our draft WRMP24.

Factor	Name
S5	Gradual Pollution
S6	Accuracy of Supply-Side Data
S8	Impact of Climate Change on Deployable Output
S9	New Sources
D1	Accuracy of Sub-Component Demand Data
D2	Demand Forecast Variation
D3	Impact of Climate Change on Demand
D4	Demand Management Measures

Table 6 Key Uncertainty Factors for the Revised WRMP19

Note that we have not included uncertainty related to the sustainability of surface or groundwater licences (target headroom components S1 and S2 respectively) or the non-replacement of time-limited licences (target headroom component S3) for any of the target headroom profiles. We have also not included uncertainty related to bulk imports as there are no planned bulk imports in the Revised WRMP19 (target headroom component S4) or uncertainty related to gradual pollution (component S5). This is in line with the Final WRMP19 approach.

Component D2 (demand forecast variation) also includes an allowance for ongoing uncertainty arising from COVID-19 impacts while we continue to find out what the 'new normal' conditions are for household and non-household demands. The impacts have been quantified based on a 2021 Artesia study.

A probability distribution is assigned to each uncertainty factor to represent a range of possible outcomes. The probability distributions are then combined using the Monte Carlo python programme to produce an overall curve that relates to a particular level of risk.

The level of risk can be set for each Monte Carlo simulation. The Water Resources Planning Guideline states that companies should accept a higher level of risk in the future. There is an expectation that, through better planning, companies will reduce higher risks in the future.

6.2.3 Headroom Uncertainty Factors

6.2.3.1 S6 - Accuracy of supply side data

This applies the same rules used for the Final WRMP19, applied to new draft WRMP24 DOs. A normal distribution is assumed, and the factor is static for the planning horizon.

6.2.3.2 S8 - Uncertainty of impact of climate change on source yields

Over 100 distributions are fitted to the 20 WRSE climate 1:500 DO runs with the Environment Agency scaling factors applied. The best distribution is selected using the Kolmogorov–Smirnov test. The distributions are fitted separately for the AA and CP scenarios.

A log-gamma (A), Logistic (P) distribution is applied, and this headroom factor varies during the planning horizon.

6.2.3.3 S9 – Uncertain output from new resource developments (Havant Thicket Reservoir)

The DO for Havant Thicket has been revised since the Final WRMP19. Default WRSE option ranges for reservoir development are assumed i.e. +/- 5% with a triangular distribution. The scheme is implemented in 2029/30, hence there is no allowance prior to this year.

6.2.3.4 S9 – Uncertain output from new resource developments (Groundwater Schemes)

This component reflects the variation for the three AMP7 groundwater schemes in addition to the 'Maximising DO at Source J' scheme. The AA and CP DOs (revised) are sourced from the from the PRT Annual Review 2021. The +/- 5% triangular distribution is based on the standard WRSE ranges for Groundwater sources. All schemes are assumed to be delivered by 2024/25.

6.2.3.5 D1 Accuracy of sub-component data (MLE)

A 2% variation is assumed for accuracy of DI meters based on the annual MLE assumption. A 1 in 10 year DI is assumed, along with a triangular distribution and an assumption that this headroom factor remains static for the planning horizon.

6.2.3.6 D1 Accuracy of sub-component data (Uplift Uncertainty)

This component addresses uncertainty associated with uplifting the outturn DI to the 1:10 Distribution Input. The demand model assumed an uplift factor derived from the WRSE/WRc stochastic DI series. Two versions of the stochastic data were created, Series 1 and Series 2. The central case assumes Series 3. In addition to the stochastic series, there is also a DI series based on the historic record which has been de-trended to the base year, produced by

Portsmouth Water. The upper and lower bands of the model assumed the difference between the minimum of maximum values from either the WRc/WRSE stochastic DI (Series 2) or the rebased historic outturn data around the central case (stochastic Series 3). As there is no upside risk associated with the CP scenario, a Half Normal distribution is used as not to put too much weight on the most extreme value. The maximum value is set as Q95 of the normal distribution.

6.2.3.7 D2 Demand Forecast Variation (Growth Forecast)

This component reflects the uncertainty around the property and population forecast and resulting impact on DI. The central scenario used by WRSE is the 'BL_H_Plan', while the Min and Max (By 2100) scenarios are used as ranges around this plan. The central planning scenario is more extreme than the Max scenario up until 2035 when the Max (by 2100) starts to exceed the BL_H_Plan scenario. This leads to an unusual uncertainty profile which is not centred around zero.

All upside risk is capped at the BL_H_Plan, assuming a half normal distribution as not to put too much weight on the extreme downside (given the upside is excluded). The Q95 of the distribution is set to be the maximum value for the given year. The artificial capping of the profile would statistically overstate the actual expected risk but results in the smoothing of the headroom profile.

6.2.3.8 D2 Demand Forecast Variation (Non-Household consumption)

This component reflects the uncertainty around the Non-Household volume forecast as produced by Artesia for the draft WRMP24. The distributions are constant across the AA and CP scenarios.

6.2.3.9 D2 Demand Forecast Variation (Natural Water Efficiency)

This component reflects the uncertainty associated with hands-off water efficiency and customer behaviour. On the one hand, households are expected to become more efficient over time as older, less water efficient devices are replaced. On the other hand, we have seen a recent trend in increasing PCC likely driven by changes in customer behaviour.

In the central forecast, customer water use is assumed to be constant over the planning period – aside from those changes driven by changes in occupancy. For the Min/Max ranges, a +0.1 to -0.2 l/h/d (per year) delta is assumed. These changes are assumed to be driven by day to day usage rather than summer demands, therefore the assumptions for the AA scenario are also carried into the CP.

6.2.3.10 D2 Demand Forecast Variation (COVID-19 impact)

This component assumes uncertainty arising from COVID-19 impacts under 'new normal' conditions impacting household and non-household demands. The distribution upper bound impacts are derived from the Artesia_collaborative-impactof-COVID-19-on-consumption report for household and non-households and applied to Portsmouth Water volumes. Specifically, the estimated uplift ranges are assumed from Figures 41, 42, 57 and 58 of the Artesia report.

The bounds of the Household and Non-household are summed together to form a single input distribution to the headroom analysis. This effectively assumes the impacts are fully correlated, i.e. when non-household demands decrease, the household demands proportionally increase.

These factors are applied to the baseline demand forecast under the AA and CP conditions. This results in the Covid-19 impact varying over time and are proportional the Household and Non-household impacts in the given year. Note that the Household impact is in part mitigated by a reduction in Non-Household consumption.

6.2.3.11 *D3 - Impact of climate change on demand*

This component reflects the changes in demand as a result of climate change. The values are based factors for South East England, derived from a 2013 UKWIR study. The p10 and p90 values factors are used to produce the Min/Max ranges. These factors are rebased to the base year and extrapolated over the planning period. The factors vary according to the AA and CP scenario.

6.2.3.12 *D4 - Demand management measures*

This component reflects the changes in demand as a result of the delivery of the AMP7 water efficiency schemes. The component varies up until 2025/26 when the schemes are assumed to be delivered, and the profile remains flat.

6.2.4 Target Headroom Allowance

The WRPG states that companies should accept a higher level of risk further into the future because the uncertainties will reduce as time progresses and there is time to adapt to any changes. Table 7 presents the risk profile adopted. This is based on an initial level of risk of 10%, followed by 5% increments in each five-year period. Figure 9 shows the resulting headroom profile which has been used for the Revised WRMP19.

