DRAFT WATER RESOURCES MANAGEMENT PLAN 2019

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APPENDICES

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Glossary of acronyms

	Term	Meaning
A	ADO	Average deployable output
	ADPW	Average day peak week
	AISC	Average Incremental Social Cost
	AMP	Asset Management Plan period
	AMP6	The current Asset Management Planning period, running from 2015/16 to 2019/20
	AMP7	The Asset Management Planning period, running from 2020/21 to 2024/25
B	BL	Baseline (Plan) The WRMP excluding all future options
C	CAPEX	Capital Expenditure
	CC	Climate change
	CCW	Consumer Council for Water
D	DAPWL	Deepest Advisable Pump Water Level
	Defra	Department for Environment, Food and Rural Affairs
	DFSE	Demand Forecasting in the South East
	DI	Distribution Input
	DMA	District Metering Area
	DO	Deployable output
	DYAA	Dry year annual average planning scenario
	DYCP	Dry year critical period planning scenario
	DYMDO	Dry year minimum deployable output planning scenario
E	EA	Environment Agency
	EBSD	Economics of Balancing Supply and Demand
F	FP	Final (Plan) i.e. The plan including all options
	fWRMP	Final Water Resources Management Plan
H	HH	Household customers
	HOF	Hands Off Flow
	HRA	Habitats Regulation Assessment
L	l/h/d	Litres per head per day
	l/prop/d	Litres per property per day
	LoS	Levels of Service
	LTA	Long Term Average
M	mAOD	Meters Above Ordinance Datum
	MDO	Minimum deployable output
	Ml/d	Megalitres per day
N	NE	Natural England
	NEP	National Environment Programme
	NHH	Non-household – i.e. commercial and industrial customers
	NYAA	Normal Year Annual Average planning scenario
O	ONS	Office for National Statistics

	OPEX	Operational Expenditure
P	PCC	Per capita consumption
	PDO	Peak deployable output
	PET	Potential evapotranspiration
	PHC	Per household consumption
	PR19	Periodic Review 2019
	PRT	Portsmouth Water
	PRV	Pressure reducing valve
	PUSH	Partnership for Urban South Hampshire
S	SDB	Supply demand balance
	SEA	Strategic Environmental Assessment
	SEAA	Severe Drought Annual Average planning scenario
	SECP	Severe Drought Critical Period planning scenario
	SELL	Sustainable Economic Level of Leakage
	SMA	Strategic Metering Area
	SPA	Special Protection Area
U	UKCP	UK Climate Projections
	UKWIR	UK Water Industry Research Ltd
W	WAFU	Water available for use
	WFD	Water Framework Directive
	WINEP	Water Industry National Environmental Programme
	WRMP	Water Resources Management Plan
	WRPG	Water Resource Planning Guidelines, produced and published by the EA
	WRSE	Water Resources in the South East group
	WRZ	Water Resource Zone
	WSW	Water Supply Works
	WWTW	Waste Water Treatment Works

1 DRAFT WATER RESOURCES MANAGEMENT PLAN EXECUTIVE SUMMARY

1.1 Introduction

Portsmouth Water has a long tradition of serving Portsmouth and the surrounding area since the Company was established in 1857. Through amalgamation, the 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.

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 companies to prepare Water Resource Management Plans and for public consultation to be carried out. The plans are prepared in accordance with the statutory guidance and policies issued by the Environment Agency and Defra.

In preparing this plan, Portsmouth Water have also engaged with a number of customers and stakeholders. Our customer engagement has, for example, shaped our approach to metering. In parallel our plan is closely aligned to the Government's expectation for ensuring resilient water supplies in the long term and contributing to regional solutions through the use of greater bulk supplies to neighbouring companies.

The most significant proposal in the plan is to commence the development of a winter storage reservoir, at Havant Thicket. This development has been considered in the past and is now required to support the request for greater bulk supplies to Southern Water, who face some significant sustainability reductions on the River Test and River Itchen. Working with our local stakeholders Portsmouth Water aim to be able to support the requirements of Southern Water.

This plan presents our Supply / Demand balance for 5 scenarios, which effectively are the result of greater drought severity. The 5 scenarios take us through a range, from our current planning assumptions of Temporary Bans being required 1 year in 20 to the most significant requirement for Drought Orders 1 year in 200. It shows the actions Portsmouth Water need to take over the next 10 years, in particular, to ensure it is resilient to greater drought severities and be able to support other water companies in the region.

1.2 Supply

The supply side forecast for this Plan includes a reassessment of Deployable Output of the 22 Company water sources.

It includes:-

- An assessment of the impact of climate change on each source.
- Quantifying the impact of any short term loss of production referred to as 'outage'.
- An assessment of the use of water in the treatment process itself.

Portsmouth Water appointed consultants, AECOM, to carry out a full reassessment of Deployable Output (DO) including a range of drought scenarios up to and including the

reference scenario of a 1 in 200 year return period (0.5% chance of occurring in each year). In addition, the consultants assessed the impact of outage and an allowance for risk referred to as 'headroom'.

Further, Portsmouth Water has revised its assessment of the impact of Climate Change on its sources, based on the UKCP09 data with consultants HR Wallingford. The results indicated that Portsmouth Water's vulnerability to climate change is 'medium'. However, given the general interest in this issue the, Company has undertaken a full assessment of climate change and this is discussed further in this plan.

Finally Portsmouth Water has assumed no sustainability reduction is required to our sources, as advised by the Environment Agency in their WINEP2 letter (September 2017).

The overall assessment has resulted in a lower estimate of the Deployable Output and water available for use than in our previous, WRMP14, plan by 7%.

1.3 Demand

Experian were appointed by a group of water companies in the South East to develop detailed property and population forecasts for the planning period 2020-2045. The results indicate that the Company's supply area will see a similar increase in both properties and population over the planning period to that estimated in the previous plan, WRMP14.

Our current metering strategy is based on metering of new houses and allowing all unmeasured customers to opt for a meter free of charge. Despite significant campaigns, meter optants have been significantly lower than planned during this 5 year period. Accordingly, Portsmouth Water approached Defra to discuss the legislation. Unlike other companies in the South East, Portsmouth Water is not Resource Stressed and therefore not able to compulsory meter its customer base. We proposed that the power for water companies to meter all customers should reflect the needs of the *region* not solely the Company. This would enable Portsmouth Water to meter its customers in line with all others in the South East.

Unfortunately, this proposal was not progressed by Defra and Portsmouth Water are now proposing the introduction of a new strategy – 'not for revenue metering' which it hopes will increase customer acceptability of metering. We will continue to review the issue of compulsory metering in the future.

Specifically, Portsmouth Water will encourage its unmeasured customers to switch to a measured charge based on information of their actual usage. Portsmouth Water will install meters at specific properties and provide the customer with a comparison between their current unmeasured bill and the resultant measured bill. We anticipate that this will encourage customers to opt for a meter.

Portsmouth Water has assumed, at this stage, that one third of the customers trialled will ultimately switch to the measured charge. It is likely that, even if customers do not switch to a measured basis, the provision of timely water consumption information will result in a reduction in demand by 5%.

The result of our proposal for metering and new growth also allows us to establish a forecast of household demand. The results show that, in line with the Government's aspirations, the

Company's PCC will fall over the planning period from 140 litres per head per day to 135 litres per head per day by 2024/25.

PCC may fall faster if developers choose to install water efficient appliances in new homes or adopt new methods of supplying households used elsewhere in the world. These include options of rainwater harvesting, grey and black water recycling. Clearly such schemes reduce demand in normal conditions – but caution needs to be applied with rainwater harvesting, for example, as we plan for dry periods of weather.

Our assessment is 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 working with their customers to reduce usage further.

The Company has re-assessed its methodology to calculate leakage as part of a wider industry revised harmonisation programme. The 'new' methodology will be applied by all companies and should ensure the reported values of leakage are determined on a consistent basis. The impact of this change in methodology is to increase the volume of reported leakage by circa 5 Ml/d, with a corresponding reduction on all other items in the water balance, in particular household usage. This results in a leakage estimate of 35 Ml/d, equating to almost 110 litres per property per day.

Our plan proposes to develop District Meter Areas in specific parts of the Company region to enable leaks to be detected more quickly. Portsmouth Water estimate that the initial tranche of DMAs could reduce leakage by almost 5Ml/d or 15% over the first five years of the plan.

1.4 Baseline Supply/Demand Balance

The 'baseline' water available for use is compared with the baseline demand forecast to assess Portsmouth Water's security of supply. This is the position before any interventions take place. It shows that we have positive headroom to meet both our customers and existing bulk supply commitments to Southern Water.

Ml/d	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	170.8	170.0	170.3	171.4	172.8	174.6
Deployable Output	226.5	226.5	226.5	226.5	226.5	226.5
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.0	0.2	0.4	0.6	0.7	0.9
Outage	14.7	14.7	14.7	14.7	14.7	14.7
WAFU	209.4	209.2	209	208.8	208.7	208.5
Bulk Supplies	30.0	30.0	30.0	30.0	30.0	30.0
Total WAFU	179.4	179.2	179.0	178.8	178.7	178.5
Available Headroom	**8.6**	**9.2**	**8.7**	**7.4**	**5.9**	**3.9**

Table 1: Baseline Supply/Demand Balance (Dry Year Annual Average) Exc. Additional Bulk Supplies

The graph below compares the Baseline Annual Average Dry Year and shows that the Water Available for Use WAFU (Red line) stays above the Total demand + headroom (Blue line) which means the Company is in surplus for the whole planning period, confirming opportunities for further bulk supplies to Southern Water.

