

**Portsmouth
Water**



**REVISED
WATER RESOURCES
MANAGEMENT PLAN 2019**

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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
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 Ordnance Datum
	MDO	Minimum deployable output
	MI/d	Megalitres per day

	Term	Meaning
N	NEUB	Non-Essential Use Ban
	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
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. On average, we distribute around 170 million litres of water each day to over 725,000 customers in nearly 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 (SWS). 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). We will be building the reservoir in close collaboration with SWS.

1.2 Revised WRMP19

As part of the WRMP process, it is a statutory requirement to 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 Review 2020 highlighted that we had not reached certain WRMP19 targets (PCC), but that we over performed significantly on other WRMP19 targets (leakage). In addition to this, our proposed AMP7 supply schemes have been undergoing environmental assessments and further analysis which has meant some delays to the implementation of these schemes.

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 as a result. 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 makes use of our most recent data and knowledge. It uses our new forecasts which have recently been developed following WRSE agreed process and reflecting industry best practice, 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.

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 scenarios from dry year 1 in 20, up to a 1 in 200 year drought event, and are also in the process of developing the 1 in 2, and the 1 in 500 year scenarios.

The levels of service and the supply options selected for the Final WRMP19 are the same as those within this Revised WRMP19, although the detail of the AMP7 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 will also be implemented in the development of our draft WRMP24.

We have continued to engage with the Environment Agency and Southern Water for this Revised WRMP19. In particular, meetings were held in May and June 2021 to review the emerging revised supply and demand balance data and to discuss mitigation measures.

Our engagement with stakeholders will continue and broaden as we move towards the pre-consultation and consultation stages of our draft WRMP24.

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 DO assessment, along with the assessment of climate change impacts and treatment process losses, has been retained for this Revised WRMP19.

The bulk supply 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 MI/d)
- Southern Water – Hampshire Southampton East (15 MI/d)

The future bulk supplies agreed with Southern Water are as follows:

- Southern Water – Hampshire Southampton East (additional 9 MI/d from 2024/25)
- Southern Water – Hampshire Southampton East (additional 21 MI/d from 2029/30)

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 towards its Regional Resilience Plan. The updated outage values have been used for this Revised WRMP19 and they are the only change from the Final WRMP19 with respect to Baseline Supply. Work on other supply components is still in progress and data for these will be updated as necessary for our WRMP24.

1.5 **Baseline Demand**

1.5.1 **Final WRMP19**

Since 2018/19 we have been seeking to attract more customers onto a meter by undertaking a trial of smart meters. The smart meters initially provide customers with more information using a dual-billing style approach referred to as 'Metering not for revenue'. We offered comparative bills and water efficiency advice to encourage our customers to switch to a meter.

In addition to existing baseline metering and the trial of smart metering described above, we considered other metering options for our Final WRMP19. These options were considered within the options appraisal process described in our published Final WRMP19, which is available on our website.

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 7.1MI/d, reducing leakage from 35 MI/d down to 27.90 MI/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

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 resilience plan. We have followed the most recent methodologies and used the latest data. 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.

1.6 Baseline Supply-Demand Balance

The Final WRMP19 deficit was reported as 27.9 MI/d in 2019/20 increasing to 80 MI/d by 2044/45 under the 1 in 200 year annual average scenario, and 27.3 MI/d in 2019/20 increasing to 84.6 MI/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 baseline supply-demand balance also shows a deficit at both annual average and critical period throughout the planning period. The deficit was 26.68 MI/d in 2019/20 increasing to 78.91 MI/d by 2044/45 under the 1 in 200 year annual average scenario, and 36.6 MI/d in 2019/20 increasing to 98 MI/d by 2044/45 under the 1 in 200 year critical period scenario. The deficit for the Revised WRMP19 critical period scenario is greater than for the Final WRMP19 as a result of our higher outturn demand and updated approach to deriving the baseline demand forecast.

1.7 Final Supply-Demand Balance

Our preferred Final WRMP19 plan contained options that we considered most appropriate to adopt 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 and the 1 in 80 year events represent the most challenging scenarios. The revised analysis indicates that the options selected under the Final WRMP19 preferred plan are still required under a range of drought conditions.

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		<p>New basket of demand side options and benefits to reflect latest WRSE Group related work streams. Including;</p> <ul style="list-style-type: none"> • 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		
CO80	Imposition of Drought Direction Restrictions (mandatory commercial restraint)	2020–21		
RO68	Source S – Drought Permit	2020–21		No change but with completed analysis and environmental reports.
RO21a	Source O – Maximising DO	2020–21		Delivery now expected to be 2023-24 with a revised yield benefit following a feasibility review.
RO23a	Source H – Maximising DO	2020–21		Delivery now expected to be 2023-24 with a revised yield benefit following a feasibility review.
RO24a	Source C – Maximising DO	2020–21		Delivery now expected to be phased over 2023-24 and 2024-25 with a revised yield benefit following feasibility review.
RO22a	Source J – Maximising DO	2024–25		Updated assumptions regarding yield benefit and operation following a feasibility review. No change to implementation date.
DO04b	Fixed network of permanent noise loggers connected to telemetry - Tranche 2		2025–26	<p>New basket of demand side options and benefits to reflect latest WRSE Group related work streams.</p>
CO06	Metering on Change of Occupancy - all properties		2025–26	
RO13	Havant Thicket Winter Storage Reservoir		2029–30	Revised DO based on updated designs

Table 1 Preferred Final and Revised Planning Programme

The revised 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 we are no longer meeting our target headroom in the 1 in 200 year annual average scenario (between now and 2032-33) or the 1 in 200 year critical period scenario (between now and 2023-24). This reflects a delay in implementing our supply side options and also revisions to the baseline demand forecast to reflect outturn values and new WRSE methodologies. The level of risk in the supply demand balance for the 1 in 80 year scenarios is similar to the 1 in 200 year scenarios.