Period	Risk	Probability
2020/21–2024/25 (AMP7)	10%	90%
2025/26–2029/30 (AMP8)	10%	90%
2030/31–2034/35 (AMP9)	15%	85%
2035/36–2039/40 (AMP10)	20%	80%
2040/41–2044/45 (AMP11)	25%	75%

Table 7 Headroom Risk Profile

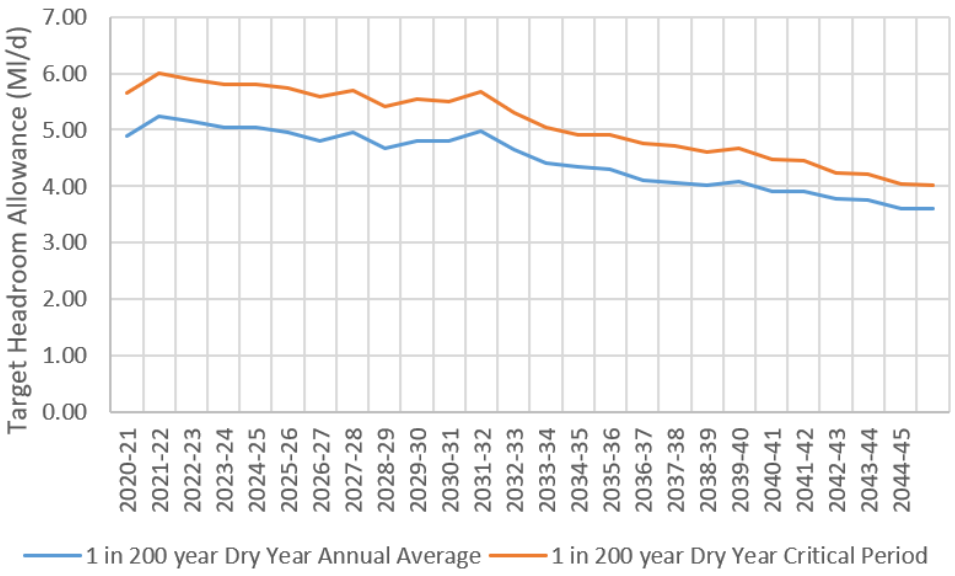

Figure 9 Headroom Profile for the Revised WRMP19

Table 8 compares the final headroom allowance for the Revised WRMP19 with that from our Final WRMP19; note the Revised WRMP19 allowance is the same as that within our Draft

WRMP24. It shows that our target headroom allowance has decreased relative to the Final WRMP19 following the update of demand side factors.

Submission	Combined Company Target Headroom Allowance (Ml/d)			
	Dry Year Annual Average		Dry Year Critical Period	
	2019/20	2024/25	2019/20	2024/25
Final WRMP19	5.3	5.6	7.1	7.7
Revised WRMP19	4.9	5.0	5.7	5.7

Table 8 Target Headroom Allowance – Comparison with Previous Results

6.3 Revised WRMP19 Baseline Supply Demand Balance

6.3.1 Introduction

The baseline supply demand balance provides a forecast of what would happen if we did not take any new supply or demand actions and did not implement any changes in company policy or existing operations.

The deficit in the baseline supply demand balance for the Final WRMP19 was reported as 27.9 Ml/d in 2019/20 increasing to 80 Ml/d by 2044/45 under the 1 in 200 annual average scenario, and 27.3 Ml/d in 2019/20 increasing to 84.6 Ml/d by 2044/45 under the 1 in 200 year critical period scenario. This indicated that options needed to be developed to meet both our customer requirements and bulk supply commitments to Southern Water. We followed an 'options appraisal' process to identify the options that should be implemented to eliminate the deficits. Further information on the options appraisal process is provided within our published Final WRMP19 Plan.

The baseline supply demand balance has been updated for this Revised WRMP19 and this is described further in the sections below. The balances and WRMP Tables have been prepared for both Annual Average and Peak Week Critical Period.

6.3.2 Design Drought Dry Year Annual Average: Baseline Supply–Demand Balance

This section presents the baseline supply-demand balance for the design drought (1 in 200 year period) under annual average conditions for the Revised WRMP19.

The baseline supply/demand balance is shown in the WRMP Table 4 (Excel spreadsheet) with deployable output information drawn from WRMP Table 2 and demand data from WRMP Table 3. The balance can be represented as five-year time steps as shown in Table 9 below. This shows the supply-demand balance as a comparison of Deployable Output and Distribution Input. Further explanation is provided below.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	178.0	181.4	185.8	188.5	191.7	194.7
Deployable Output	193.5	193.5	193.5	193.5	193.5	193.5
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.1	0.2	0.4	0.6	0.8	1.0
Outage	6.7	6.7	6.7	6.7	6.7	6.7
WAFU	184.3	184.2	184.0	183.8	183.6	183.4
Bulk Supplies	22.5*	39.0	60.0	60.0	60.0	60.0
Total WAFU	161.8	145.2	124.0	123.8	123.6	123.4
Target Headroom	4.9	5.0	4.8	4.3	3.9	3.6
Available Headroom	-16.2	-36.2	-61.8	-64.7	-68.1	-71.3
Supply Demand Balance	-21.0	-41.2	-66.6	-69.0	-72.0	-74.9

***** Bulk supplies increased to 30 Ml/d in 2020/21.

Table 9 Revised WRMP19 Baseline Supply Demand Balance – Design Drought Annual Average

As it is a 1 in 200 year scenario (severe drought), the DO is lower than in a normal or average year. This is because groundwater levels and river flows would be low and therefore the amount of water available for abstraction would be less. For the baseline balance, the annual average demand represents a 1 in 20 dry year condition because it is 'unconstrained'; the reduction as a result of demand restrictions in a 1 in 200 year event is considered in the final planning tables. This approach is in line with the regulator's Water Resources Planning Guideline.

In Table 9, there are reductions in DO as a result of climate change, outage and process losses. The resulting volume is termed 'Water Available For Use' (WAFU). After allowing for existing bulk supplies, and new bulk supplies, WAFU is compared with DI. This figure is called 'Available Headroom' and it can be compared to the 'Target Headroom' calculated in Section 6.2. If 'Available Headroom' is greater than 'Target Headroom', at any given time step, then there is a surplus.

Table 9 shows that under the baseline scenario, which includes the bulk supplies to Southern Water, the supply-demand balance is in deficit throughout the planning period and other options will be required to address this imbalance. This position is similar to that within the baseline supply demand balance for the Final WRMP19, although the deficit is up to 7 Ml/d smaller following the re-assessment of WRMP components.

The supply-demand balance can also be represented graphically. The graph in Figure 10 comes from the Revised WRMP19 Tables and includes a representation of the components of total demand (household and non-household consumption, leakage and other factors). The changes through the planning horizon are due to our baseline activities.

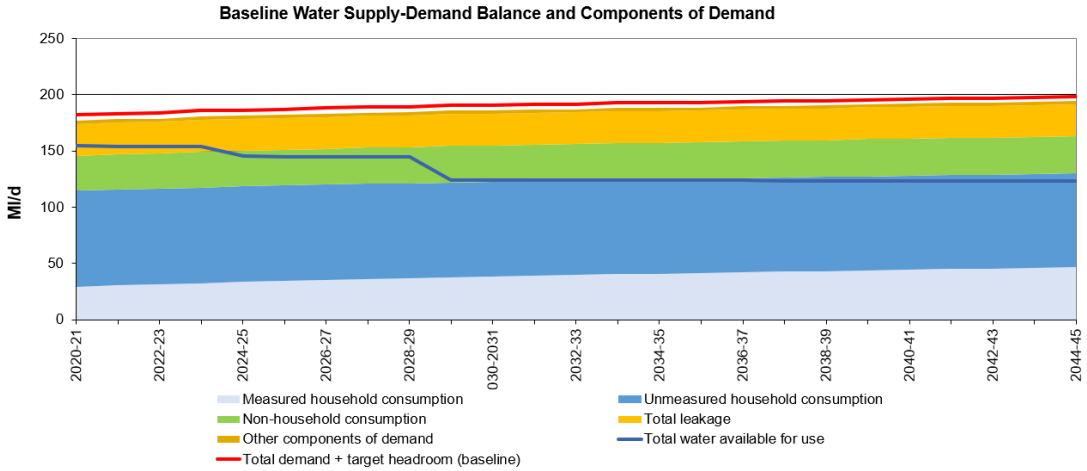

Figure 10 Baseline Supply Demand Graph - Design Drought Annual Average

In Figure 10, the red line represents demand plus target headroom and the blue line represents total water available for use (Total WAFU). The supply-demand balance can be determined through comparison of the red and blue lines.