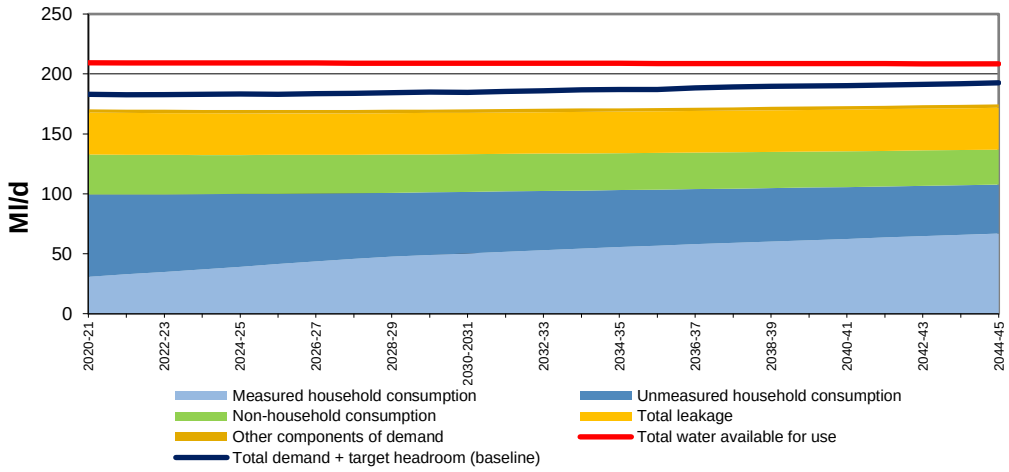


Figure 1: Baseline Supply/Demand Balance (Dry Year Annual Average) Exc. Additional Bulk Supplies

A surplus also exists for the Baseline Peak Week and the Baseline Minimum Deployable Output scenarios.

Bulk Supplies

A key expectation of Government, is that companies will work together to improve resilience of water supply for all customers. This is not something new for Portsmouth Water as it already provides Southern Water with a bulk supply which was commissioned in 2004. In preparing for this plan we have had considerable discussions with Southern Water about their requirements.

Analysis undertaken by WaterUK and detailed work undertaken by Water Resources in the South East (WRSE) both indicate that greater bulk supplies from Portsmouth Water to Southern Water are both necessary and economic. These studies indicate that, to facilitate these greater supplies, resource development is required; Havant Thicket is a significant development and effectively becomes a regional source, meeting the needs of the region as opposed to meeting the needs of customers of Portsmouth Water.

By end of 2017/18 the Company will provide Southern Water with two bulk supplies, both for 15 Ml/d to their Sussex and Hampshire zones up to 30 Ml/d (from Whiteways Lodge to their SRN Source D site and River Itchen into supply in Hampshire respectively).

They have asked for two additional supplies, of 9 Ml/d and 21 Ml/d into their Hampshire zone in 2022/23 and 2028/29 respectively; the water will come from Source A on the River Itchen and effectively take all available water from that source for Southern Water's needs.

The total bulk supply to Southern Water will therefore be up to a total of 60 Ml/d by 2030.

There is, however, some uncertainty over the requirements for these additional supplies to Southern Water as it has challenged the Environment Agency proposals to reduce its abstraction licences on the Test and Itchen. A public enquiry is planned for March 2018.

Portsmouth Water will continue to work with Southern Water and other stakeholders to progress this issue. However, we have assumed, in this plan that the requirements are confirmed and both supply and demand options will need to be undertaken to meet this requirement.

Finally, South East Water have asked for a 10 Ml/d bulk supply to Petersfield in 2057/58. This is beyond the planning horizon and Portsmouth Water will consider the availability of supplies in the next plan.

1.5 Options appraisal

To determine what Portsmouth Water should do in the period, in particular to meet the requirements of Southern Water, it has undertaken an Options Appraisal exercise which identifies options Portsmouth Water have available to meet the supply / demand balance.

The Company conducted its Options Appraisal in accordance with the Water Resource Planning Guidelines. Firstly an 'unconstrained list' of options for balancing a supply demand deficit was produced. These options are technically feasible but not constrained by environmental permits or planning issues.

The options range from resource development, changing the way we operate a source, greater metering, reducing leakage and greater water efficiency activity with customers and even drought permits in one scenario. This exercise was undertaken by AMEC Foster

Wheeler, who are recognised as experts in this field and have worked with other companies in the water industry for many years.

The initial list of options, of almost 200, was then screened against eight criteria including yield uncertainty, social impacts and technical difficulty by an expert panel made up of Portsmouth Water representatives, reducing the unconstrained options to 20 feasible options.

Each feasible option was then assessed for costs on a financial, social, environmental and carbon basis. The risk of delivery and yield was also assessed. This allowed Average Incremental Social Costs (AISC's) to be calculated to assist in ranking the options.

The most significant option was that of Havant Thicket. Portsmouth Water therefore engaged Atkins to quantify both the yield of the source and its likely capital cost with greater certainty than AMEC were in a position to easily provide.

The table below shows the detail of the actions we plan to take.

Option	Description	Earliest Construction Date	Earliest Commissioning Date	Dry Year Yield (Ml/d)	Severe Year Yield (Ml/d)
D005	District Metering – leakage	2020	2025	5.0	5.0
C026-46	Water Efficiency	2018	2019	1.6	1.6
R021-24	Deployable Output Recovery Schemes	2018	2019	7.8	7.8
R022a	Source J	2020	2023	12.5	12.5
R013	Havant Thicket Reservoir	2018	2029	23.0	23.0
R068	Source S Drought Permit	Scenario specific		-	8.5
Total				**49.9**	**58.4**

Table 2: Summary of selected options

1.6 The Draft Plan

Portsmouth Water believes it has prepared an ambitious draft plan for consultation which is in line with Government Policy Priorities, customers' expectations and meets the requirements set out in the Water Resources Planning Guidelines.

Specifically there are six key elements in the plan which are discussed in more detail throughout this document and associated appendices.

The six elements are as follows:-

- The Company is forecasting a falling per capita consumption over the planning period as a result, in particular, of its new approach to domestic metering.
- The Company is planning to reduce leakage significantly over the planning period as a result of investment in District Meter Areas.
- The Company can accommodate requests from Southern Water for bulk supplies to support the environment elsewhere in the region.
- The Company will further develop resources at Source J and Havant Thicket with the associated recreational and biodiversity benefits at Havant Thicket reservoir.
- The Company will meet the longer term supply challenges of rising population and climate change and can demonstrate that it will continue to have no detrimental impact on the environment.
- The Company can quantify how resilient supplies are to greater and more frequent droughts expected in the future and provide confidence that it can meet such events.

The table below quantifies the key elements of the proposed.

Ml/d	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Baseline WAFU	179.4	179.2	179.0	178.8	178.7	178.5
Resource Schemes	7.8	20.3	43.3	43.3	43.3	63.3
New Bulk Supplies	0.0	9.0	30.0	30.0	30.0	40.0
Final WAFU	**187.2**	**190.5**	**192.3**	**192.1**	**192.0**	**201.8**
Baseline Distribution Input	170.8	170.0	170.3	171.4	172.8	174.6
Demand Management	-1.2	-6.6	-6.6	-6.6	-6.6	-6.6
Final Distribution Input	**169.6**	**163.4**	**163.7**	**164.8**	**166.2**	**168.0**
Available Headroom	**17.6**	**27.1**	**28.6**	**27.3**	**25.7**	**33.7**

Table 3: Final Supply/Demand Balance (Dry Year Annual Average)

The graph below again compares the Final Plan Annual Average Dry Year Demand and shows that the Water Available for Use WAFU (Red line) stays above the Total demand + headroom (Blue line) which means the Company is in surplus for the whole planning period.

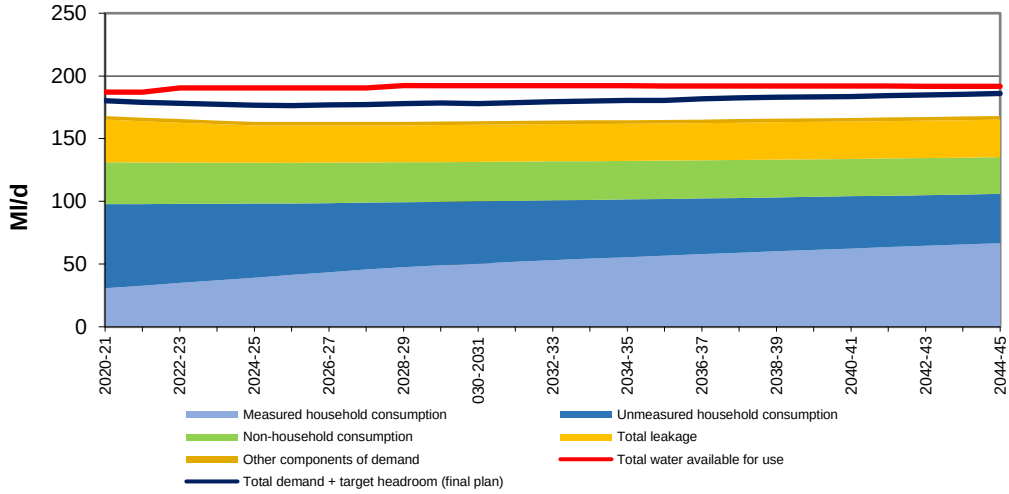


Figure 2: Final Supply/Demand Balance (Dry Year Annual Average)

A surplus also exists for the Peak Week and the Minimum Deployable Output scenarios.

1.7 Testing the Sensitivity of the Plan

The Company has undertaken analysis to test its plan to ensure that it stands up robustly against the assumptions made. The Company has investigated how changes to assumptions for supply and demand changed the outcome of the Plan. This analysis confirmed that the Plan is robust.

1.8 Consultation and next steps

This document is the basis of a statutory consultation process with stakeholders which will start in early 2018.

A shorter, non-technical summary, will be produced for this purpose. It will be available on the Company website, with links to the technical detail as appropriate.

Further, we will hold workshops for stakeholders and undertake further customer engagement to ensure all customers have a good opportunity to comment on this plan,

2 INTRODUCTION AND BACKGROUND

The Company has a duty as a water undertaker to ensure that it meets its customers' expectations in terms of the provision of public water supplies in a sustainable manner. The Company undertakes Water Resources Planning to show that it will be able to meet this duty both now and in the future.

In developing Water Resources Management Plans (WRMP) the Company recognises the need to balance the provision of secure water supplies with the needs of the environment and the affordability of customer's bills.