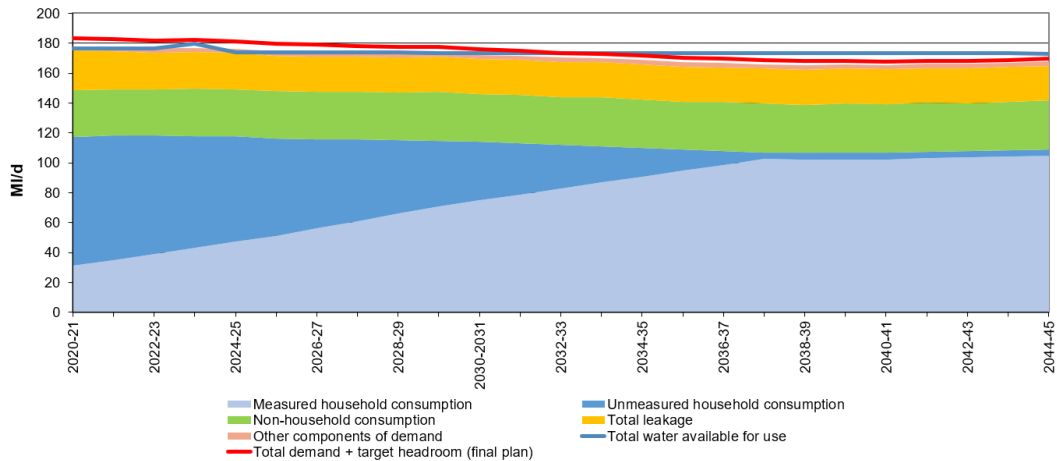


Figure 1 Revised Final Planning Supply-Demand Balance Graph - Annual Average

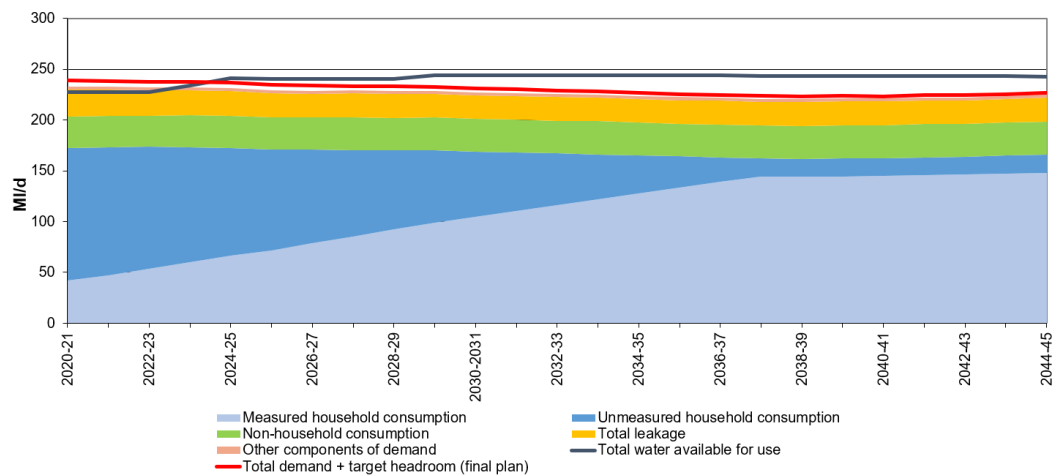


Figure 2 Revised Final Planning Supply-Demand Balance Graph - Critical Period

1.8 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 80 year drought event or a 1 in 200 year event occurring within the next few years is low, we are currently exploring a range of mitigation measures with the Environment Agency and Southern Water to maintain our supply demand balance.

We will provide a key progress update to our regulators in December 2021 and a further update in June 2022 to present conclusions and any necessary mitigation. 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

As part of the WRMP process, it is a statutory requirement to 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 Review 2020 highlighted that we had underperformed and not reached certain WRMP19 targets (PCC), but that we over performed significantly on other WRMP19 targets (leakage). In addition to this, our proposed AMP7 supply schemes have been undergoing environmental assessments and further analysis which has meant further delays to the implementation of these schemes.

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

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 fully 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.

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 170 million litres of water each day to over 725,000 customers in nearly 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 722,000 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 170 MI/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.

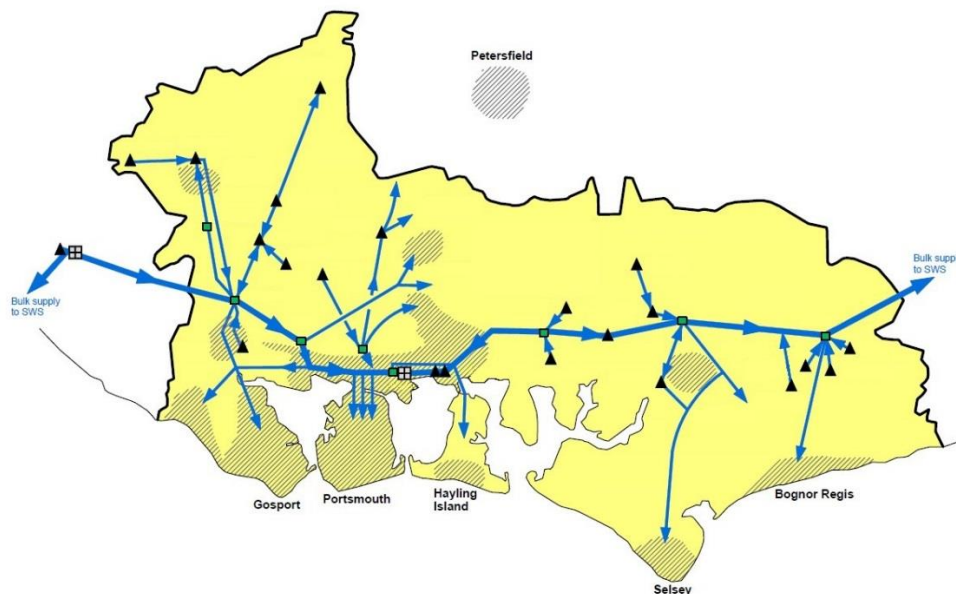


Figure 3 Map of Portsmouth Water Area of Supply

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.

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 scenarios from dry year 1 in 20, up to a 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 supply options selected for the Final WRMP19 are the same as those within this Revised WRMP19, although the detail of the AMP7 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 will also be 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. In particular, meetings were held in May and June 2021 to review the emerging revised supply and demand balance data and to discuss potential mitigation measures.

Our engagement with stakeholders will continue and broaden as we move towards the pre-consultation and consultation stages of our draft WRMP 2024 (WRMP24).

4 Supply

4.1 Introduction

The majority (88%) 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, only the outage assessment has been updated for our Revised WRMP19. This is because the outage assessment has been fully updated and audited by the WRSE Group towards the draft regional resilience plan. Work on other supply components is still in progress and data for these will be updated as necessary for our WRMP24.

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

4.2 Outage Assessment

Outage is defined as a temporary loss of deployable output 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 resilience 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.