In Figure 10, it can be seen that the blue line is significantly below the red line throughout, which shows there is a supply demand deficit. The deficit increases with time with the impact of climate change and as the volume of bulk supplies increase.

6.3.3 Design Drought Critical Period: Baseline Supply–Demand Balance

This section presents the Revised WRMP19 baseline supply-demand balance for the design drought (1 in 200 year period) for the critical period.

We have historically been a peak driven company due to the shape of the demand profile and the lack of raw water storage. The critical period has always been the peak week. The baseline supply-demand balance for the peak week is represented as five-year time steps in Table 10.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	218.8	223.8	229.5	233.3	237.6	241.6
Deployable Output	238.8	238.8	238.8	238.8	238.8	238.8
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.2	0.7	1.2	1.7	2.2	2.7
Outage	6.4	6.4	6.4	6.4	6.4	6.4
WAFU	229.8	229.3	228.8	228.3	227.8	227.3
Bulk Supplies	22.5*	39.0	60.0	60.0	60.0	60.0
Total WAFU	207.3	190.3	168.8	168.3	167.8	167.3
Target Headroom	5.7	5.7	5.5	4.9	4.5	4.0
Available Headroom	-11.5	-33.5	-60.7	-65.0	-69.8	-74.3
Supply Demand Balance	-17.2	-39.2	-66.2	-69.9	-74.3	-78.3

***** Bulk supplies increased to 30 Ml/d in 2020/21.

Table 10 Revised WRMP19 Baseline Supply Demand Balance – Design Drought Critical Period

In this scenario, the DI is higher as it is peak week. The deployable output is also higher as it reflects the DO during the peak summer demand period in a 1 in 200 year event. This is not the period when groundwater levels and river flows are at their lowest.

The critical period demand is 1 in 20 year and 'unconstrained'; the reduction as a result of demand restrictions in a 1 in 200 year event is considered in the final planning tables.

Table 10 indicates that under the baseline critical period scenario, which includes the bulk supplies to Southern Water, the supply-demand balance is in deficit throughout the planning period and other options will be required to address this imbalance. This position is similar to that within the baseline supply demand balance for the Final WRMP19, although the deficit is up to 10 Ml/d smaller following the re-assessment of WRMP components.

The supply-demand balance is represented graphically in Figure 11.

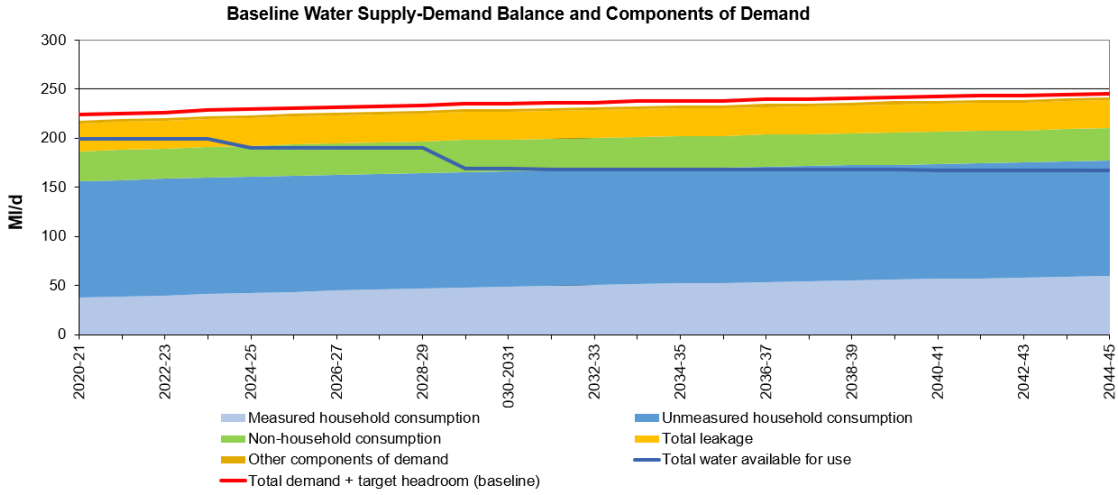

Figure 11 Revised WRMP19 Baseline Supply Demand Graph - Design Drought Critical Period

In Figure 11, the red line represents demand plus target headroom and the blue line represents total water available for use (Total WAFU).

It can be seen that the blue line is significantly below the red line throughout which shows there is a supply demand deficit. As with the annual average scenario, the deficit increases with time with the impact of climate change and as the volume of bulk supplies increase.

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7 Revisions to Options

7.1 Introduction

To determine how to meet the supply-demand balance, an options appraisal was undertaken for the Final WRMP19, in accordance with the Water Resource Planning Guidelines and the recommended best practice guidance. The least-cost plan was arrived at by identifying the projected supply-demand deficit after allowance for headroom, each year for 25 years ahead. The options that could be used to meet any deficits were then identified. The options were chosen considering those with the lowest Average Incremental Social Cost (AISCs) (least-cost) first. The least-cost plan was then assessed against a number of factors (such as Customer preferences), and from this, the preferred final plan was arrived at. Further details are provided within our published Final WRMP19.

The Final WRMP19 makes a major contribution to long-term resilient water resources in the South East by providing additional bulk supplies to Southern Water. It is planned that this will be enabled by a twin-track approach to reduce leakage and lower PCC, and the development of Havant Thicket Winter Storage Reservoir (HTWSR). The reservoir was selected by the Water Resources in the South East (WRSE) modelling as a solution to future potential water shortages in the region. We will be building the reservoir in close collaboration with Southern Water. We also believe that it is a significant step in achieving the Regulator's vision of a South East strategic Plan and resilient network for water resources in the South East as set out in their joint letter of 9th August 2018 "Building Resilient Water Supplies".

A new options appraisal has not been undertaken for this Revised WRMP19. However, the implementation year and benefit of the Final WRMP19 supply options has been updated following our feasibility studies in 2020-21 and Pywr modelling in 2021-22. The demand options have also been updated to reflect those included within the regional modelling for the WRSE Group for use in the regional plan and our WRMP24. The updates to these options are described further in the sections below.

7.2 Supply options

7.2.1 Final WRMP19 options

The supply options selected for our Final WRMP19 were as follows:

- RO21a: Source O – Maximising DO
- RO23a: Source H – Maximising DO
- RO24a: Source C – Maximising DO
- RO68: Source S – Drought Permit
- RO22a: Source J – Maximising DO
- RO13: Havant Thicket Winter Storage Reservoir

Progress on these options is outlined below.

7.2.2 Source O, H, C and J

DO resilience schemes were proposed at four of our groundwater sites in our Final WRMP19 with proposed solutions to target the following improvements:

- **Source O Water Treatment Works (WTW):** When groundwater levels drop below the adit level, turbidity issues have been experienced at this site. This scheme aimed to mitigate that impact and therefore provide an additional 1.8 Ml/d in a 1 in 20 year drought, increasing the total output in a 1 in 20 to 5.5 Ml/d. The 1.8 Ml/d applies to the drought conditions on a sliding scale where the target is an ADO of 4.6 Ml/d additional yield for a 1:200 year drought.

- **Source H WTW:** Turbidity issues have been experienced when running at higher flows. This scheme was to mitigate that impact and therefore provide an additional 2 Ml/d between 1 in 20 and 1 in 200 drought conditions.
- **Source C WTW:** Air and turbidity issues were experienced when running the larger borehole pumps; this scheme was to mitigate that impact and therefore provide an additional 4 Ml/d between 1 in 20 and 1 in 200 drought conditions.
- **Source J:** This scheme intended to provide resilience to supplies once the committed bulk transfer to Southern Water from Source A increases from 15 Ml/d to 24 Ml/d in 2024-25. The scheme had originally been intended as a straightforward increase in abstraction capability designed to allow the Source J source as a whole to increase output by 12.5 Ml/d, closer to its licensed limit of 22.73Ml/d under drought conditions. Currently the source Deployable Output is limited by the Deepest Advisable Pumped Water Level (DAPWL) in borehole 3, to around 8.5Ml/d under severe drought conditions.