The Company has a long tradition of serving Portsmouth and the surrounding area. The Company was first established in 1857 and has only once imposed a temporary usage ban, during the National Drought in 1976. In 2004 a bulk supply was made available to a neighbouring company as a result of taking a regional view of Water Resource Planning. This bulk supply has supported the recipient company during recent droughts. Over the last few years the Company has also, pro-actively, varied a significant number of their abstraction licences to offer increased protection to the environment.

The preparation and review of Water Resources Management Plans became a statutory requirement in April 2007, under the Water Industry Act 1991 as amended by the Water Act 2003 (HM Government, 2003). The Water Resources Management Plan Regulations 2007 (HM Government, 2007) and the Water Resources Management Plan Directive 2017 (HM Government, 2017) provides further detail on the process and further matters a water company must address when preparing its plan.

The WRMP has been prepared to meet the following levels of service:

- Temporary Bans 1 in 20 (Dry Year)
- Ordinary Drought Orders 1 in 80 (Extended Drought)
- Emergency Drought Orders 1 in 200 (Severe Drought)

The actions required to meet these Levels of Service are set out in the Draft Drought Plan 2018 (Appendix 'U').

2.1 Characteristic of Portsmouth Water

Portsmouth Water supplies 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, Portsmouth Water has due regard to the purposes of the national park. The Company abstracts an average of around 170 Ml/d from boreholes, natural springs and one river. The Company has no significant raw water storage, and consequently is reliant on the recharge of groundwater over the winter period.

Within Portsmouth Water's 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 gives an overview of the sources Portsmouth Water abstract from. 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 T, Source Q, Source R and Source S)
- LMNOP Group (Source P, Source O, Source L, Source M and Source N)

There are also a further 6 sites that are licenced in their own right.

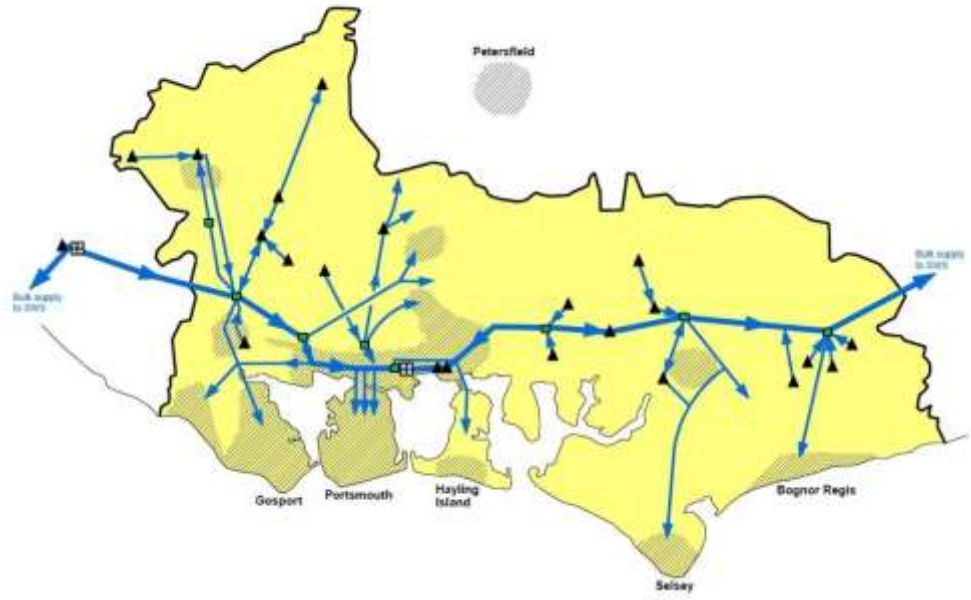


Figure 3: Map of Portsmouth Water Area of Supply

Over the last few years the Company has undertaken a number of infrastructure reinforcement projects which has resulted in improved connectivity between sources. As a result, Portsmouth Water has a single Water Resource Zone. The justification for the single zone is set out in Appendix 'E'.

2.2 Water Resources Management Plan Statutory Process

Water Resources Management Plans are statutory documents and the procedure and timetable which must be followed is set out in legislation and regulations.

The steps of the statutory process are set out below and this is reproduced from the Water Resources Planning Guideline (Environment Agency 2017).

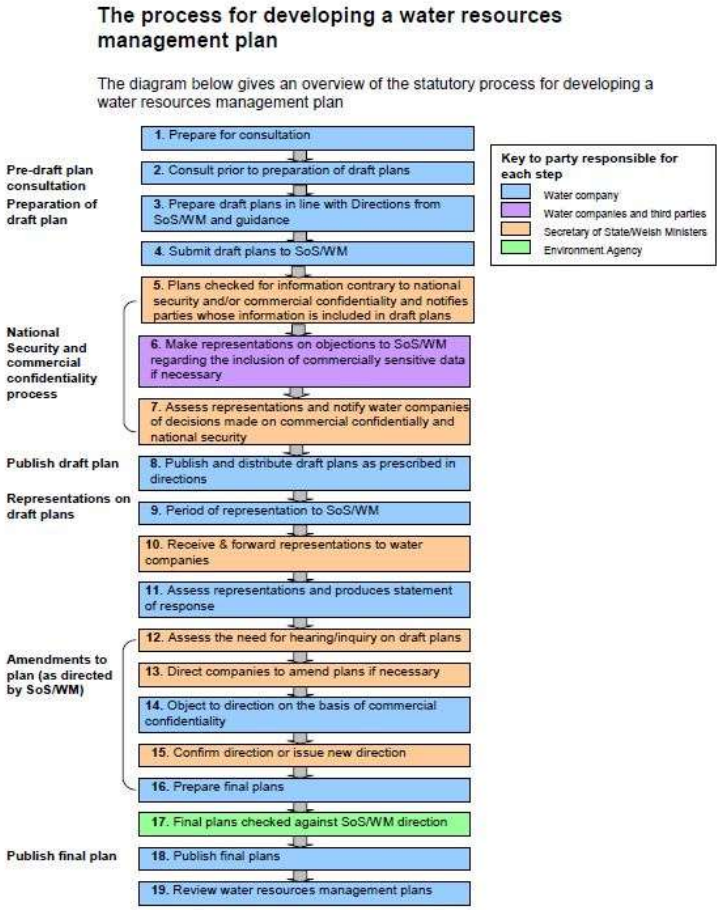


Figure 4: Process for developing a WRMP

The Company must undertake a period of pre-consultation prior to the preparation of its Draft Plan. The process of pre-consultation ensures that companies take account of the views of the statutory consultees namely the Environment Agency and Natural England. Once the Draft Plan has been prepared it is vetted to ensure there are no security issues and when approved by Defra, is published for public consultation. All representations to the public consultation are reviewed and a statement of response is prepared for the Secretary of State which sets out how the Company will reflect the representations in its final plan. The Secretary of State determines if the plan should be published, requires modification or if an examination in public of the plan is needed.

The water resources planning process runs in parallel to the process for setting water Company price limits. The two processes are linked and the Company has taken an integrated approach to ensure a consistent approach between the plans. This is particularly important to ensure the outcomes that reflect what customers' value are aligned with the WRMP. The Company has provided regular updates to the Portsmouth Water Customer Challenge Group.

2.3 Components of the Supply Demand Balance

The Company builds a forecast of its supply and its demand by considering the individual elements. The section below sets out the key building blocks that are considered in developing the forecasts.

2.3.1 Supply Side Components

- Deployable Output Assessment – The deployable output of each source considers a full range of scenarios from the 'Dry Year' to a 'Severe Drought'.
- Outage Assessment – The Company must make an allowance for the time that treatment works are unavailable to supply water because of asset failure.
- Treatment Work Losses – Treatment works that have filtration as part of their processes use water to wash the filters. The supply assessment must take account of this requirement as the water will not be available to supply customers.
- Climate Change – The Company needs to take account of how its sources may be impacted as a result of the changing climate over time.
- Sustainability Reductions – Where companies abstractions have the potential to damage the environment, then it is possible that these abstractions may have to be reduced to protect the environment.
- Bulk Supply Imports – if the Company is the recipient of bulk supplies from its neighbours this will also be reflected in the supply forecast.

2.3.2 Demand Side Components

- Household Consumption – The Company builds a household consumption forecast taking account of changes to population and properties for its area of supply. The forecast also takes into account how water use will change over the planning period and the impact of the metering policy.
- Non-Household Consumption – The Company must make an assessment of the demand for water from commercial activities.
- Leakage Forecasts – The demand forecast needs to take account of water that will be lost through leaks in the piped network. The forecast is now based on the new leakage methodology.
- Bulk Supplies – these are considered to be part of the demand side of the balance.

2.4 Previous Water Resources Management Plan

The Company published its previous WRMP in August 2014. The 2014 Plan ran from 2015 to 2039 and included an additional bulk supply to Southern Water. This will be commissioned in 2018 and will be regarded as a baseline provision in the new Plan. The 2014 Plan did not

forecast a deficit and there were no new supply or demand management options required as a result.

2.4.1 Commitment for Further Work

In Section 8.2 of the Final WRMP 2014 the Company gave details of its commitment to further work.

The commitment was to undertake further work on deployable output and resilience of the Plan to drought and climate change and to include stakeholders in a dialogue of this further work.

Since the publication of the 2014 Plan, Portsmouth Water have reviewed all of the components and engaged consultants to re-assess several elements of the supply/demand balance. This work has been shared with the Environment Agency throughout the preparation of this plan.

2.5 Government Policies Influencing this Plan

2.5.1 Government Documents

In the preparation of this WRMP, Portsmouth Water has taken account of the following Government Policy:

- Guiding Principles for Water Resources planning (May 2016)
- Strategic Priorities and Objectives for Ofwat (September 2017)
- The Water Resources Management Plan Direction (April 2017)

Portsmouth Water agrees and support the aims set out in these documents and has developed the WRMP accordingly.

2.5.2 Water Stress Assessment

In 2012 the Environment Agency produced a revised assessment of 'Water Stress'. This assessment is referred to in the legislation for compulsory metering and the 2017 Directive requires Water Companies to consider this option if their area of supply is 'Seriously Water Stressed'.