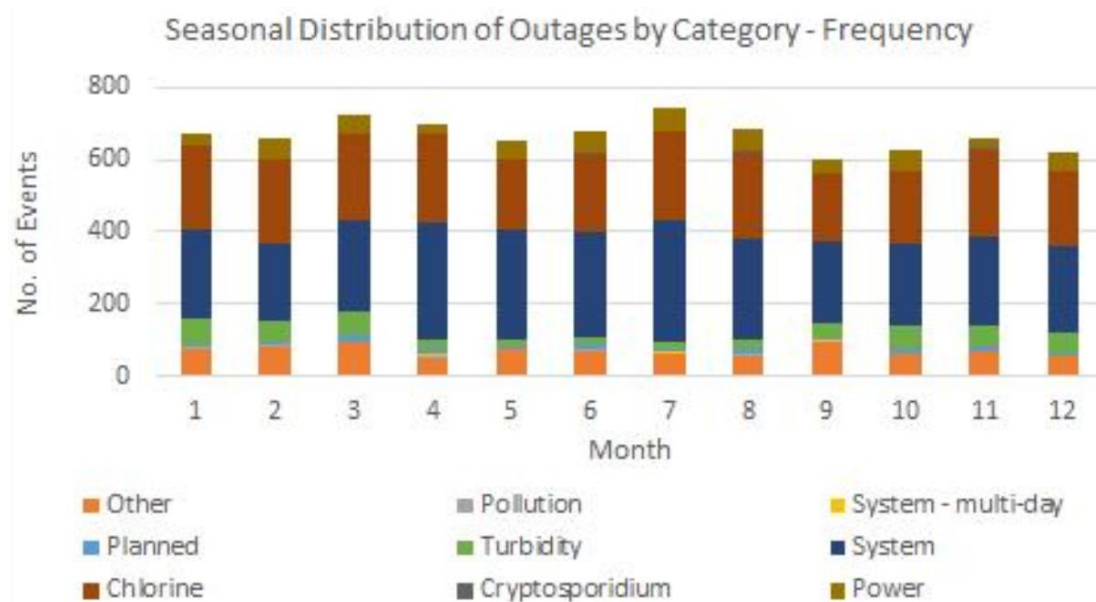


Figure 4 Seasonal Distribution of Recorded Outage Events, 2013-2020

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 MI/d	As % of DO	Value in MI/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 (MI/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 MI/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.

We will continue to collect outage data and review the need to update our assessment for the draft WRMP24.

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 involved encouraging unmeasured customers to opt to have a meter installed (optants). In WRMP14 we committed to 5,000 meter optants per year. In the first three years of AMP6, despite additional promotional efforts by us to increase the uptake of metering, the outturn number of optants fell below the aspiration.

Since 2018/19 we have been seeking to attract more customers onto a meter by undertaking a trial of smart meters. The smart meters initially provide customers with more information using a dual-billing style approach referred to as 'Metering not for revenue'. We offered comparative bills and water efficiency advice to encourage our customers to switch to a meter through us offering comparative bills and water efficiency advice.

In addition to existing baseline metering and the trial of smart metering described above, we considered other metering options for our Final WRMP19. These options were considered within the options appraisal process described in our published Final WRMP19.

We currently 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 7.1MI/d, reducing leakage from 35 MI/d down to 27.90 MI/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.

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 resilience plan. We have followed the most recent methodologies and used the latest data. 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.

Further information on our revised baseline demand calculations is provided below.

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 MI/d to the three-year average of 28.36 MI/d. This 4 MI/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. The dry year (DY) scenarios are classed as the 1 in 10 year demand, which is the agreed Dry Year definition for the WRSE Group for the regional resilience plan, and for our WRMP24.

For this Revised WRMP19 we have also derived demands for 1 in 20, 1 in 80 and 1 in 125 year AA and CP scenarios so that we can test our ability to meet our agreed levels of service to customers, and so that our Revised WRMP19 definition of Dry Year is comparable to that of our Final WRMP19 (1 in 20 year).

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 MI/d, which is close to our 2019/20 outturn figure of 174.0 MI/d (post-leakage adjustment).

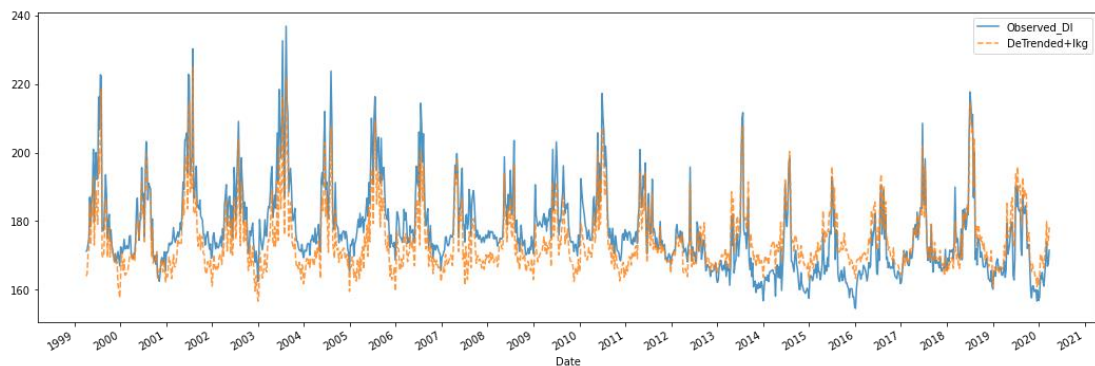


Figure 5 Calculating the NYAA by detrending the historic series. The NYAA is the medial annual average and annual maximum week.

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 (MI/d) in 2099. Table 3 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 3 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 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 4.

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 4 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 MI/d impacts, we multiplied the factors by the base year total household consumption, which also varies according to the relevant climatic scenario. The total MI/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.

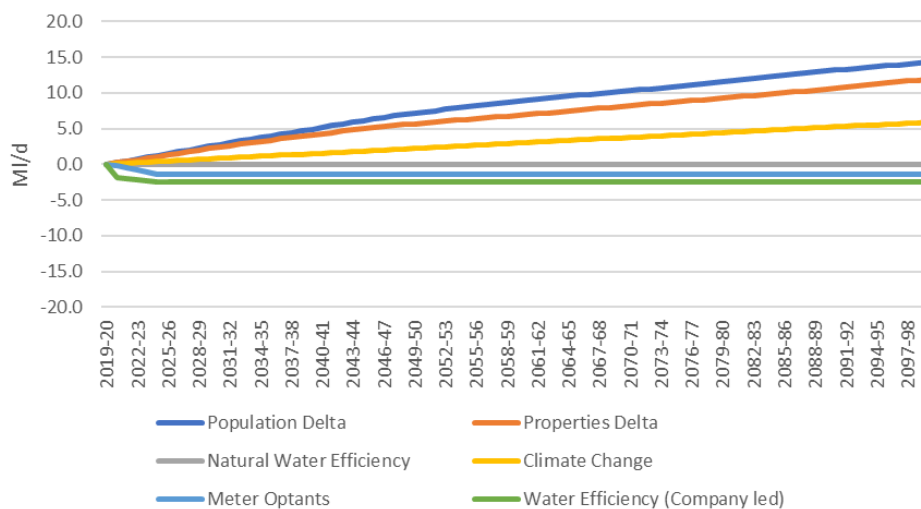


Figure 6 Example VF cumulative impacts for NYAA (MI/d)

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.