In November 2020 we commenced our 'Deployable Output Recovery Scheme' project (AECOM, 2021). The objective of this was to determine the maximum 1 in 200 year deployable output from our Sources O, H and C, utilising the current assets and treatment processes ensuring regulatory and process compliance. The project was completed by AECOM in March 2021 giving us a clearer understanding of what each of the schemes would achieve in a 1 in 200 year drought event.

The estimated benefits for schemes at Sources, O, H, C and J had previously assumed there are no pipeline transfer constraints within our supply network. During autumn 2021 we were able to model the schemes within our Pywr model. This provides a more accurate estimate of scheme benefits by including a representation of our supply network. The results indicate that the combined benefit of the schemes under the DYAA scenario is 5.7 Ml/d in a 1 in 20 year drought event rising to 13.3 Ml/d in a 1 in 200 year event. The combined benefit of the schemes under the DYCP scenario is 4.4 Ml/d in a 1 in 20 year drought event rising to 10.5 Ml/d in a 1 in 200 year event. The DYCP scenario benefits are lower than originally anticipated because water from the schemes cannot be fully transferred to the parts of our Water Resource Zone where this water is most needed.

The Pywr modelled benefits are used within the Revised WRMP19 tables and they have also formed part of our upload to the regional modelling towards our draft WRMP24.

A summary of scheme progress is as follows:

<u>Source J:</u>

- We completed an initial desk study in May 2020, followed by further desk studies, groundwater modelling and a site visit between January and March 2021. Through this programme of work we have been able to demonstrate that there is no long term average risk to the Chalk aquifer, as the increased abstraction would only occur in severe drought.
- Six sites were targeted for investigation, although we only achieved landowner consent for investigation at three sites. We have also now completed the drilling and testing of three pilot boreholes (one at each site).
- Next steps are to:
  i. report the result of the drilling and testing investigations to the Environment Agency and Southern Water in January 2023;
  ii. confirm in February 2023 how the result should be reflected within the supply and demand balance of the Revised WRMP19 and Revised WRMP24; and
  iii. if appropriate, deliver production borehole drilling and testing, licensing and development of headworks/transfer infrastructure as required in 2023 and 2024.

Source H WTW:

- In the 2021 Annual Review Source H was considered to be a long term outage (water quality concerns) with a plan to bring the site back on line.
- Improvements have now been made to this source and abstraction re-commenced in 2022/23 i.e. the scheme has been completed.

Source C WTW:

- The current deployable output assessment for the site assumes that the site can achieve up to 22.5 Ml/d.
- A new pump has recently been installed in Borehole 1 and it is expected that following water quality testing, the source will be able to provide up to 25 Ml/d by March 2023.
- Next steps are to
    i. update the assessment of benefit (Ml/d) for this scheme in January 2023 using a newly developed Southern Water and Portsmouth Water Pywr model that contains an improved representation of the River Itchen; and
    ii. depending on the results of the modelling, decide whether to progress with the design and installation of filters at the treatment works to mitigate turbidity issues in 2024.

Source C WTW:

- Concerns have been raised because of land-use related water quality risks at this site (turbidity and cryptosporidium in particular). We have also identified this site as being high priority for Water Industry National Environment Programme (WINEP) investigation and options appraisal in AMP8 because of the new Environment Agency 'environmental destination' and 'licence capping' policies, and therefore the site is at higher risk of future sustainability reductions (i.e. reductions in the licensed amount that we can abstract).
- For these reasons we are currently considering an alternative scheme at Source L, which would form part of a wider planned WTW upgrade project. We believe this site is lower priority for WINEP investigation and option appraisal.
- Initial Pywr modelling has indicated that the scheme would provide at least as much Deployable Output as the Source O scheme.
- Next steps are to
    i. update the assessment of benefit (Ml/d) for Source L in January 2023 using the newly developed Southern Water and Portsmouth Water Pywr model;
    ii. depending on the results of the modelling, either incorporate 'drought resilience' aspects into the detailed design of Source L WTW (due April 2023), or begin investigations at Source O WTW in 2023; and
    iii. delivery of the scheme in 2024.

7.2.3 Source S

Source S is our drought permit source, which was estimated to provide 8.5 Ml/d benefit to the DYAA and DYCP scenarios in droughts equivalent to, or worse than, a 1 in 125 year event. The nature of the option remains unchanged from our Final WRMP19. However we have undertaken further work to demonstrate:

- that the source has operated at rates close to those required in the past.
- there is sufficient time to mobilise temporary treatment infrastructure as a drought develops.

- the environmental impact of the drought permit and the necessary monitoring and mitigation.

Furthermore we have used our Pywr model to check for constraints within our supply network. The results indicate that Source S permit may only provide a benefit of up to 4.5 Ml/d under the DYAA and DYCP scenario in droughts equivalent to, or worse than, a 1 in 125 year event.

This is because the water from the Source S permit cannot be fully transferred to the parts of our Water Resource Zone where this water is most needed. The Pywr modelled benefits are used within the Revised WRMP19 tables and the final supply demand balance.

We are working closely with Southern Water on the environmental monitoring to maximise opportunities for joint efficiencies with a source they operate nearby. We have also provided the reports and progress updates to the Environment Agency through our regular meetings.

Further information is available within our final 2022 Drought Plan.

7.2.4 Havant Thicket Winter Storage Reservoir

Havant Thicket Winter Storage Reservoir is a significant construction project being undertaken as a collaboration between Portsmouth Water and Southern Water. It will provide resilient water supplies to the region, supporting reduced abstraction on chalk rivers. The project has an overall biodiversity net gain and will offer a new community leisure facility for the area.

Planning permission for the reservoir has just been granted and the implementation date of this option has not been adjusted for the Revised WRMP19. However, since publication of the Final WRMP19, there is more clarity on the operational methodology of the completed reservoir and initial assumptions have been revised.

For our June 2021 Revised WRMP19 and based on a simple Pywr model that only contained Havant Thicket with an export to Southern Water, we estimated benefits of 21 Ml/d average and 25 Ml/d critical period up to the 1 in 200 year drought condition. The modelling update in autumn 2021 incorporates a representation of our wider supply network and therefore provides an improved understanding of Havant Thicket yield, which ranges from 16 Ml/d up to 21 Ml/d depending on the scenario and drought severity. The new Pywr model estimates a lower benefit than previously assumed.

The latest Pywr modelled benefits are used within the Revised WRMP19 tables and the final supply demand balance. We have also used our Pywr simulation model to identify a network upgrade option that unlocks further benefit from Havant Thicket. This option has now been included within the regional modelling that will inform our draft WRMP24, although it has not been included within our Revised WRMP19 tables.

To be able to fully explore the full range of conjunctive benefits provided by the reservoir, a project has commissioned earlier in 2022 to develop a single Pywr model that incorporates our network and Southern Water's Hampshire network. This model will be used to inform future June reports as well as both company's WRMP24 and the ongoing development of the Enhanced Havant Thicket Strategic Resource Option.

7.2.5 Temporary Use Bans and Non-Essential Use Bans

Our Drought Plan describes how we use Temporary Use Bans (TUBs) and Non-Essential Use Bans (NEUBs) to lower the demand for water and conserve supplies as a drought develops.

We have used the regional WRSE Pywr simulation model to identify the supply benefit of TUBs and NEUBs. Our Revised WRMP19 now includes this benefit as a supply side option in line with our levels of service.

7.3 Demand options

7.3.1 Final WRMP19 options

The demand options selected for our Final WRMP19 and to be implemented in 2020-21 were as follows:

- CO46: Household water efficiency programme (partnering approach, home visit)
- CO46b: Waterwise programme
- CO26: Subsidy to customers that purchase water efficient appliances (washing machines and dishwashers, showers and WCs)
- CO34: Water saving devices – Retrofitting existing toilets
- CO06a: Metering on change of occupancy – existing meter pits
- DO04a: Fixed network of permanent noise loggers connected to telemetry - Tranche 1
- CO84: Voids metering
- CO40: Water saving devices – spray taps
- CO43: Water saving devices – trigger nozzles for hoses
- CO05: Smart Meter MNFR Trial
- CO78: Voluntary restraint and leakage action
- CO79: Mandatory restraint
- CO80: Imposition of Drought Direction Restrictions (mandatory commercial restraint)

The demand options selected for implementation in 2025–26 were as follows:

- DO04b: Fixed network of permanent noise loggers connected to telemetry - Tranche 2
- CO06: Metering on Change of Occupancy – all properties

Our demand options have now been updated to reflect the new basket of options selected by WRSE towards its draft regional plan.