Portsmouth Water's area of supply is only 'Moderately Water Stressed' and Defra have confirmed verbally, in April 2017, that the Company cannot legally compulsory meter its domestic customers.

2.5.3 Environment Agency Documents

Portsmouth Water have taken account of the following EA document in producing the WRMP:

- Water Resources Planning Guideline (April 2017)
- River Basin Management Plan (February 2016)
- Water Industry National Environment Programme (WINEP) (September 2017)

2.6 Natural England Documents

Portsmouth Water have considered guidance and reports produced by Natural England:

- Conservation 21 Strategy (2016)

- Sussex and Kent Focus Areas (2017)
- Common Standards Monitoring Guidance (2016)

The Conservation Strategy for the 21st Century reflects recent political changes and aims to focus on resilient landscapes and seas. The Focus Areas will help Portsmouth Water promote joint working with the catchment partnerships.

2.7 Environmental Legislation

In recent years Portsmouth Water has undertaken a significant number of Environmental Studies to determine if its abstraction of water results in an adverse impact on the environment. As a result of these studies Portsmouth Water has varied a large number of abstraction licences.

All of the abstraction licences are fully compliant with the Habitats Regulations and the Water Framework Directive.

2.8 Legislative Framework

The Water Industry Act 1991 (as amended by the Water Act of 2003) set out the requirements for water companies to prepare and maintain a WRMP.

Further detail on process and requirements on matters to be addressed in the Plan are set out in the Water Resources Management Plan Regulations 2007 (HM Government, 2007) and the Water Resources Management Plan Directions (Appendix L).

2.9 Stakeholder Engagement

Portsmouth Water recognises the importance of effective engagement with its stakeholders to ensure that the Plan has broad support. The Company used a number of mechanisms to engage with a variety of stakeholders.

Portsmouth Water's process of stakeholder engagement formed the basis of the pre-consultation on its Draft WRMP. Through the mechanisms outlined below, Portsmouth Water shared details on the approach to preparing their Draft WRMP and was able to consider issues raised by stakeholders (Appendix Z).

2.9.1 Water Resources Management Plan Stakeholder Group

A WRMP Stakeholder Group was established and organisations were invited to join the group who had made representations or expressed an interest in the Company's previous plan. These consisted of the Consumer Council for Water (CCW), Environment Agency, Ofwat, Natural England and Partnership for Urban South Hampshire (PUSH) representing local authorities. The Company is grateful for the time and effort these organisations have contributed to the Water Resources Planning process thus far.

2.9.2 Portsmouth Water Customer Challenge Group

The Water Services Regulatory Authority (Ofwat) has asked that customers should be placed at the heart of the price review process. Companies are required to maintain a Customer Challenge Group which provides a report to Ofwat on their view of how well the Company engaged with their customers throughout the price setting process and if the Business Plan reflects the views of customers.

Water resources are obviously a key element of this process and have been a standing agenda item at meetings, allowing a dialogue to take place on the various issues arising from the Company's Water Resources Management Plan.

2.9.3 Customer Research

Portsmouth Water is undertaking a programme of customer research to inform its Business Plan and outcomes for the PR19 process. This research consists of a qualitative phase based around a number of focus groups and quantitative research used to derive values customers place on elements of service. This research has helped Portsmouth Water to understand customer views with regard to water resources and to take account of them in the preparation of the Plan. The research has covered issues such as:

- Resilience
- Leakage
- Temporary Bans
- Water Efficiency
- Interruptions to Supply
- Carbon Footprint
- Biodiversity
- Hardness of the water
- Public Amenities and Community Support
- Customer Funded Subsidies

The key results of the market research, in terms of water resources, were:

- Support for reduced leakage
- Support for Temporary Bans
- Support for increased water efficiency
- Support for better wildlife habitat

As a result of the customer engagement, the following concerns have been addressed:

- Sustainable Economic Level of Leakage (SELL) has been re-calculated using the new methodology an action plan developed to reduce leakage to the new target
- More information has been provided about the Drought Plan to describe actions we will take in times of drought.
- Water efficiency activities are included in the demand forecast
- Development of catchment management and biodiversity programmes. This is not explicitly discussed further here.

2.9.4 Local Authority Engagement

Portsmouth Water engages with Local Authorities in its area of supply with the aim of developing a consistent set of assumptions between Portsmouth Water's WRMP and Local Authority Plans.

Portsmouth Water has also worked with the Partnership for Urban South Hampshire (PUSH) on the development of an Integrated Water Management Study. This reflects the 2014 WRMP, but future updates will need to take account of the WRMP 2019.

2.9.5 Contact Plan

Portsmouth Water recognises the importance of giving due consideration to potential bulk supplies and possible solutions to deficits that may be delivered by third parties. Portsmouth Water developed a Contact Plan to record these opportunities. This Contact Plan involved publishing a document setting out the likely surplus water Portsmouth Water forecasting over the planning period. The Company has worked closely with other water companies in the region, both through Water Resources in the South East (WRSE) and through bilateral meetings to determine mutually beneficial trades.

2.9.6 Water Resources in the South East (WRSE)

The WRSE Group comprises six water companies, the Environment Agency, Ofwat, Defra, The Consumer Council for Water and Natural England. The WRSE Group was set up to consider a regional water resources issues comprising a range of options to find the best solution for customers and the environment in the South East of England.

Portsmouth Water has been an active participant of WRSE providing data to enable the work to take place and contributing to the development of the modelling approach.

The results produced by WRSE have confirmed the Company supply/demand position and scope for greater supplies to Southern Water.

Portsmouth Water has considered the results of the WRSE modelling in preparation for its WRMP.

For further details about Water Resources in the South East see appendix ‘S’.

2.9.7 Response to Pre-Consultation

Companies are under a statutory obligation to formally pre-consult on their plan and Portsmouth Water wrote to the statutory consultees to seek their views. A copy of the pre-consultation letter and response received are contained in Appendix Z.

Portsmouth Water received written responses to their pre-consultation from Defra, the Environment Agency, Ofwat, Natural England and Southern Water.

The Environment Agency, Natural England and Defra noted that they expected the Company to take account of the:

- Collaboration with others
- Customer requirements
- Water Resources Planning Guideline
- Risk Management
- To give due consideration to a range of options including Regional Solutions

The Company’s Plan has been prepared giving due consideration to these elements. The Company has included in Appendix ‘L’ a table setting out the requirements of the Water Resources Planning Directive 2017 and which sections of the Plan demonstrate compliance with the directive.

The Environment Agency raised a number of technical points in its response. The Company, through further meetings and provision of information, has sought to address these issues.

Natural England made reference to Drought Permits and the fact that they did not sit comfortably with protecting the water environment. Portsmouth Water will try to avoid the use of Drought Permits, if possible, but the Drought Plan does make reference to a Source A Drought Order. This is not required to satisfy Portsmouth Water's needs but it is a short term measure related to Southern Water's sustainability reduction on the River Itchen and to provide the bulk supply to Southern Water.

2.9.8 Habitats Regulations Assessment and Strategic Environmental Assessment

In preparing its Plan, the Company undertook a Strategic Environmental Assessment and a Habitats Regulating Assessment. These processes formed an integral part of the Plan and further details are given in Section 6.4.7.

3 SUPPLY

3.1 Introduction

The estimates of output available from our sources of supply were fully revised for the WRMP 2019. It now reflects a detailed re-assessment of source yields and the variation of deployable output with return period. The key assumptions included in the supply side forecast are outlined briefly below with more detail in the following sections:

- Deployable Output Assessment
- Sustainability Reductions
- Climate Change
- Outage Assessment
- Treatment Works Losses
- Bulk Supply Imports

3.1.1 Deployable Output Assessment

The assessment has been totally revised for the WRMP 2019 using the latest UKWIR guidance. The Consultant, AECOM, has reviewed drought events to identify a range of scenarios from the 'Dry Year' to a 'Severe Drought'.

In addition to the 'Annual Average' deployable output, two further 'Critical Period' scenarios have been investigated. These are 'Peak Week' which is assumed to occur in August and 'Minimum Deployable Output' which is assumed to occur in October, November or December.

3.1.2 Sustainability Reductions

Portsmouth Water have now completed the National Environmental Programme Schemes for the 'Water Framework Directive' (WFD). This included a channel restoration scheme on the River Ems and water quality improvements on the River Hamble.

The EA have recently published the Water Industry National Environment Programme (WINEP) (Sept 2017). This includes further WFD investigations but Portsmouth Water do not believe that there will be any DO reductions as a consequence.

3.1.3 Climate Change

Following publication of the UKCP09 scenarios, and further guidance from the Environment Agency, Portsmouth Water carried out a 'Vulnerability Assessment' (see Appendix C) of climate change impacts. The results showed the Company has a 'medium' vulnerability and so further climate change studies were commissioned from AECOM/HR Wallingford.

The impacts of climate change on flows in the River Itchen and on groundwater sources have been investigated.

The future risk of climate change is included in headroom both in supply and demand.

3.1.4 Outage Assessment

Companies need to take account of the reduction in deployable output that results from treatment works being temporarily unavailable.

The outage assessment has been repeated using data from 2007-2016. Events longer than 90 days are excluded where they relate to raw water quality issues resulting from domestic heating oil spills and cryptosporidium.

The current outage data is seasonal with higher outage in the winter and lower outage in the summer. This is to be expected as the Company schedules maintenance at periods of lower demand. This is reflected in the figures for Peak Deployable Output (PDO) and Minimum Deployable Output (MDO).

3.1.5 Treatment Works Losses

The allowance of treatment works losses is based on water used for cleaning filters from the more complex sites such as Farlington and the River Itchen Works. The losses from Farlington have been significantly reduced due to the replacement of the membrane filters with a UV treatment plant.

3.1.6 Bulk Supply Impacts

WRSE modelling has been used to identify possible bulk supplies of water between companies. Although several of the bulk supplies are potentially bi-directional, Portsmouth Water has not formally been offered any bulk supply imports or any third party supplies.