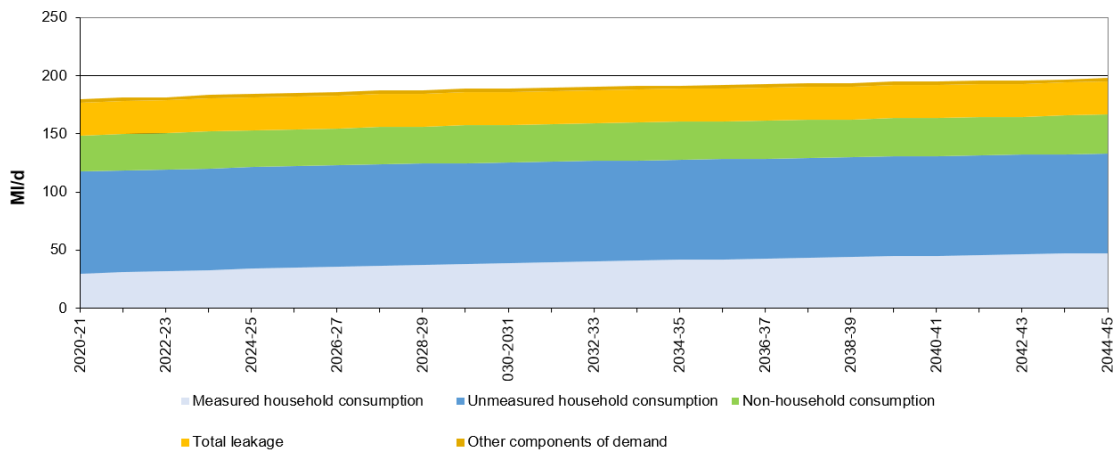


Figure 7 Baseline components of demand for the 1 in 200 year AA scenario

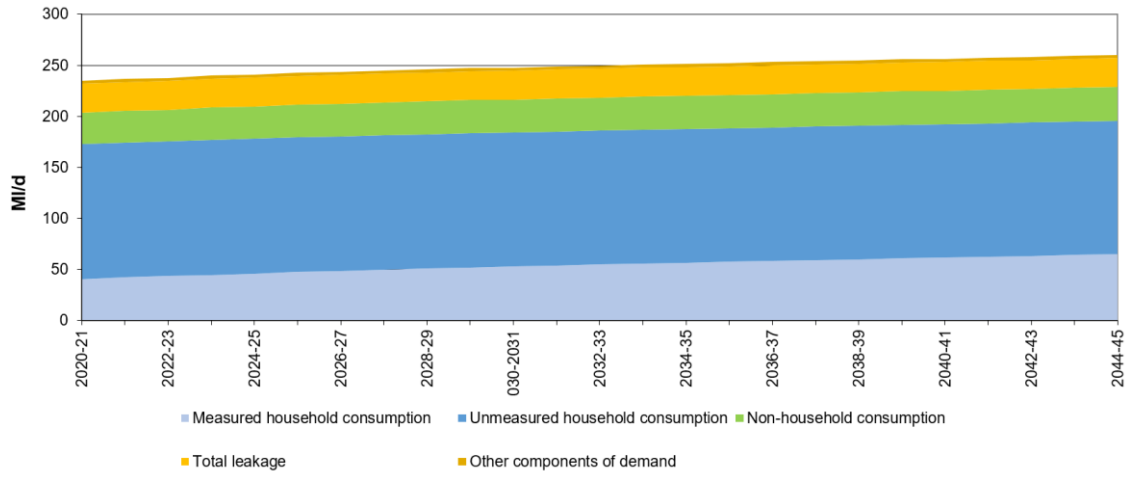


Figure 8 Baseline components of demand for the 1 in 200 year CP scenario

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. 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 updated analysis for the Revised WRMP19 includes a further three factors which are highlighted in red within Table 5.

Factor	Name
S1	Vulnerable Surface water licences
S2	Vulnerable Groundwater licences
S3	Time Limited Licences
S4	Bulk Imports
S5	Gradual Pollution
S6	Accuracy of Supply-Side Data
S7	Single Source Dominance
S8	Impact of Climate Change on Deployable Output
S9	New Sources
D1	Accuracy of Sub-Component Demand Data
D2	Demand Forecast Variation

Factor	Name
D3	Impact of Climate Change on Demand
D4	Demand Management Measures
D5	Demand uplift Uncertainty
D6	Non-household consumption
D7	Natural Water Efficiency Variation

Table 5 Uncertainty Factors

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

The following factors remain unchanged from the Final WRMP19 within this Revised WRMP19:

- S1 Vulnerable Surface Water Licences
- S2 Vulnerable Groundwater Licences
- S3 Time Limited Licences
- S4 Bulk Imports
- S5 Gradual Pollution
- S6 Accuracy of Supply Side Data
- S7 Single Source Dominance
- S8 Impact of Climate Change on Deployable Output
- S9 New Sources
- D1 Accuracy of Sub-Component Demand Data

For further information on these factors, please refer to the published Final WRMP19 on our website. The remaining factors are described below.

6.2.3.1 D2 Demand Forecast Variation

The demand forecasts for the Final WRMP19 submission were based upon population and property estimates provided by Experian. In addition to the central estimate, Experian also provided forecasts at 10% and 90% confidence. These bands were used as scenarios in our demand model to derive a 'low' and 'high' forecast which in turn were used in the headroom assessment.

For this Revised WRMP19 assessment a triangular distribution was derived from the Min, Baseline Housing Plan and Max demand forecast scenarios described in Section 5. As the Baseline Housing Plan scenario is one of the most severe growth scenarios, and can rise above the 'max' (by 2099) scenario in some years, this can lead to negative headroom. While this is statistically acceptable, as the uncertainty is around the Plan based scenario and not the central scenario, it is arguably not in the spirit of the planning guidance which suggests that companies should meet planned growth. To negatively adjust this level of resilience in the headroom calculation would contradict this. Therefore, for modelling purposes, only years in which the max scenario demand is higher are included in the model, which takes impact from 2035.

6.2.3.2 *D3 Impact of Climate Change on Demand*

For the Final WRMP19 we assessed the impacts of climate change on our demand forecasts following UKWIR guidance (UKWIR, 2013). Three climate change scenarios were produced for measured and unmeasured household demand:

- Minimum (10th quantile)
- Most likely (median)
- High (90th quantile)

These values were used to determine the parameters for the statistical probability distribution in the headroom calculation to calculate the uncertainty in climate change impacts on demand.

The Revised WRMP19 assessment uses the same factors from UKWIR 2013 study, although they are applied to the updated Distribution Input.

6.2.3.3 *D4 Demand Management Measures*

Our Final WRMP19 demand forecasts include assumptions relating to the average number of meter optants each year, percentage savings from metering and the magnitude of leakage reduction included in the plan. The uncertainty surrounding the demand savings which will be achieved in practice from these demand management measures is accounted for within factor D4 of the headroom calculation.

For our Final WRMP19 we calculated a central forecast and a lower and upper band representing the possible variations on our demand forecast due to metering assumptions. The range between the forecasts was taken to define the parameters for the statistical probability distribution in the headroom calculation. The distributions contribute to the target headroom allowance in each year across the planning horizon.

For the Revised WRMP19 assessment this factor was used to represent uncertainty surrounding the AMP7 water efficiency and leakage delivery up to 2024/25.

6.2.3.4 *D5 Demand Uplift Uncertainty*

Our demand forecasts include uncertainty relating to the estimation of what the level of demand would be in increasingly more severe droughts. This factor broadly reflects the uncertainty in the estimated demand between the historic demand and those estimated from the new stochastic datasets. Given that the new stochastic data produces more severe estimates of demand and are what assumed in the main scenario, this component is negatively skewed. An allowance for this was not included in the Final WRMP19 assessment but is now included for this Revised WRMP19 assessment.