7.3.2 Revised WRMP19 options

Our demand management options in AMP7 and beyond have been updated in this Revised WRMP19 to reflect our current strategies, which are based on our WRMP19 starting point and best available information going forwards. The options are named as follows for this Revised WRMP19:

- Optants (metering)
- Change of occupancy (metering)
- Universal metering (after 2024-25)
- Household Water Efficiency Programme
- Non-Household (NHH) Water Efficiency
- Leakage reduction (AMP7)
- Leakage reduction (Long Term i.e. after 2024-25)

The benefit of the options is included within the final supply demand balance of this Revised WRMP19.

<u>Optants (metering) and change of occupancy (metering)</u>

Our current metering programme contains two elements; an optional metering element where unmeasured customers are encouraged to switch to a meter using promotional activities, and a change of occupier metering element where we install a meter at suitable properties when we are notified of an occupancy change.

Optant metering was included within the baseline forecast for Final WRMP19, although the change of occupancy metering is comparable with option CO06a in the Final WRMP19.

In the early years of the current plan period, these programmes were hampered by access restrictions arising from Covid and the need to adhere to social distancing rules to protect our customers. Over 2021–22 the number of metered properties on our network rose by 2,255. However, in 2022–23 a metering recovery programme has been initiated with a trajectory to install the 27,500 meters specified in WRMP19 by December 2024. Our recent progress can be seen in Figure 12.

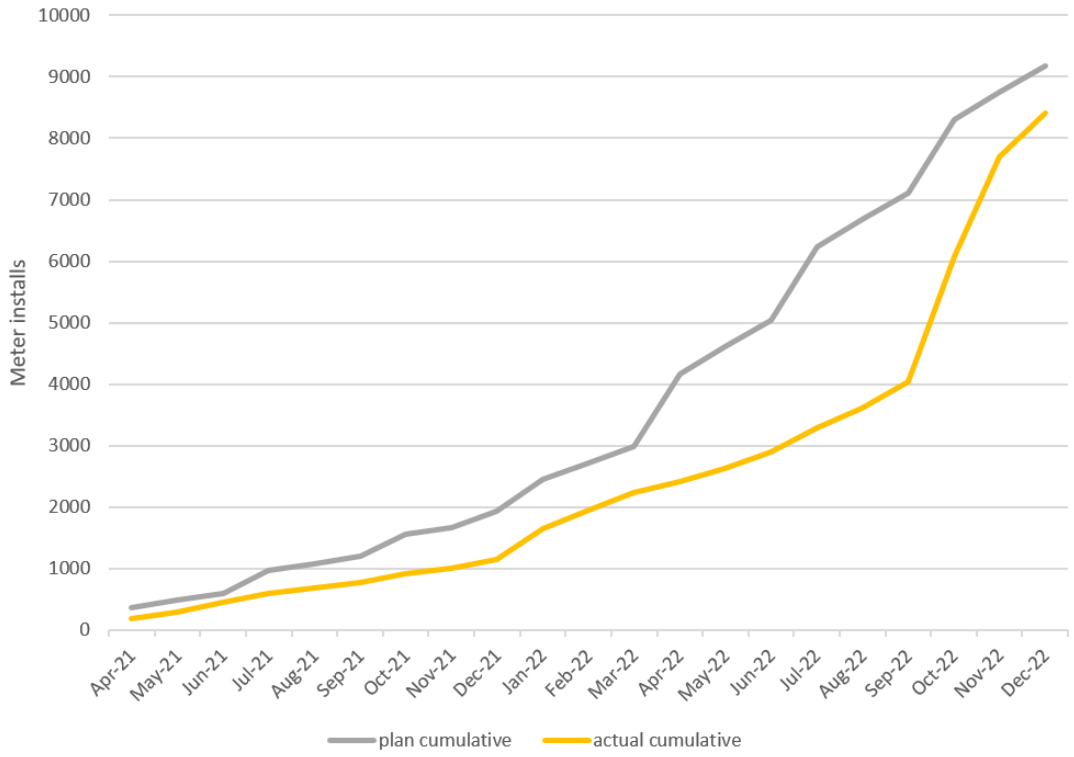

Figure 12 Meter installs during 2021-22 and 2022-23

Bearing in mind the effectiveness of metering in reducing PCC, we have taken legal advice and written to both the EA and the Secretary of State to request the authority to introduce universal metering before the adoption of the draft WRMP24 and gain PCC reduction benefits early. We are not confident we can overcome the barriers that currently prevent that course of action but will continue to explore the possibility.

Universal metering (after 2024-25)

Universal metering was not a feasible option for the Final WRMP19. In light of our new (2021) designation as an area of 'serious water stress', we are able to propose universal metering as a demand management option to allow us to manage the water balance.

Our WRSE investment model has indicated that universal metering is a cost efficient way of reducing demand and therefore we are proposing it as an option to be delivered in our Draft WRMP24.

Our plan is to install 206,000 smart domestic meters in the first 10 years of the planning period (in AMP8 and AMP9). This will be supported by a programme of communications and engagement to maximise water savings and support vulnerable customers to ensure water remains affordable for all.

Household and Non-household water efficiency

Our approach to water efficiency has been multi-faceted. Following a cost benefit review of the effectiveness of several interventions for our Draft WRMP24 we have selected a suite of activity we feel represents our most influential mix of activity, whist also providing value for our customers. The interventions we are making for our current Revised WRMP19 are described below:

- Intensified promotion of our GetWaterFit platform (www.getwaterfit.co.uk/#/): This is a mobile friendly platform run by Save Water Save Money where customers can complete a survey on their household usage, order free water saving devices and complete daily challenges to reduce consumption. The platform provides: (i) Customers free access to water saving devices, tailored to their needs. (ii) Gamification of personal and household water efficiency challenges. (iii) Incentivisation through community support initiatives. Across the past year we have had 3,727 new customers sign up for the GetWaterFit scheme. Of these 3,727 customers, 657 (17 per cent) took part in water efficiency challenges, resulting in savings of around 989 litres per day in total. This equates to around 1.5 l/h/d. Early indications suggest that if all our domestic customers were to sign up to this scheme, we could reduce demand by as much as 1.1 Ml/d. Our aim is to get 10,000 customers signed up to the Get Water Fit service by March 2023. Across 2022–23 we are planning to increase customer engagement through our water efficiency schemes. With the assistance of Advizzo we are set to launch a scheme for 20,000 of our customers who live in metered properties. This involves the development of an accessible platform which gives customers insights into their water consumption as well as sharing advice as to where they can change behaviours to reduce usage.
- General broadcast messages: We are looking to engage with more of our customers about water efficiency through re-designing and increasing customer engagement activity, both seasonally and in line with national campaigns. We will widen the number of channels previously used including: (i) Banners and merchandise at our community events. (ii) Scheduled posts on our social media pages. (iii) Advertorials in local publications, (iv) Increased use of video / dynamic content online.
- Tailored communications: High consumption alerts: We are engaging directly with customers who have increased their water use between billing cycles. We are proactively contacting any currently metered customers who have exhibited a rise in historical consumption of over 10 per cent. We will offer water efficiency advice, promote the free gadgets available through GetWaterFit and our leak detection customer support package.
- Customer engagement portal: We are working with a specialist consultancy, Advizzo, who design customer engagement solutions for water and energy companies, to sign some customers up to a water usage dashboard designed to motivate water efficiency behaviours.
- Leakbot: Household water use / leakage detector (https://leakbot.io/): We are giving away 1000 ‘Leakbots’ to our high consuming customers using above average volumes of water. We expect the use of such a device to provide insight to the customer allowing them to possible adjust their water use habits and provide assurance against household leakage being a factor in their high levels of consumption.
- Non-household: Site assessments are also planned for all education establishments and will also be available virtually for small businesses. An online engagement platform will also be available to all businesses and site leak detection will be offered to the highest 10% of non-household water users (assessed by volume).