The existing bulk supply to Southern Water's Sussex North Zone, via Whiteways Lodge, is subject to an agreement that was renewed in 2016. A second bulk supply, at Source A, is due to be commissioned in 2018.

3.1.7 Future Bulk Supplies

Southern Water have previously asked for additional bulk supplies from Source A on the West of Portsmouth Water's area of supply. These are considered in the demand section (Section 4.9) where they reduce the amount of Water Available for Use (WAFU).

3.2 Deployable Output Assessment

In the WRMP 2014 Portsmouth Water gave an undertaking to do further work on deployable output and to look at resilience to drought and climate change.

To comply with these requirements, Portsmouth Water appointed AECOM to carry out a full DO assessment in additional to an assessment of outage and headroom. This included an assessment of a range of drought scenarios and the impact of 'Deepest Available Pumped Water Level' on deployable output.

3.2.1 Previous Deployable Output Assessments

As part of the WRMP 2009 Portsmouth Water submitted a DO assessment which was largely based on previous work. These previous assessments were:

- Southern Water Authority 1984
- Portsmouth Water 1997

These studies used operational data from 1973 and 1976 which were considered to be the worst drought periods in the last 100 years.

The surface water assessment for the River Itchen was based on groundwater modelling data for the period 1970-2002 which was provided by the Environment Agency.

For the WRMP 2014 Portsmouth Water submitted a DO assessment based on the unified methodology (UKWIR 2000) and the WR27 report on Water Resources Planning Tools (UKWIR 2012).

The DO assessment used data from 1880 until 2012 and included the latest statistical approach to calculate DO's for droughts beyond the 'Worst Drought on Record'.

3.2.2 Current Guidance on Deployable Output Assessment

The Water Resources Planning Guideline (WRPG) sets out the procedure for assessing deployable output and this refers to the UKWIR report 'Handbook of Source Yield Methodologies' (2014) and the UKWIR report 'WRMP19 Methods – Risk Based Planning Methods' (2016).

The first report sets out a five step process to follow:

Step 1 – Choose a DO Assessment Framework

Step 2 – Assess Vulnerability to Climate Change

Step 3 – Establish DO Assessment Data Sheet

Step 4 – Calculate DO with a Confidence Table

Step 5 – Report DO Assessment

This work has been undertaken by our Consultant AECOM who worked with the Environment Agency on their 'Reliability of Southern Region Public Water Supplies' (2011) project.

The full report from AECOM is included in Appendix 'A' and this includes summaries of the data used.

3.2.3 Drought Scenarios

The WRMP used to be based on a 'Dry Year' with a return period set by the level of service for Temporary Bans. Events rarer than this were covered by the Drought Plan and the Emergency Plan.

The Drought Plan is now fully integrated into the WRMP and all the Drought Scenarios and Drought Options have been considered as part of the overall process. Scenarios with a return period of greater than 1 in 200 are covered by the Emergency Plan and are not included in the WRMP.

The Company's record from its groundwater monitoring borehole centrally located at Well 'X', near Rowlands Castle, dates back to 1932. As a result, it provides the Company with a significant record of the most critical conditions for single and multi-season droughts recorded in more than eighty five years.

Due to the strategic location of this borehole and the availability of this long term record, the Company has based its drought planning scenarios upon the likely effects of drought sequences on groundwater levels and the consequent impact upon source yields.

Figure 5 shows most of the key drought years from the recent history.

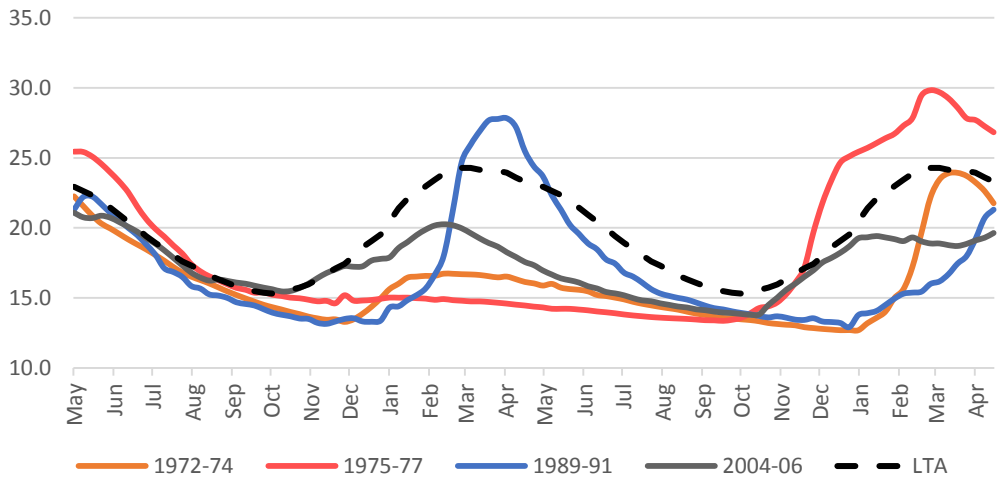


Figure 5: Historic Well 'X' Levels 1972 to 2006

Portsmouth Water has undertaken further analysis of groundwater levels to test if more severe events occurred prior to 1932 when Well 'X' records began. To extend the groundwater level record it is possible to use an Environment Agency observation borehole at Well 'Z'. Records of groundwater level at this site are available from 1836 until the present day.

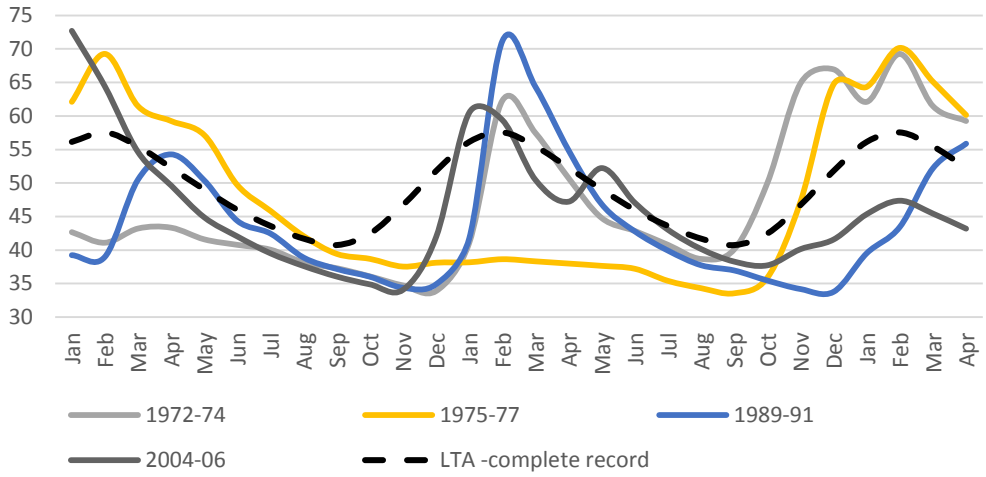


Figure 6: Well 'Z' Levels 1972 to 2006

Comparison of the Well 'X' Levels and the Well 'Z' Levels shows that for the same years the shape of the curve is similar. For example, 1975-1977 shows groundwater levels above the LTA in May, June and July. Levels then stay almost flat until the groundwater recovery in November of 1976. In 1989-1991, groundwater levels fell to a minimum in the first dry winter, rise above the LTA, and then fall again to a minimum in the second dry winter. In 1972-1974, groundwater levels fell to a minimum in the first dry winter, rise significantly during the spring, and then fall again to a second low.

This gives the Company confidence that groundwater levels recorded at Well 'Z' are correlated to those at Well 'X' and it is appropriate to consider Well 'Z' data in determining possible drought scenarios.

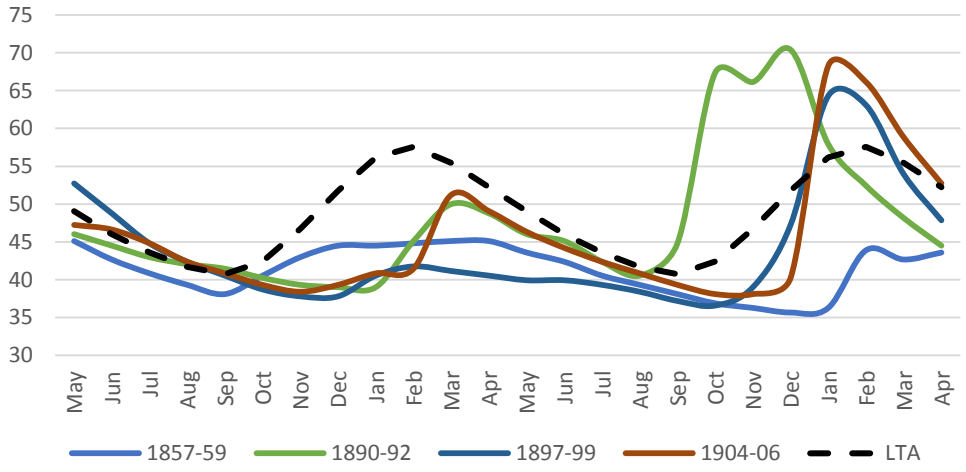


Figure 7: Well 'Z' Levels 1857-1907

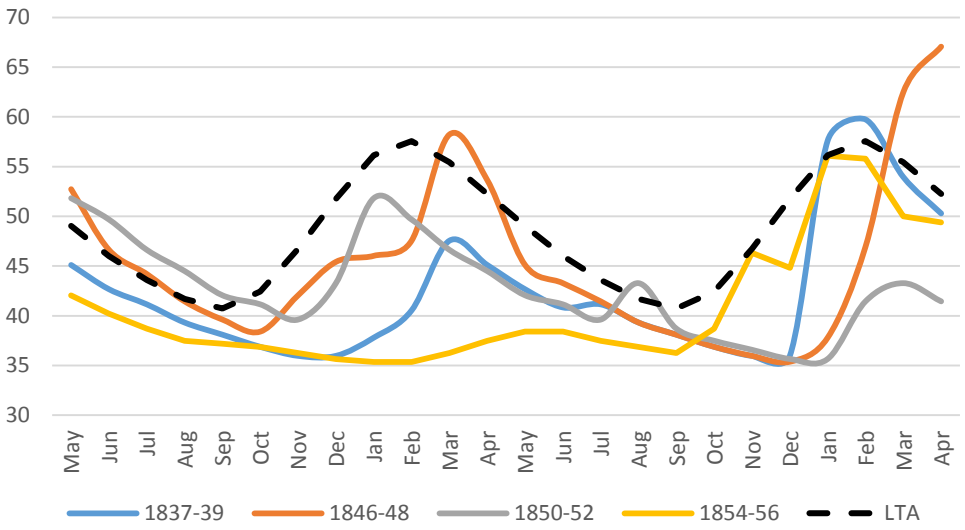


Figure 8: Well 'Z' Levels 1837-1856

The data shows that minimum groundwater level is influenced by winter rainfall and the timing of the recovery. However, the aquifer is very resilient to drought and all the events tend towards a minimum groundwater level of around 33 mAOD for Well 'Z' and around 13 mAOD for Well 'X'.