6.2.3.5 *D6 Non-household consumption*

The uncertainty associated with non-household consumption was included within D2 for the Final WRMP19. However it is separated out for this Revised WRMP19 assessment., reflecting the deviation of the max and min scenarios from the central scenario.

6.2.3.6 *D7 Natural Water Efficiency Variation*

The uncertainty associated with natural water efficiency was previously included within D2 for the Final WRMP19 assessment, however the revised assessment separates this out. A triangular distribution assumes + 0.1 to – 0.2 l/h/d per year variation around water efficiency. The central case is set to zero.

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 6 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)	15%	85%
2030/31–2034/35 (AMP9)	20%	80%
2035/36–2039/40 (AMP10)	25%	75%
2040/41–2044/45 (AMP11)	30%	70%

Table 6 Headroom Risk Profile

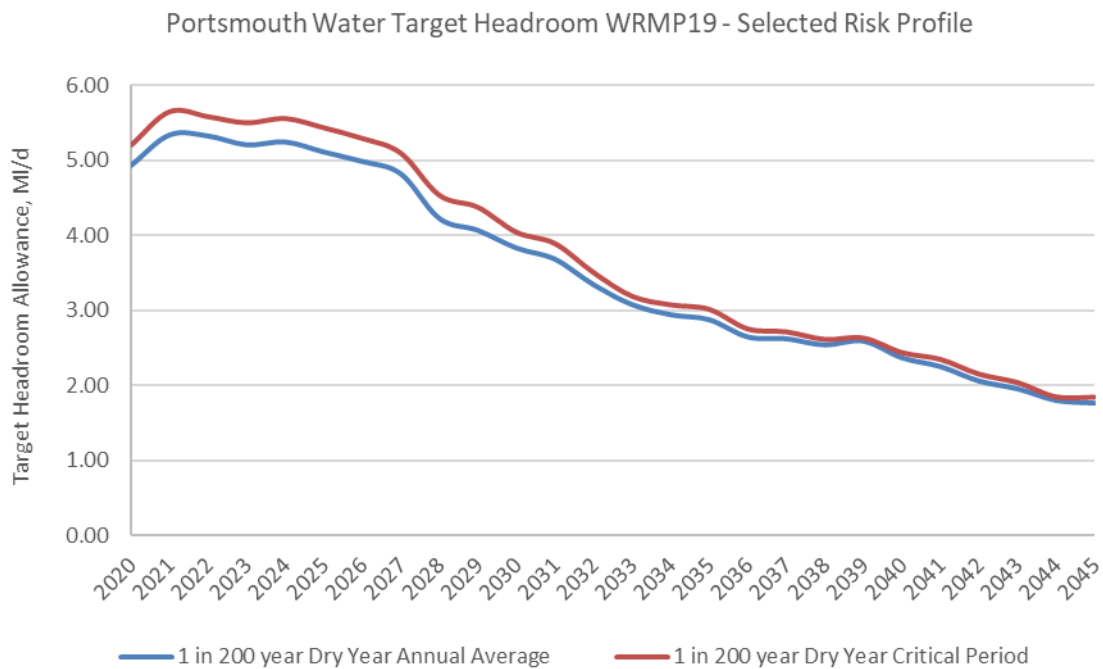


Figure 9 Headroom Profile for the Revised WRMP19

Headroom allowance typically increases over the planning period as uncertainties generally increase over time. In this case, the opposite trend is seen due to the inclusion of demand uncertainty factor D5 (Demand Uplift uncertainty), which reduces the headroom allowance by approximately 2.5 MI/d across the planning period (see Appendix A). This combined with the fact that D2 (Demand Forecast Variation) has a negligible impact on the headroom allowance during the planning period 2020-2045 (see Appendix A), can explain the reversal in the headroom profile trend. D2 historically contributed to a large proportion of the increase in headroom allowance over time, however in this assessment there is a skew in the household growth forecast, as the Housing Plan based scenario is very severe. The result is a total uncertainty that remains relatively flat until 2035, which when combined with the reducing risk profile results in an overall MI/d reduction over time.

Table 7 compares the final headroom allowance for the Revised WRMP19 with that from our Final WRMP19. These allowances are based on the 1 in 20 year scenario. It shows that our target headroom allowance has increased following the updated demand side factors.

Submission	Combined Company Target Headroom Allowance (MI/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	6.0	6.2	8.9	9.2

Table 7 Target Headroom Allowance – Comparison with Previous Results

For our Revised WRMP19 we have also calculated 1 in 200 year headroom allowances and a summary of the data is provided in Table 8.

Year	Dry Year Annual Average MI/d	Dry Year Critical Period MI/d (Peak Week)
2019/20	4.94	5.21
2024/25	5.12	5.44
2029/30	3.84	4.05
2034/35	2.88	3.02
2039/40	2.37	2.45
2044/45	1.77	1.85

Table 8 Headroom Allowance through the Planning Period (1 in 200 year scenario)

We have used the data from the 1 in 20 year headroom results within our 1 in 20 and 1 in 80 year Revised WRMP19 tables (Appendix B). The data for the 1 in 200 year headroom results have been used within our 1 in 125 and 1 in 200 year Revised WRMP19 tables.

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 MI/d in 2019/20 increasing to 80 MI/d by 2044/45 under the 1 in 200 annual average scenario, and 27.3 MI/d in 2019/20 increasing to 84.6 MI/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.

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.

The baseline supply/demand balance is shown in the Water Resource Management Planning Table 4 with deployable output information drawn from Table 2 and demand data from Table 3 (see Appendix B). The balance can be represented as five-year time steps as shown in Table 9. 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	180.78	184.24	188.71	191.52	194.78	197.79
Deployable Output	190.7	190.7	190.7	190.7	190.7	190.7
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	181.53	181.35	181.18	181.00	180.82	180.64
Bulk Supplies	22.5*	39.0	60.0	60.0	60.0	60.0
Total WAFU	159.03	142.35	121.18	121.00	120.82	120.64
Target Headroom	4.94	5.12	3.84	2.88	2.37	1.77
Available Headroom	-21.75	-41.89	-67.54	-70.52	-73.96	-77.15
Supply Demand Balance	-26.68	-47.01	-71.37	-73.40	-76.34	-78.91

* Bulk supplies increase to 30 MI/d in 2020/21.

Table 9 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 dry year because it is 'unconstrained'; the reduction as a result of demand restrictions is considered in the final planning tables.

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 around 1 MI/d smaller following the re-assessment of headroom and outage.

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.