Leakage

In line with national aspirations, we aim to deliver a 50 per cent reduction of leakage by 2050, measured against a base year level in 2017–18, and then an additional two per cent each subsequent 5-year AMP period following 2050. These ambitious leakage targets have been adopted by all water companies in the region. We have undertaken leakage modelling to identify how we could achieve these reductions in the most cost efficient and optimal way.

We believe we would be able to achieve this through existing technologies, although at increased cost compared to current spend on leakage. This is because as leakage levels reduce the cost of further reducing leakage increases as the remaining leaks are harder to find. Progressively as overall leakage reduces, each leak is more resource intensive to find, and once fixed, saves a smaller volume of water.

We, and the water industry, are committed to finding more cost-effective ways to reduce leakage and are continuingly reviewing and implementing innovative technologies, to reduce the costs of reducing leakage.

We are also heavily involved in the development of the WaterUk leakage road map, working with and the rest of the industry to identify the key leakage interventions and to widely share best practice.

Since missing our target in 2017-18, our leakage recovery plan has reduced leakage from 33.38 Ml/d down to 26.93 Ml/d through improved efficiencies and additional expenditure. We are fully committed to continuing to reduce leakage, and will do so by:

- Expanding our network of acoustic monitors;
- Continuing our innovative work on micro-pressure logging and AI software; and,
- Continuing to enhance our ability to run a calm network through the creation of a company-wide Digital Twin network model.

7.3.3 Impact of Revised Options on the Revised WRMP19

Our published Final WRMP19 Preferred Plan included the preferred combination of feasible options which balanced supply and demand throughout our supply area from 2020/21 to 2044/45. We arrived at this preferred programme through consideration of our priorities, government policy priorities, and the perceived priorities of its customers.

The adjustments to the supply and demand options outlined in the sections above have resulted in a change to our final supply demand balance. The revised balance is described in the next section.

8 Revised Planning Supply-Demand Balance

8.1 Revised Plan

Our preferred Final WRMP19 plan contained options that we considered at the time most appropriate to deliver over the twenty-five year planning period to maintain the balance between water supply and demand.

We based our Final WRMP19 planning on a 1 in 200 year drought event. This is more appropriate than the worst historic drought on record which is not considered severe enough for Water Resources Planning. However we considered different return periods and calculated the supply-demand balance of each.

The new Revised WRMP19 analysis has confirmed that the 1 in 200 year event represents the most challenging scenario. The revised analysis indicates that the options originally selected for the Final WRMP19 preferred plan are still required under a range of drought conditions, but that the benefits of those options might not be the same as they were understood to be at the time.

Table 11 sets out the options within our preferred Final WRMP19 Plan and their planned start dates along with updates for the Revised WRMP19.

Option code	Preferred Final Plan Option name	AMP7 (2020/21-2024/25)	AMP8 (2025/26-2029/30)	Revised WRMP 2019 adjustment
CO46	Household water efficiency programme (partnering approach, home visit)	2020–21		New basket of demand side options and benefits to reflect latest WRSE Group related work streams. Including; • Revised water efficiency programme • Virtual home visits • Change of Occupier metering • Further fixed network noise loggers to reduce leakage • The targeted provision of water saving devices
CO46b	Waterwise programme	2020–21		
CO26	Subsidy to customers that purchase water efficient appliances (washing machines and dishwashers, showers and WCs)	2020–21		
CO34	Water saving devices – Retrofitting existing toilets	2020–21		
CO06a	Metering on change of occupancy – existing meter pits	2020–21		
DO04a	Fixed network of permanent noise loggers connected to telemetry - Tranche 1	2020–21		
CO40	Water saving devices – spray taps	2020–21		
CO84	Voids metering	2020–21		
CO78	Voluntary restraint and leakage action	2020–21		
CO79	Mandatory restraint	2020–21		New view on the effectiveness of mandatory restraint from Pywr modelling
CO80	Imposition of Drought Direction Restrictions (mandatory commercial restraint)	2020–21		
RO68	Source S – Drought Permit	2020–21		Completed analysis and environmental reports. Revised yield benefit following Pywr modelling.
RO21a	Source O – Maximising DO	2020–21		Delivery now expected to be 2024-25 with a revised yield benefit following a feasibility review and Pywr modelling.
RO23a	Source H – Maximising DO	2020–21		Delivered and in place for 2022-23.
RO24a	Source C – Maximising DO	2020–21		Delivery now expected to be 2024-25 with a revised yield benefit following feasibility review and Pywr modelling.
RO22a	Source J – Maximising DO	2024–25		Updated assumptions regarding yield benefit and operation following a feasibility review and Pywr modelling. No change to implementation date.
DO04b	Fixed network of permanent noise loggers connected to telemetry - Tranche 2		2025–26	New basket of demand side options and benefits to reflect latest WRSE Group related work streams. This includes universal metering from 2025-26.
CO06	Metering on Change of Occupancy - all properties		2025–26	
RO13	Havant Thicket Winter Storage Reservoir		2029–30	Revised DO based on updated designs and further Pywr modelling

Table 11 Preferred Final and Revised Planning Programme

8.2 Revised Final Planning Supply-Demand Balance

The revised final supply-demand balance including the influence of the preferred options is presented in the following sub-sections for the DYAA and DYCP scenarios respectively.

8.2.1 Dry Year Annual Average: Revised Final Planning Supply-Demand Balance

Table 12 presents the Revised WRMP19 final planning supply-demand balance for the 1 in 200 year design drought under dry year annual average conditions. It is represented as five-yearly time steps.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input (final)	178.0	173.5	168.4	161.4	158.9	159.4
Demand Management	0.0	7.9	17.3	27.1	32.9	35.3
Deployable Output (baseline)	193.5	193.5	193.5	193.5	193.5	193.5
Resource Schemes	20.2	33.5	54.6	54.6	54.6	54.6
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.1	0.2	0.4	0.6	0.8	1.0
Outage	6.7	6.7	6.7	6.7	6.7	6.7
WAFU	204.5	217.7	238.6	238.4	238.2	238.0
Bulk Supplies	22.5	39.0	60.0	60.0	60.0	60.0
Total WAFU	182.0	178.7	178.6	178.4	178.2	178.0
Target Headroom	4.9	5.0	4.8	4.3	3.9	3.6
Available Headroom	4.1	5.2	10.1	17.0	19.4	18.7
Supply Demand Balance	**-0.8**	**0.2**	**5.3**	**12.7**	**15.4**	**15.1**

Table 12 Revised WRMP19 Final Planning Supply-Demand Balance – Dry Year Annual Average

Table 12 shows that the balance under the revised plan is such that we were no longer meeting our target headroom in the 1 in 200 year annual average scenario for 2019/20; the shortfall is -4.3 Ml/d in 2022-23, -4.8 Ml/d in 2023-24, before returning to a surplus of 0.2 Ml/d in 2024-25. The shortfall is largely a result of higher than anticipated outturn PCC in combination with the reduced benefit and delayed delivery of the AMP7 DO recovery schemes. It means there is a slightly higher risk we'd need to introduce emergency restrictions in a very severe drought.

The supply-demand balance for the 1 in 200 year scenario is represented graphically in Figure 13. As with the baseline supply-demand balance graph (Figure 10), the graph includes a representation of the components of total demand.

It can be seen from Figure 13 that the reduction over time in total demand plus target headroom is largely a result of reducing household consumption. This is owing to optant and change of occupier metering in AMP7, and then primarily universal metering from 2025-26, resulting in a large proportion of our customer base switching from higher unmeasured to lower measured consumption patterns and the implementation of water efficiency schemes.