The data set contains long periods of low groundwater levels such as 1989-1991 and 1904-1906. In these cases, winter recharge was just enough to prevent a year on year fall in groundwater level. Both these events produced groundwater levels well above the critical level at Well 'X' of 12.7 mAOD, which is based on levels at the end of the recession in 1973.

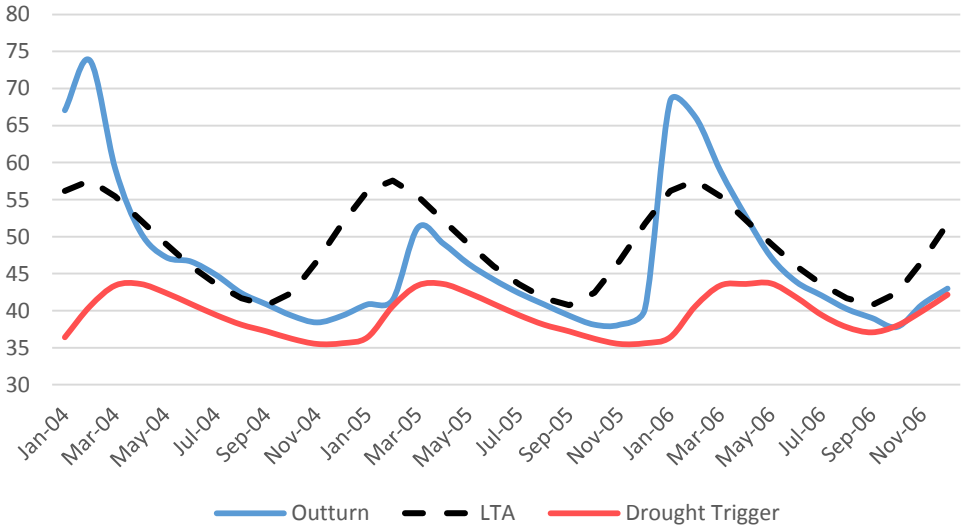


Figure 9: Well 'Z' Level 1904-1906

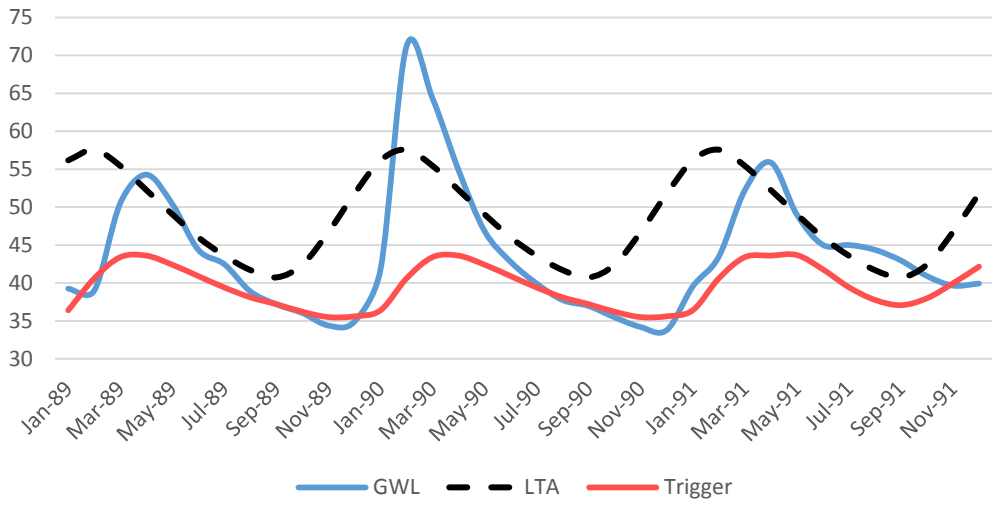


Figure 10: Well 'Z' Level 1989-1991

The above analysis of the Well 'Z' data demonstrates that although low periods of rainfall and groundwater have been experienced in the past, these have not led to more severe drought scenarios than the Company had previously considered.

3.2.4 Single Season Droughts

Portsmouth Water has no significant raw water storage, but the South Downs chalk aquifer is very resilient to drought. The most significant single season dry summer occurred in 1990. The summer of 1990 was very dry but groundwater levels did not reach the critical level of 12.7 mAOD which was recorded at the end of 1973. Groundwater levels were below average throughout the summer and autumn without significantly impacting upon source yields. Levels recovered early in 1991, following average rainfall in the winter.

A 'Single Season Drought' is considered unlikely to have a critical effect on the supply/demand balance for Portsmouth Water. Further experience from the dry summers of 1995 and 2003 when, again, drought measures were not required, demonstrates the Company's capability to cope with single season dry summers.

3.2.5 Multi-Season Droughts

Multi-Season Droughts are defined as two or more consecutive seasons of below average rainfall, and have a much greater impact upon the Company's ability to balance demands with available supplies, especially if they are combined with high summer peak demand.

The most serious drought years of 1973, 1976 and 2005 all started with groundwater levels close to the LTA at the end of the summer of the preceding year. As a result of low rainfall during the first winter, limited recharge occurred and groundwater levels were well below average at the beginning of the summer period. Below average rainfall was recorded during the summer and groundwater levels continued to fall, albeit at a much slower rate, due to water was 'drawn from storage' in the chalk. As the second dry winter developed, groundwater levels reached their lowest levels. In each of these years, groundwater recharge occurred in the spring of the third year following a return to wetter conditions.

These events represent the worst droughts on record which we have called 'Historic Drought'.

For drought scenarios outside the recent history, Portsmouth Water have used groundwater simulations based on rainfall and temperature records. These simulations are similar to the work done for the Water UK report 'Water Resources Long Term Planning Framework 2015-2065' and were carried out by same consultant AECOM.

The Company has developed three additional scenarios for multi-season droughts, which are more extreme than the 'Rarest Drought on Record' and scenarios which are considered to be challenging but plausible. Emergency planning will be used if the Company experienced an unprecedented event such as loss of a major treatment works from a pollution incident, combined with an extreme drought.

For the WRMP, and therefore the Drought Plan, the following scenarios have been considered:

- Dry Year (1 in 20)
- Scenario 'A' Historic Drought (1 in 40)
- Scenario 'B' Extended Drought (1 in 80)
- Scenario 'C' Serious Drought (1 in 125)
- Scenario 'D' Severe Drought (1 in 200)

There is no 'Design Drought' but each scenario has been considered and a supply/demand balance produced. The Water Resources Planning Guideline refers to a 'Reference Level of Service'. This is set at a 0.5% chance of customers experiencing an emergency Drought Order. This is covered by Scenario 'D' which has a nominal return period of 1 in 200 (0.5%) and is designed to avoid the use of standpipes in the street.

3.2.6 Planning Scenarios

The WRMP is developed from a baseline forecast which is defined in Section 5 of this Plan. The guideline requires companies to complete tables for the 'Annual Average' scenario and, if appropriate, a 'Critical Period'. In the past Portsmouth Water completed tables for annual average and peak week.

In the last plan we considered the possibility that the period at the end of the groundwater recession, when deployable output is at a minimum could be a critical period for Portsmouth Water. Tables were produced for ADO, MDO and PDO and were compared to determine the critical period.

MDO was not critical for the last Plan and the deployable output assessment for this Plan also shows that this is not a critical scenario for Portsmouth Water.

For the WRMP 2014 Portsmouth Water presented supply/demand balances for the full range of scenarios. Even allowing for the proposed bulk supplies to Southern Water the Company remained in surplus.

The WRMP 2019 is based on the same approach with each scenario considered in terms of supply, demand, bulk supplies and feasible options. Some of the feasible options are only available in rarer droughts and each scenario has a different final planning demand forecast. Demand management options, such as Temporary Bans, are considered to provide simple percentage reductions.

The supply/demand balance is set out in detail in the associated tables but is summarised in Section 5.3.

3.2.7 Critical Periods

Portsmouth Water is historically a peak driven company because of its groundwater supplies and lack of raw water storage. Previous yield assessments concentrated on drought deployable output recorded during events such as the summer of 1976. Recent licence variations have often retained peak week abstraction capacity at the expense of annual average licence totals.

For this deployable output assessment the sources have been considered individually and as part of the current group licences. The published methodology is based on daily abstraction with a 7 day running mean over a 5 week period either side of the peak week.

Operational data for critical years such as 1976 has been lost, so water level data has been collected for recent years. This data is summarised in the main AECOM report which is included as Appendix 'A'.

To represent the worst drought on record, curve shifting has been used. The degree of shift in rest water levels is calculated from observation borehole records and produces scaling factors that can be applied to each source. A 'signature' borehole is allocated to each source and represents the appropriate part of the aquifer.

The assessment diagrams, included in the Deployable Output Assessment, show the operational data and the predicted drought curves. There are diagrams are for peak week and annual average data for each of the source works.

Weekly flows are available for the Source B spring source for the period 1980 to 2016. The method for calculating DO is similar to that used for the groundwater sources.