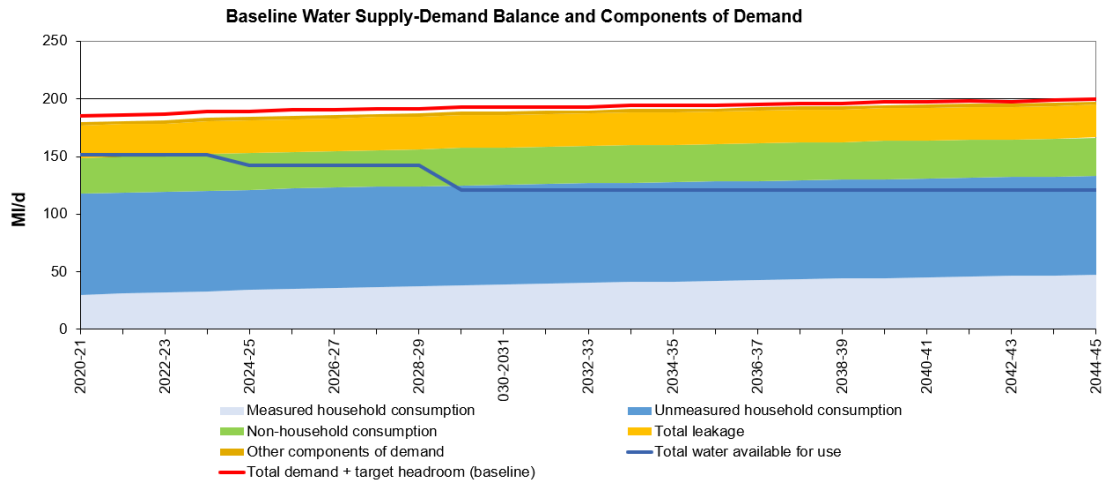


Figure 10 Baseline Supply Demand Graph - Design Drought Annual Average

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 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	235.5	240.9	247.1	251.3	255.9	260.3
Deployable Output	235.6	235.6	235.6	235.6	235.6	235.6
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	204.10	187.10	165.60	165.10	164.60	164.10
Bulk Supplies	22.5*	39.0	60.0	60.0	60.0	60.0
Total WAFU	204.10	187.10	165.60	165.10	164.60	164.10
Target Headroom	5.21	5.44	4.05	3.02	2.45	1.85
Available Headroom	-31.4	-53.8	-81.5	-86.2	-91.3	-96.2
Supply Demand Balance	-36.6	-59.3	-85.6	-89.2	-93.7	-98.0

* Bulk supplies increase to 30 MI/d in 2020/21.

Table 10 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. This is not the period when groundwater levels and river flows are at their lowest.

The critical period demand is ‘unconstrained’; the reduction as a result of demand restrictions 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 around 9 MI/d to 14 MI/d greater as a result of our higher outturn demand and the updated approach to deriving the baseline demand forecast.

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

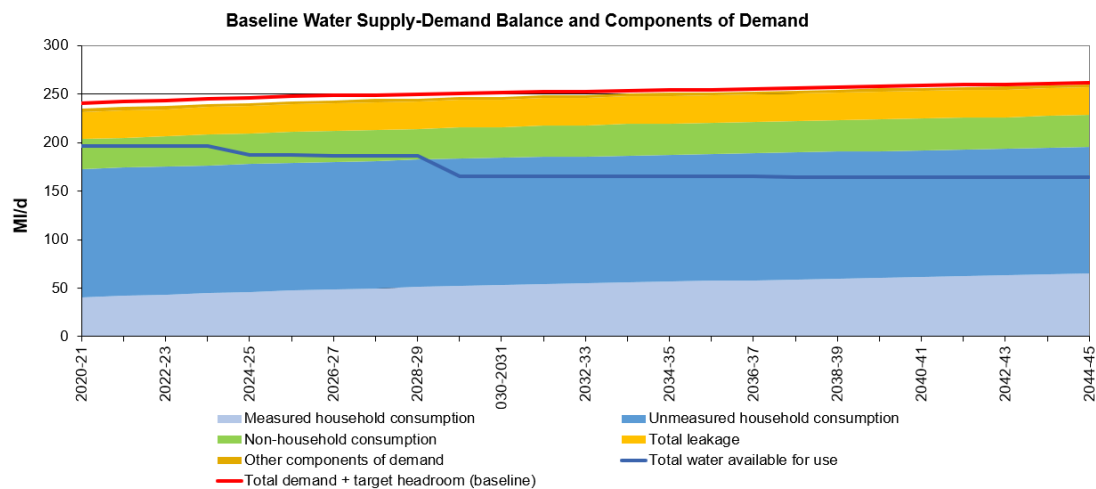


Figure 11 Baseline Supply Demand Graph - Design Drought Critical Period

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.

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 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 (SWS). 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 SWS. 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 AMP7 supply options has been updated following our feasibility studies in 2020-21. The demand options have also been updated to reflect those included within the regional modelling for the WRSE Group for use in the regional resilience 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 and C

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:

- Source O: The scheme will benefit the DYAA scenario by 1.2 MI/d in a 1 in 20 year drought event and 2.9 MI/d in 1 in 200 year event. It will also benefit the DYCP

scenario by 2 MI/d in a 1 in 20 year event rising to 3.6 MI/d in a 1 in 200 year event. The scheme now targets implementation within 2023/24.

- Source H: The scheme will benefit the DYAA scenario by 0.4 MI/d, although there is no benefit to the DYCP scenario. The scheme now targets implementation within 2023/24.
- Source C: The scheme will not benefit the DYAA scenario but will improve the DYCP scenario by 6.5 MI/d across all drought scenarios. The scheme now targets partial implementation within 2023/24 and full implementation in 2024/25. This is to recognise that the full benefit of the option may not be realised until our bulk supply to Southern Water is increased in 2024/25.

These benefits and implementation timescales are reflected within the Revised WRMP19 tables and the final supply demand balance.

7.2.3 Source S

Source S is our drought permit source, which provides 8.5 MI/d benefit to the DYAA and DYCP scenarios in droughts equivalent to, or worse than, a 1 in 125 year event. 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.

Further information is available within our draft 2021 Drought Plan, which is currently being consulted on.

7.2.4 Source J

The Source J scheme is due to be implemented in March 2024 in order to realise an additional 12.5 MI/d benefit from 2024-25. This scheme aligns with our commitment to supply Southern Water with an additional 9 MI/d in 2024-25, in addition to our current exports of 30 MI/d.

We completed an initial desk study in May 2020, followed by further desk studies, groundwater modelling and a site visit. We have also utilised our new Pywr system simulator to help us understand the drought conditions under which our Source J scheme would need to be in place. Through this programme of work we have been able to demonstrate that there is no long term average risk to the Chalk aquifer and we are progressing to a site investigation phase.

Our Final WRMP19 plan assumed this option would provide a source DYAA benefit of 12.5 MI/d and a source DYCP increase of 15 MI/d under the 1 in 200 year condition. This has been revised to 3.1 MI/d for DYAA and 12.5 MI/d for DYCP to reflect an assumption that the scheme will only operate for a few months of a drought year.

7.2.5 Havant Thicket Winter Storage Reservoir

Havant Thicket Winter Storage Reservoir is a £103m construction project, and a collaboration between Portsmouth Water and Southern Water, through the Water Resources in the South East group, to provide resilient water supplies to the region. It supports reduced abstraction on chalk rivers, has an overall biodiversity net gain and will offer a new community leisure facility for the area.