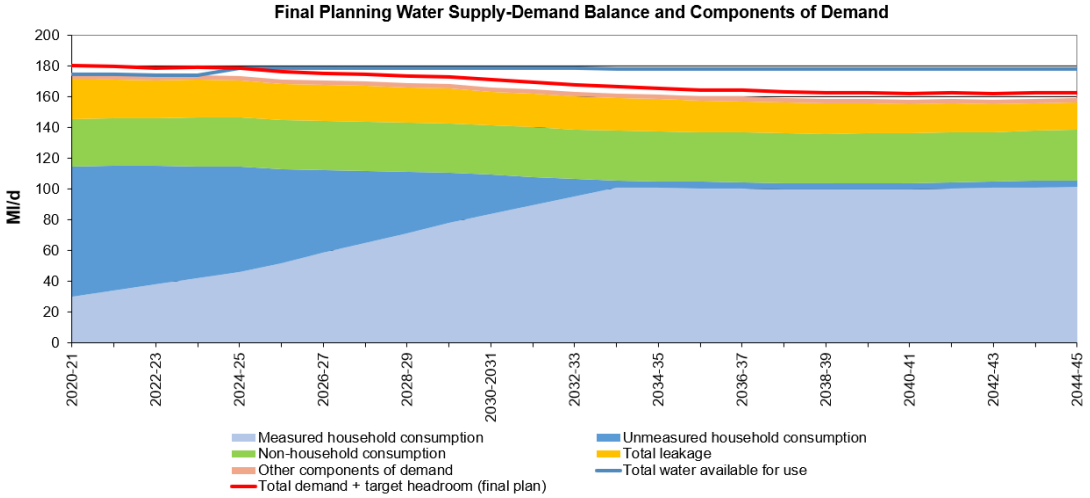

Figure 13 Revised Final Planning Supply-Demand Balance Graph - Annual Average

8.2.2 Dry Year Critical Period: Revised Final Planning Supply-Demand Balance

Table 13 presents the Revised WRMP19 final planning supply-demand balance for the 1 in 200 year design drought under dry year critical period (peak week) conditions. It is represented as five-yearly time steps. The supply-demand balance is represented graphically in Figure 14.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input (final)	218.8	214.6	208.7	201.2	199.5	201.1
Demand Management	0	9.1	20.8	32.1	38.1	40.5
Deployable Output (baseline)	238.8	238.8	238.8	238.8	238.8	238.8
Resource Schemes	26.0	36.5	57.8	57.8	57.8	57.8
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.2	0.7	1.2	1.7	2.2	2.7
Outage	6.4	6.4	6.4	6.4	6.4	6.4
WAFU	255.8	265.8	286.6	286.1	285.6	285.1
Bulk Supplies	22.5	39.0	60.0	60.0	60.0	60.0
Total WAFU	233.3	226.8	226.6	226.1	225.6	225.1
Target Headroom	5.7	5.7	5.5	4.9	4.5	4.0
Available Headroom	14.5	12.2	17.9	24.9	26.1	24.0
Supply Demand Balance	**8.8**	**6.5**	**12.4**	**20.0**	**21.6**	**20.0**

Table 13 Revised WRMP19 Planning Supply Demand Balance – Dry Year Critical Period

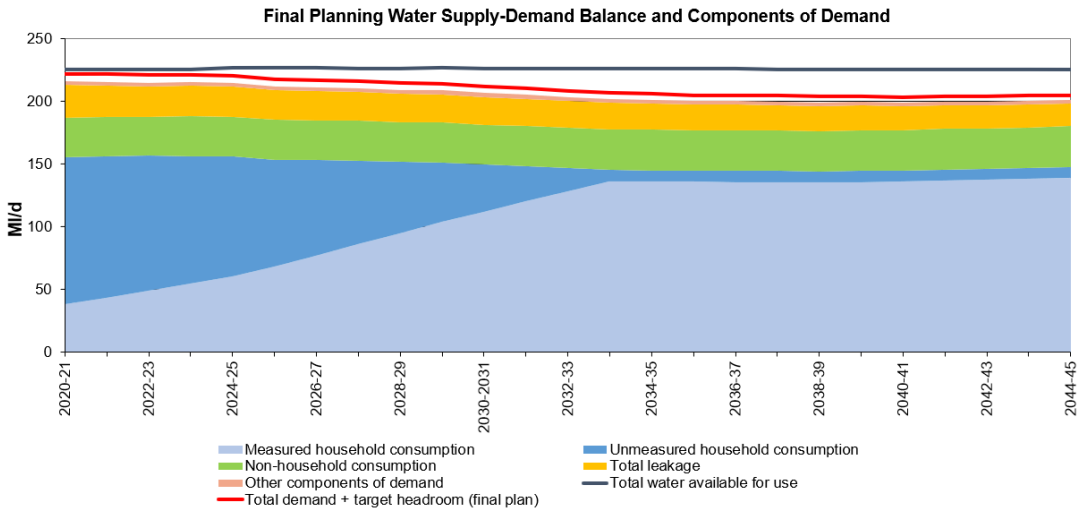

Figure 14 Revised Planning Supply-Demand Balance Graph - Critical Period

Figure 14 shows similar trends to those observed under the annual average scenario. Demand reduces over the planning period primarily due to falling household consumption, attributable to metering and water efficiency options. However, unlike the annual average scenario, there is a surplus of water across the whole planning horizon.

8.3 Mitigation and Monitoring Measures

8.3.1 Introduction

We would like to take this opportunity to reassure our customers, regulators and stakeholders that we are doing everything within our capabilities to safeguard the service to our customers and the regional supplies to Southern Water.

We have been exploring mitigation measures and monitoring with the Environment Agency and Southern Water to address the residual risk within our 1 in 200 year scenario. These are outlined below.

8.3.2 Pywr modelling of AMP7 schemes

We continue to undertake further work to understand and optimise the benefit of our AMP7 schemes through Pywr modelling. Pywr allows us to explore the DO benefits at a network and water resource zone level to determine whether we can readily increase the DO benefits, and where in the network this would be most beneficial.

This workstream has already led to the identification of a new network option (a booster pumping station upgrade) to 'unlock' deployable output associated with Havant Thicket reservoir. The option has been selected as part of the preferred programme for our draft WRMP24.

As described in Section 7.2.2 we have also used our Pywr model to test a potential alternative to the Source O AMP7 scheme. Initial modelling has indicated that an upgrade to Source L would provide at least as much Deployable Output as the Source O scheme (and potentially more).

Next steps involve reconfirming the AMP7 scheme benefits within a newly developed Southern Water and Portsmouth Water joint Pywr model, which contains an improved representation of the River Itchen compared to our single water resource zone Pywr model. These model runs

are planned to take place in January 2023 so that the results can be reflected in the supply and demand balance of the Revised WRMP19 and Revised WRMP24. The results will also help decision making around the prioritisation of AMP7 schemes.

8.3.3 Enhanced monitoring of the drought condition

This Revised WRMP19 has demonstrated that we may be slightly more vulnerable to a severe drought than previously understood. In order to better understand the risk this posed to our customers, we undertook analysis using the new stochastic groundwater level datasets, developed through WRSE for the regional model. We used these, along with the knowledge that observed groundwater levels were 14.5 maOD in early September 2022, to understand the potential for severe droughts in the near future.

Our analysis was based on 919 sequences of stochastic groundwaters that start at 14.5 maOD in early September. It demonstrated that there was a 1 in 20 chance or 5% risk that groundwater levels could be equivalent to those in our worst historic 1970s droughts by early 2023 (see the yellow line on Figure 15). The red line on Figure 15 demonstrates an extreme scenario where there is no winter recharge, with a 1 in 200 chance or a 0.5% risk of occurring.

New observed data has now been added to Figure 15, which indicates that groundwater levels are tracking between the 'wet' and 'median – most likely' scenarios. We are in a better position than previously expected due to significant rainfall and aquifer recharge in November 2022.

The risk of a severe 1 in 200 year drought event developing over the next two years is currently low. Despite this, we will continue to monitor groundwater levels to understand the risks to our supply demand balance and provide updates to our environmental regulator should the risk increase.