The River Itchen source at Source A is linked by its licence to the Environment Agency's gauging station close by at Riverside Park. A suite of de-naturalised flow records has been developed but it is important to consider the impact of Southern Water's abstractions and discharges which are upstream of Source A.

Portsmouth Water in 2011 varied its abstraction licence on the River Itchen as a result of the Site Action Plan put in place to comply with the Habitats Directive. The site action plan also requires Southern Water to vary their abstraction licence. At present Southern Water have not varied their abstraction licence and this is now the subject of a Public Hearing expected to start in March 2018.

Portsmouth Water's deployable output assessment assumes that Southern Water have complied with the Habitats Directive and are working to a 198 Ml/d Hands Off Flow (HOF) at Highbridge and Allbrook. In the short term this will not be possible and Southern Water will have to apply for a Drought Order to overturn the Hands Off Flow (HOF) at Source A. This is covered in more detail in the Drought Plan 2018.

3.2.8 External Constraints

The deployable output assessment involved liaison with Southern Water over the modelling of naturalised flows in the River Itchen. This included the assumptions made about Chickenhall effluent discharges. After completion of the DO assessment Southern Water informed Portsmouth Water that the discharge from Chickenhall could be a lot lower in

drought events. Rather than re-run all the modelling for the River Itchen we have taken a nominal 5 Ml/d from the Source A DO for the drought scenarios. This represents a degree of pain sharing between Southern Water and Portsmouth Water as we would expect the bulk supplies to be reduced accordingly.

3.2.9 Source Constraints

Deployable output can be constrained by a number of factors:

- Licence Constraints
- Environmental Constraints
- Source Works Constraints
- Distribution Constraints
- Deepest Advisable Pumping Level

The following table sets out the licence quantities following the implementation of the Habitats Directive Review of Consents in December 2015.

	Abstraction Licence (Ml/d)	
Source Works	**Average**	**Peak Week**
Source A	45.5	45.5
Source C	20.5	31.5
Source E	0.5	0.5
Source F	9.0	15.0
Source H	9.1	13.6
Source I	1.5	7.0
Source J	22.7	25.2
Source K	11.4	13.6
Source B	98.0	137.0
LMNOP Group	65.0	94.6
QRST Group	28.4	41.0
Company Total	**312**	**425**

Table 4: Abstraction Licence Quantities (Ml/d)

The Source A surface water abstraction, on the River Itchen, is subject to a Hands Off Flow (HOF) condition of 198 Ml/d. This was set as part of the Habitats Regulation Review of Consents Site Action Plan. Portsmouth Water has fully implemented this requirement as a Licence Variation (September 2011).

Source B Springs also have a Minimum Residual Flow (MRF) condition where the Company cannot abstract water if the fresh water flows to the harbours fall below a prescribed level. The main part of this condition relates to the Brockhampton Mill Lake which has a MRF of 6.0 Ml/d. The second part relates to the Langstone Mill Stream which has a MRF of 1.3 Ml/d. These conditions were agreed in February 2010.

Some groundwater sources that were assessed as part of the Habitats Regulations Review of Consents were subject to a group licence condition. The LMNOP Group includes six source works and has additional seasonal abstraction conditions at Source P.

The current group licences are:

- Source B Springs
- Source C and Source D
- Source F and Source G
- QRST Group
- LMNOP Group

The LMNOP Group licence was the first licence to have a Minimum Residual Flow (MRF) condition included in the licence. The Source N licence also has a further condition associated with a compensation flow that must be provided to the River Ems when the flow in the river falls below 2.7 Ml/d. This augmentation water is now provided by our raw water source at Source U.

Source works constraints have been considered in the preparation of the assessment forms and diagrams (See Appendix 'A'). Pump capacity and pump depth are considered and a pump cut out level of 3m above pump depth has been assumed.

Only Source B Springs are constrained by treatment works capacity. When the licence was revised at Source B the annual total was set at 98.0 Ml/d. This is sufficient to allow Havant Thicket Reservoir to be filled but is also the nominal maximum treatment capacity at Works A.

Portsmouth Water only has a single Water Resources Zone and this implies that there is sufficient mains capacity to allow abstraction to be distributed across the Company's area. A high level assessment was undertaken for the WRMP 2009 and no significant changes have been made since then.

'Deepest Advisable Pumping Water Levels' (DAPWL) have now been calculated and they have resulted in lower DO's in some cases.

3.2.10 Sourceworks Assessment

From the source assessment diagrams AECOM initially calculated peak and average deployable outputs for each source. This took account of pump and borehole constraints but did not take account of group licences. The assessment was undertaken for the worst drought on record which for Portsmouth Water occurred in 1973.

The results for individual source works are shown below:

Sourceworks Individual Deployable Outputs		
Sourceworks	Average 1973	Peak 1973
Source A	39.2	40.7
Source B	52.5	71.0
Source C	20.5	22.5
Source D	0.7	2.7
Source E	0.5	0.5
Source F	9	12.4
Source G	1.9	3.8
Source H	9.0	9.1
Source I	1.5	2.2
Source J	10.2	10.2
Source K	11.4	12.3
Source L	16.0	16.0
Source M	4.0	6.3
Source N	26.1	35.2
Source O	1.8	5.4
Source P	10.0	10.0
Source Q	12.0	13.0
Source R	12.5	14.0
Source S	2.5	2.5
Source T	8.1	8.8

Table 5: Sourceworks Deployable Outputs

The values for MDO are essentially the same as ADO for individual sources.

Compared to the previous yield assessment for WRMP14 the following key changes have occurred:

- Source K is now available
- Source M DO reduced because of a large cavity DAPWL
- Source O DO has decreased due to DAPWL
- Source J DO has been reduced because of a major fissure flow DAPWL
- Source I DO has been reduced because of a new environmental river flow condition
- Source H DO has been reduced following reassessment at the environmental river flow condition
- Source C DO has decreased due to throttling of the borehole pumps to overcome a turbidity issue

- Source U is now unavailable due to the potential risk of cryptosporidium

3.2.11 Resource Zone Assessment

A resource zone model was developed by AECOM to calculate the deployable output for various levels of service. The resource zone model includes a time series of abstraction rates for each source. The model sums these time series, applies group licence constraints, and gives a total available abstraction rate. The introduction of a demand profile allows the critical period to be identified and a customer 'Level of Service' (LOS) analysis to be undertaken.

The WRPG requires companies to relate deployable output to levels of service. As a minimum, the Environment Agency expects companies to assess DO for the following levels of service:

- No Restrictions 'Dry Year' 1 in 20
- Reference Level of Service 'Severe Drought' 1 in 200

For the latest DO assessment AECOM has developed a 1,000 year time series based on stochastic weather data. This allows DO to be calculated for drought events outside the historic recorded data. The guideline describes these to be 'challenging but plausible droughts'. For Portsmouth Water the full range of scenarios is as follows:

- Dry Year 1 in 20
- Historic Drought: Scenario 'A' 1 in 40
- Extended Drought: Scenario 'B' 1 in 80
- Serious Drought: Scenario : Scenario 'A' 1 in 125
- Severe Drought: Scenario 'D' 1 in 200

The deployable output was also calculated for more extreme events but these do not form part of this WRMP.

The resource zone model determines observation borehole groundwater levels on a daily time step and calculates rest water levels. This gives the maximum available abstraction rate which the model then corrects for licence constraints and sums the source DO's to give the resource zone DO. The model runs the selected groundwater scenario and increases demand until the available resource fails to meet demand for a target number of years. So fifty failures within the 1,000 year stochastic sequence represents a 1 in 20 year event.

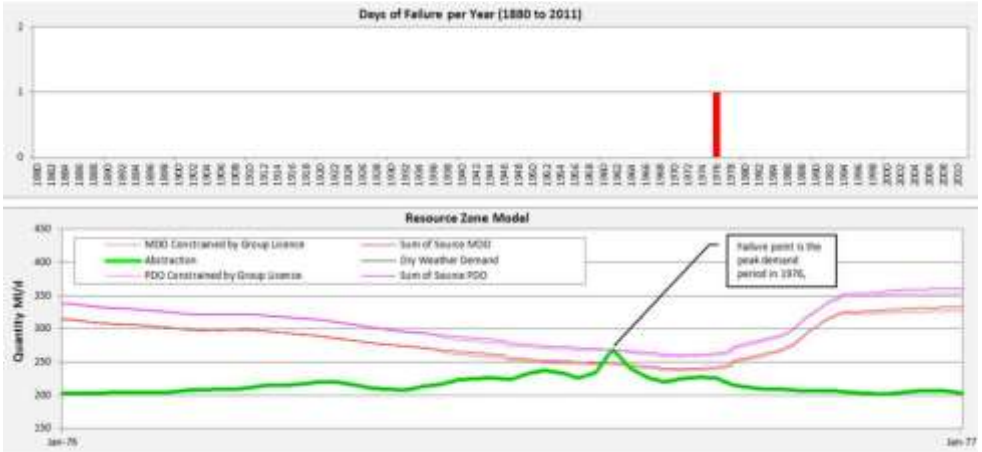


Figure 11: Return Period Calculation

Portsmouth Water has produced demand profiles to represent unrestricted demand (Dry Year 1 in 20) and a range of restricted demands. These represent the impact of Temporary Bans, Non-essential Use Bans and emergency Drought Orders. The Water Resource Zone model uses these profiles to predict deployable output.

Compared to the previous assessments the demand profile is now less smooth over the year and recognises a minor peak around Easter. It also shows the peak week in August which is later than previous profiles. This produces more conservative DO's and may reflect changing customer behaviour and the impact of climate change.