The implementation date of this option has not been adjusted for this Revised WRMP19. However, since publication of the Final WRMP19, the design stage of the Havant Thicket project has progressed substantially, and so the benefit of the option has been changed to

reflect this, and is now 21 MI/d average and 25 MI/d critical period up to the 1 in 200 year drought condition, to be implemented in 2029-2030.

7.2.6 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 our new Pywr simulation model to identify the 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 resilience 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
- Household Water Efficiency Programme
- Non-House Hold (NHH) Water Efficiency
- Leakage reduction (AMP7)
- Leakage reduction (Long Term)

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

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 options outlined above has 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 most appropriate to adopt 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 and the 1 in 80 year events represent the most challenging scenarios. The 1 in 80 year event (which is comparable to the worst historic drought on record) contains a smaller level of supply-demand risk to the 1 in 200 year event, with marginal risks to the target headroom, until 2024-25. The revised analysis indicates that the options selected for the Final WRMP19 preferred plan are still required under a range of drought conditions.

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		<p>New basket of demand side options and benefits to reflect latest WRSE Group related work streams. Including;</p> <ul style="list-style-type: none"> • 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		
CO80	Imposition of Drought Direction Restrictions (mandatory commercial restraint)	2020–21		
RO68	Source S – Drought Permit	2020–21		No change but with completed analysis and environmental reports.
RO21a	Source O – Maximising DO	2020–21		Delivery now expected to be 2023-24 with a revised yield benefit following a feasibility review.
RO23a	Source H – Maximising DO	2020–21		Delivery now expected to be 2023-24 with a revised yield benefit following a feasibility review.
RO24a	Source C – Maximising DO	2020–21		Delivery now expected to be phased over 2023-24 and 2024-25 with a revised yield benefit following feasibility review.
RO22a	Source J – Maximising DO	2024–25		Updated assumptions regarding yield benefit and operation following a feasibility review. No change to implementation date.
DO04b	Fixed network of permanent noise loggers connected to telemetry - Tranche 2		2025–26	<p>New basket of demand side options and benefits to reflect latest WRSE Group related work streams.</p>
CO06	Metering on Change of Occupancy - all properties		2025–26	
RO13	Havant Thicket Winter Storage Reservoir		2029–30	Revised DO based on updated designs

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 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	180.8	176.3	173.7	168.7	165.9	167.9
Demand Management	0	7.9	15.0	22.9	28.9	29.9
Deployable Output	190.7	190.7	190.7	190.7	190.7	190.7
Resource Schemes	25.0	31.4	52.4	52.4	52.4	52.4
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.0	0.2	0.4	0.6	0.8	1.0
Outage	6.7	6.7	6.7	6.7	6.7	6.7
WAFU	206.5	212.9	233.6	233.4	233.3	233.1
Bulk Supplies	22.5	39.0	60.0	60.0	60.0	60.0
Total WAFU	184.0	173.8	173.6	173.4	173.3	173.1
Target Headroom	4.9	5.1	3.8	2.9	2.4	1.8
Available Headroom	3.3	-2.5	-0.1	4.8	7.3	5.2
Supply Demand Balance	-1.7	-7.6	-3.9	1.9	5.0	3.4

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

Table 12 shows that the balance under the revised plan is such that we are no longer meeting our target headroom in the 1 in 200 year annual average scenario (between now and 2032-33). The deficits are largely driven by higher than anticipated outturn PCC and delayed delivery of the AMP7 DO recovery schemes. There are also deficits within our 1 in 80 year scenario, where we don't achieve our target headroom, because it is assumed that our drought permit for Source S and the enhanced output for Source J are not available until the 1 in 125 year scenario.

There is a surplus in our 1 in 20 year scenario because in a lesser drought our existing sources can achieve higher rates of abstraction. There is also a surplus in the 1 in 125 year scenario because the Source S drought permit and Source J enhanced output become available.

The supply-demand balance for the 1 in 200 year scenario is represented graphically in Figure 12. 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 12 that the reduction over time in total demand plus target headroom is largely a result of reducing household consumption which is due to optant and

change of occupier metering 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.

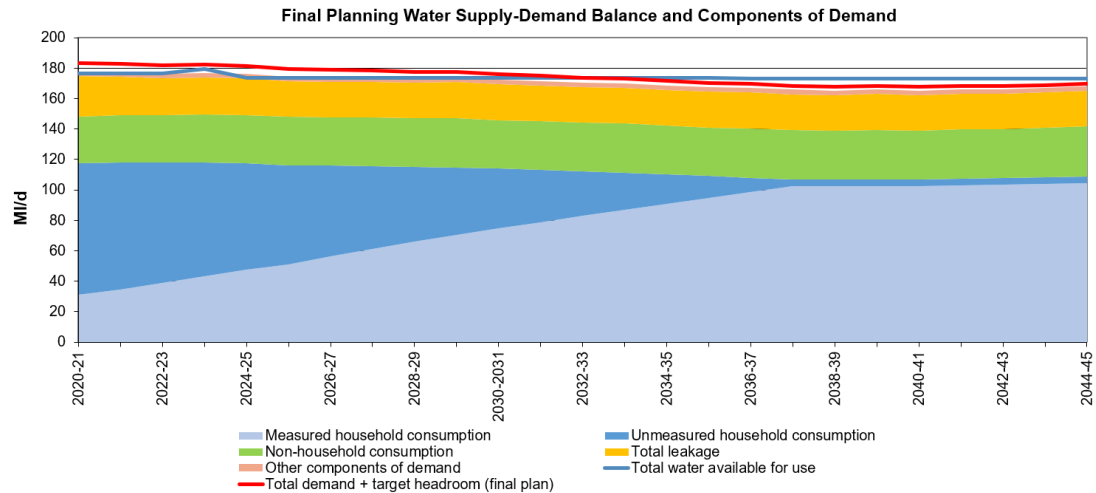


Figure 12 Revised Final Planning Supply-Demand Balance Graph - Annual Average

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

Table 13 presents the revised 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 13.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	235.5	231.3	228.7	223.7	221.3	224.7
Demand Management	0	9.7	18.4	27.6	34.5	35.6
Deployable Output	251.7	266.2	315.7	315.2	314.7	314.2
Resource Schemes	31.1	53.7	78.7	78.7	78.7	78.7
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	257.7	279.8	304.3	303.8	303.3	302.8
Bulk Supplies	22.5	39.0	60.0	60.0	60.0	60.0
Total WAFU	235.2	240.8	244.3	243.8	243.3	242.8
Target Headroom	5.2	5.4	4.1	3.0	2.5	1.9
Available Headroom	-0.3	9.5	15.6	20.1	22.0	18.1
Supply Demand Balance	-5.5	4.1	11.5	17.1	19.5	16.3