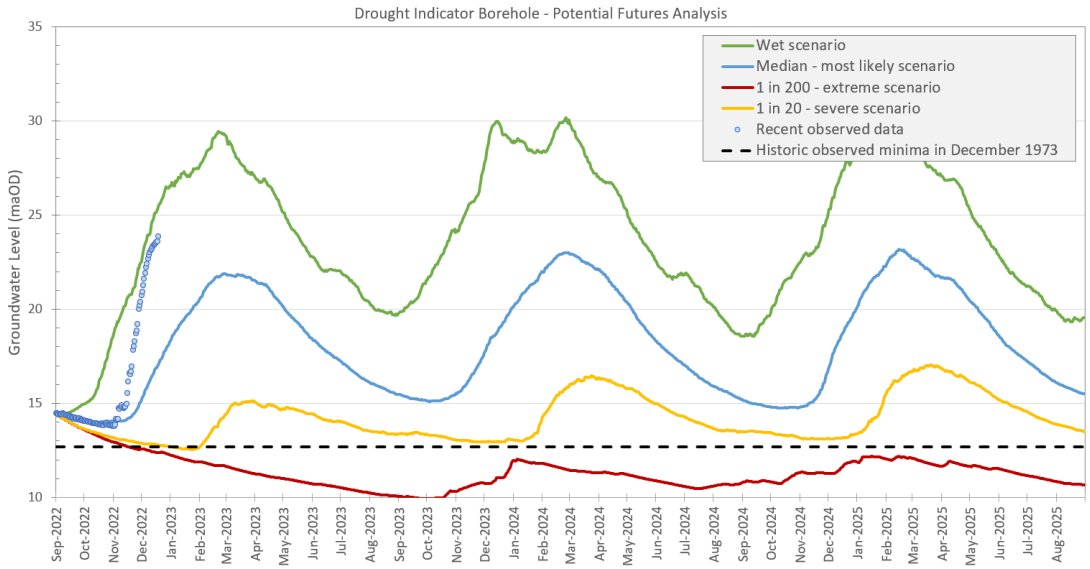

Figure 15 Analysis on the potential for a drought in the near future

8.3.4 Enhanced demand management (PCC recovery action plan)

Currently our customer PCC is higher than the projections we made in the Final WRMP19 and above the levels set in our regulatory performance commitment. In part this is due to the impact Covid-19 has had on consumption patterns over the last 2 years but is also a result of slow starts to a number of our planned initiatives.

Both the WRMP and our Ofwat target require us to reduce PCC by 5% in the course if this AMP, with the WRMP requiring us to continue to make savings into the future beyond that. The interventions and initiatives we are undertaking to influence PCC and recover our

performance in line with regulatory commitments and the WRMP are largely described in Section 7.3.2.

In addition to these, we will conclude our 'Club50' smart metering project that is retrofitting "jellyfish" smart devices onto standard household meters making them smart. The project is designed to intensively engage with a small number of customers to test the effectiveness of different messaging and interactions in changing behaviours.

For the project a number of customers have signed up to the challenge through the Get Water Fit website and have taken advantage of initiatives such as daily water efficiency challenges, free water efficiency devices and advice and support from a water saving expert.

Participants also receive monthly updates from us which will tell them how much they have used month on month as well as any potential savings. We include water saving tips and important motivational messages focusing on benefits to water efficiency that relate to environment, financial savings and social responsibility.

We are working with our customers on the trial to learn which messages drive are most impactful and drive the most change. Each customer will take part in 6 monthly surveys which will help us to review the success of the trial.

A summary of our PCC recovery strategy is shown in Figure 16. These actions serve as mitigation measures for the near-term short falls in target headroom within our Revised WRMP19.

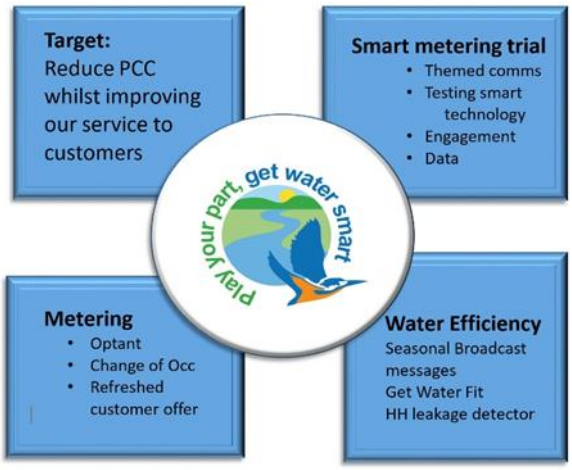

Figure 16 Summary of our PCC recovery strategy

The most effective intervention we can make to influence PCC is the delivery of meters. In the Final WRMP19 we planned to deliver 27,500 meters across the 5 years of the plan, through Optant and Change of Occupier metering initiatives.

In the early years of the current plan period, these programmes were hampered by access restrictions arising from Covid and the need to adhere to social distancing rules to protect our customers. Over 2021-22 the number of metered properties on our network rose by 2,255. However, in 2022-23 a metering recovery programme has been initiated with a trajectory to install the 27,500 meters specified in WRMP19 by December 2024. We will continue with our Optant programme after that point, delivering more meters than in our plan, but we anticipate the focus of 2024-25 to be testing and gearing up for our planned universal metering programme introduced in our draft WRMP24. Our recent progress can be seen in Figure 12.

Bearing in mind the effectiveness of metering, we have taken legal advice and written to both the EA and the Secretary of State to request the authority to introduce universal metering before the adoption of the draft WRMP24 and gain PCC reduction benefits early. We are not

confident we can overcome the barriers that currently prevent that course of action but will continue to explore the possibility.

8.3.5 Explore access to additional supplies of water

We have reviewed the capability of our groundwater sources and improved our understanding of whether they could produce more water through the removal of constraints on abstraction.

We sought the Environment Agency's views on several alternative proposals to ensure that we considered all available options. For example, the transfer of licensed quantities or the implementation of additional drought permits. Our latest Pywr modelling has now demonstrated that the options are unlikely to significantly improve the supply demand balance. This is because there are no options that would help the 'pinch points' within our supply area due to network constraints.

We plan to continue our discussions with the Environment Agency and reconsider this type of mitigation option if new information arises. Should this type of mitigation measure progress, it will need to be tested within the Environment Agency's regional groundwater model to understand the environmental impacts.

8.3.6 Explore the potential to accelerate funding for AMP8 metering proposals

We are currently working with our financial regulator, Ofwat, to explore the potential for accelerated funding of metering programmes. The accelerated funding will help us to install a greater number of meters in AMP7 and ensure we are ready for a rapid roll out of smart metering in AMP8.

8.4 Conclusions and Next steps

Planning for a 1 in 200 year drought event provides future resilience and, as we have committed to providing a bulk supply to Southern Water with water available up to a 1 in 200 year event, it is appropriate to undertake planning based on this event.

The balance under the Revised WRMP19 is such that we were no longer meeting our target headroom in the 1 in 200 year event (annual average scenario) for 2019/20; the shortfall is -4.3 Ml/d in 2022-23, -4.8 Ml/d in 2023-24, before returning to a surplus of 0.2 Ml/d in 2024-25. The shortfall is largely a result of higher than anticipated outturn PCC in combination with the reduced benefit and delayed delivery of the AMP7 DO recovery schemes. It means there is a slightly higher risk we would need to introduce emergency restrictions in a very severe drought.

Whilst the risk of a 1 in 200 year event occurring within the next few years is relatively low as they take multiple dry winters to evolve to such a severity, we are continuing to explore a range of mitigation measures with the Environment Agency and Southern Water to maintain our supply demand balance.

In addition to implementing our PCC recovery plan, we will investigate the following mitigation options over the coming months:

- Acceleration of the metering programme, including preparations for universal smart metering.
- Moving one of our AMP7 supply schemes to a new location to provide additional water.

Our Draft WRMP24 will be updated in 2023 and this is expected to lead to revisions in methodologies and data (e.g. new base year for the baseline demand forecast). Therefore, we will review the need to update this Revised WRMP19 with our regulators in early May 2023.

In addition to mitigating the AMP7 situation, these activities will ensure that our statutory WRMP24 is robust and has a realistic starting point as we look forward into AMP8.

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