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

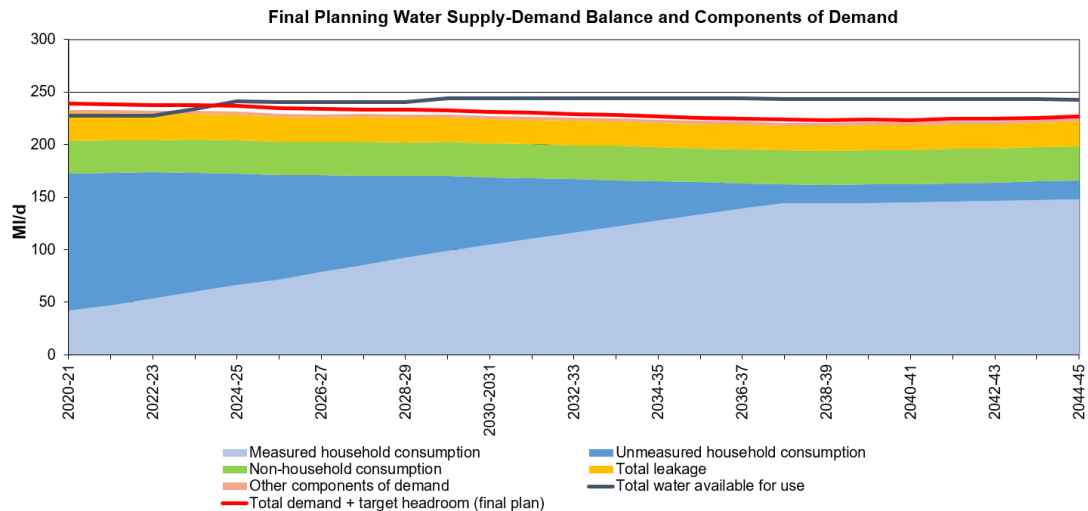


Figure 13 Revised Planning Supply-Demand Balance Graph - Critical Period

As with the annual average scenario we are no longer meeting our target headroom, although only until 2023-24. The deficits are largely driven by the higher than expected outturn PCC and delayed delivery of the AMP7 DO recovery schemes. There are also target headroom deficits within our 1 in 80 year scenario, until 2024-25, although there is a surplus in our 1 in 20 year and 1 in 125 year scenarios (for the same reasons as given in Section 8.2.1).

Figure 13 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.

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 during 2021. These are outlined below.

8.3.2 Pywr modelling of AMP7 schemes

We are undertaking further work to understand and optimise the benefit of our AMP7 schemes through the Pywr model. 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. It is thought that there may be some 'locked in DO', which could be released with appropriate network solutions. This would allow existing water available in the system to reach areas of the network which currently experience unsatisfied demand within the model– and therefore result in a deficit being recorded in the tables.

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 have used these, along with the knowledge that observed groundwater levels were 19.5 maOD in early June 2021, to understand the potential for droughts in the near future.

Our analysis is based on 1,470 sequences of stochastic groundwaters that start at 19.5 maOD in early June. It demonstrates that by January 2022 there is a 1 in 20 chance or 5% risk that groundwater levels could be equivalent to those in our worst historic droughts (see the yellow line on Figure 14). The red line on Figure 14 demonstrates an extreme scenario where there is no winter recharge, with a 1 in 200 chance or a 0.5% risk of occurring.

The risk of a severe drought developing by summer 2022 is low and it is more likely that groundwater levels will be close to the blue line on Figure 14. 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 on a frequent basis.

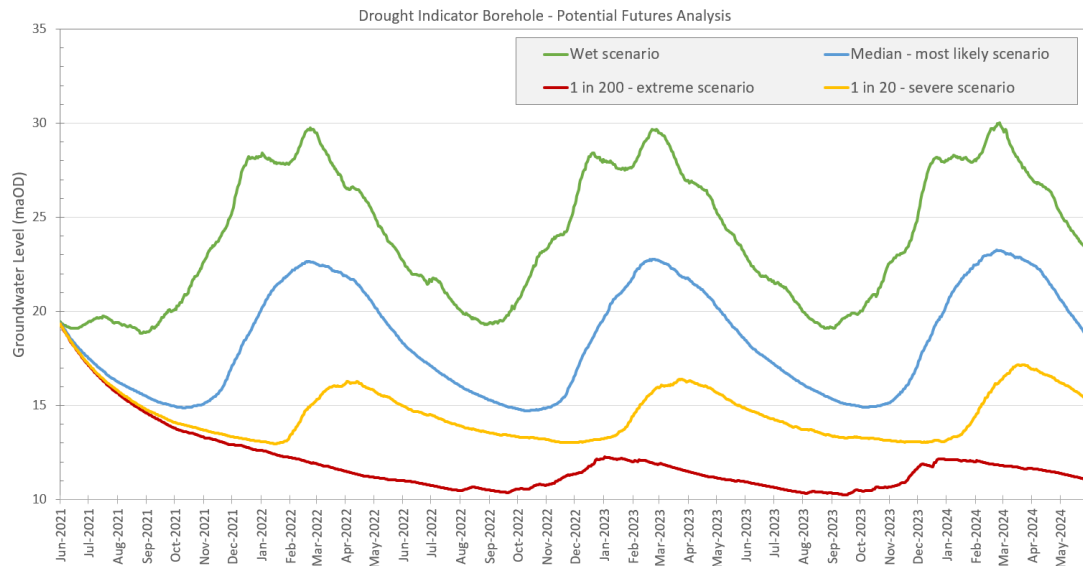


Figure 14 Analysis on the potential for a drought in the near future

8.3.4 Enhanced demand management

We are currently exploring whether we can further manage the demand for water in droughts to help reduce the risk within our supply demand balance. This type of mitigation measure requires further investigation and discussion with the Environment Agency.

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 through the use of our Pywr model.

We are currently seeking the Environment Agency’s views on several alternative proposals so that we have considered all options. For example, via the transfer of licensed quantities or the implementation of additional drought permits.. We will then commence further work if required to confirm the feasibility of the proposals from an operational and environmental perspective. This type of mitigation measure will need to be tested within the Environment Agency’s regional groundwater model to understand environmental impacts and also within our Pywr simulation model to identify if there are any network constraints.

8.4 Next steps

Planning for a 1 in 200 year drought event provides future resilience and, as we have committed to providing a further 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 Revised WRMP19 final supply demand balances demonstrate that we are no longer meeting our target headroom in the 1 in 200 year annual average scenario (between now and 2032-33) or the 1 in 200 year critical period scenario (between now and 2023-24). There is a smaller level of risk to our target headroom within our 1 in 80 year scenarios.

Whilst the risk of a 1 in 80 year drought event or a 1 in 200 year event occurring within the next few years is low, we are currently exploring a range of mitigation measures with the Environment Agency and Southern Water to maintain our supply demand balance.

We will continue progress on the mitigation and monitoring measures identified above, including the investigation of AMP7 scheme and mitigation measure benefits using our new Pywr simulation model. We will provide a key progress update to our regulators in December 2021 and a further update in June 2022 to present conclusions and any necessary mitigation. 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.

9 References

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