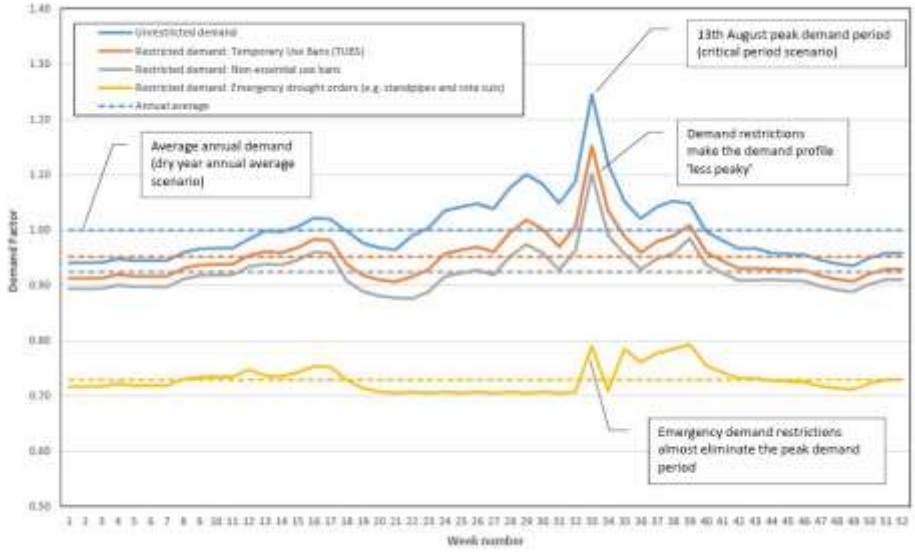


Figure 12: Water Resource Zone Demand Profiles

The Water Resources Zone Model produces unrestricted and restricted estimates of deployable output. The restricted estimates use the scenario profiles to calculate DO for a given return period.

The following graph shows how this relates to ADO, PDO and MDO.

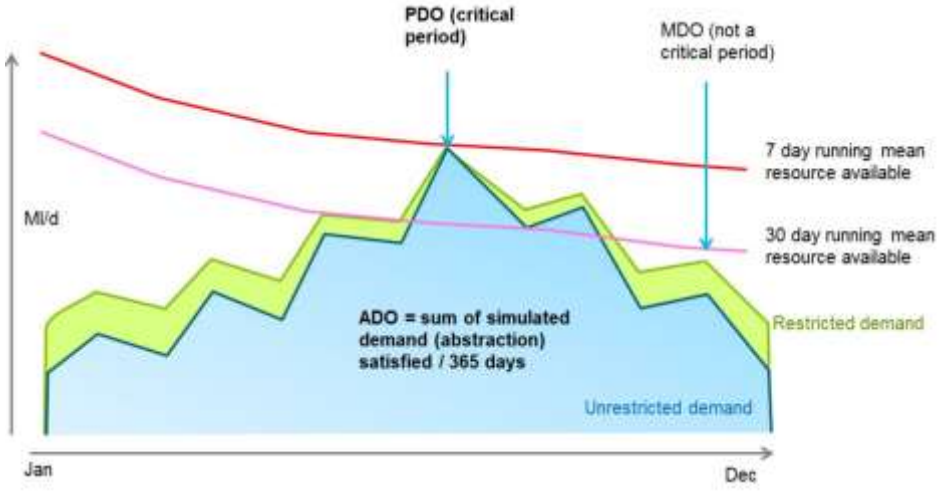


Figure 13: Influence of Demand Profile on Deployable Output

The demand profiles do not impact on modelled groundwater levels but it is possible that demand restrictions could help conserve aquifer storage. The effect is believed to be relatively minor when compared to the impact of demand restrictions on surface water storage reservoirs.

Emergency Drought Orders are not part of the WRMP process and supply side Drought Permits are excluded for the DO assessment. Drought Permits are considered to be options and are representative in the Final Planning Tables if required.

The Resource Zone Model does not take account of bulk supplies to Southern Water. These are represented as separate inputs to the WRMP tables.

3.2.12 Deployable Output Assessment

The deployable outputs for each source works for each of the scenarios is given in Appendix 'A'. Rather than use the deployable output of an actual Dry Year as was done in the past, the Water Resource Zone Model now uses a simulated one. This is based on the latest demand profiles and matched the 'Dry Year' level of service of 1 in 20.

The 'Worst drought on record'/'Historic Drought' is also simulated with a return period of 1 in 40. Under this scenario demand restrictions would apply but no drought permits would be required. Portsmouth Water has only implemented one demand restriction, a temporary usage ban in 1976.

Return period	ADO Ml/d	PDO Ml/d	MDO Ml/d
1 in 20	227	280	252
1 in 40	212	270	237
1 in 80	207	263	233
1 in 125	198	252	234
1 in 200	191	236	222

Table 6: Total Deployable Output

As noted earlier, since the production of the DO Assessment Southern Water have stated that the discharge from Chickenhall WTW is likely to be lower than previously forecast. This will reduce the DO from Source A and therefore the overall Company DO.

The table below allows for a 5.0 Ml/d reduction in yield from Source A for scenarios with a return period of 1 in 40 or greater.

Total deployable output is used in Section 5 as part of the overall supply/demand balance.

	1 in 20: Dry	1 in 40: Historic	1 in 80: Extended	1 in 125: Serious	1 in 200: Severe
Source A	36.9	31.6	30.3	30.2	20.0
Source B	53	47.6	46.6	42.4	42.9
Source C	17.3	17.2	16.6	16.5	16.3
Source D	1.1	0.8	0.8	0.6	0.8
Source E	0.4	0.4	0.4	0.4	0.4
Source F	7.2	7.3	7.1	7.2	6.9
Source G	1.5	1.6	1.5	1.5	1.5
Source H	7.7	7.6	7.3	7.3	7.2
Source I	1.5	1.4	1.4	1.3	1.4
Source J	9.1	8.5	8.5	7.8	8.3
Source K	9.6	9.5	9.2	9.1	9.0
Source L	13.7	13.3	12.9	12.5	12.6
Source M	4.5	3.7	3.5	2.8	3.8
Source N	22.2	22.1	21.3	21.1	20.9
Source O	4.1	2.9	2.8	1.6	2.8
Source P	8.4	8.4	8.1	8.0	7.9
Source Q	9.7	9.7	9.7	9.6	9.6
Source R	10.3	10.2	10.2	10.1	10.1
Source S	1.9	2.0	1.9	2.0	1.9
Source T	6.4	6.5	6.5	6.4	6.4
Total	**227**	**212**	**207**	**198**	**191**

Table 7: Sourceworks Average Deployable Output

The peak week values have not been reduced because the Chickenhall input will be greater during the critical period when demand for water is higher.

	1 in 20: Dry	1 in 40: Historic	1 in 80: Extended	1 in 125: Serious	1 in 200: Severe
Source A	40.6	40.6	40.6	40.6	39.4
Source B	57.8	52.1	48.7	43.9	39.0
Source C	22.5	22.5	22.5	22.5	21.8
Source D	2.4	2.1	1.9	1.7	1.5
Source E	0.5	0.5	0.5	0.5	0.4
Source F	11.7	11.9	12.1	11.9	8.8
Source G	3.3	3.1	2.9	2.6	2.3
Source H	9.1	9.1	9.1	9.1	8.8
Source I	2.1	2.0	1.9	1.9	1.8
Source J	10.2	10.2	10.2	7.9	7.9
Source K	12.3	12.2	12.2	12.2	13.2
Source L	15.5	15.0	14.7	14.3	13.6
Source M	6.0	4.8	3.9	2.8	2.0
Source N	35.2	35.2	35.2	33.9	30.7
Source O	4.2	2.7	1.7	1.3	1.0
Source P	10.0	10.0	10.0	10.0	10.0
Source Q	12.4	12.1	11.6	11.7	11.2
Source R	13.5	13.1	12.5	12.6	12.0
Source S	2.5	2.5	2.4	2.5	2.4
Source T	8.5	8.4	8.0	8.2	7.8
Total	**280**	**270**	**263**	**252**	**236**

Table 8: Sourceworks Peak Deployable Output

	1 in 20: Dry	1 in 40: Historic	1 in 80: Extended	1 in 125: Serious	1 in 200: Severe
Source A	40.1	45.0	45.0	39.7	32.4
Source B	56.4	42.6	41.3	44.8	61.8
Source C	21.0	20.9	20.8	20.8	14.6
Source D	0.9	0.5	0.5	0.5	1.2
Source E	0.5	0.5	0.5	0.5	0.3
Source F	8.9	9.2	9.1	9.1	5.9
Source G	1.9	1.9	1.9	1.9	1.2
Source H	9.3	9.1	9.1	9.1	6.5
Source I	1.6	1.5	1.5	1.5	1.7
Source J	10.4	7.5	7.1	8.3	8.1
Source K	11.6	11.6	11.5	11.5	11.0
Source L	16.1	15.1	14.9	15.2	13.1
Source M	4.6	1.9	1.7	2.4	4.3
Source N	26.8	26.6	26.5	26.5	18.6
Source O	2.8	0.4	0.3	0.7	5.1
Source P	10.3	10.2	10.2	10.1	7.1
Source Q	9.9	10.9	10.6	10.6	9.8
Source R	10.4	11.3	11.0	11.1	10.6
Source S	2.0	2.4	2.3	2.3	1.8
Source T	6.6	7.4	7.2	7.2	6.4
Total	**252**	**237**	**233**	**234**	**222**

Table 9: Sourceworks Minimum Deployable Output

3.2.13 Future Reviews of Deployable Output

In addition to linking the deployable output from the WRMP with the drought planning scenarios, it would be sensible to co-ordinate work on the River Itchen. The use of the Environment Agency groundwater model and Southern Water's sustainability reductions will need to be reviewed for the next plan.

With the requirement to plan for rarer droughts it will be necessary to do further work on deepest available pumped water level. This will indicate if pumps can be dropped under drought conditions to retain the deployable output. In some cases, the pump level will be constrained by the presence of audits and critical fissures. Portsmouth Water will undertake to carry out this work in time for the next Drought Plan/WRMP.

3.3 Sustainability Reductions

Reductions in deployable output can occur as a result of environmental investigations which determine that abstraction has an adverse impact on the environment.

3.3.1 Previous Sustainability Reductions

The first sustainability reductions to affect the Company resulted from investigations into the impact of abstraction in the Bishop's Waltham area in the 1990's where, it was determined that Hoe Water Treatment Works impacted on the Moors SSSI. An options appraisal led to the closure of Hoe in August 2003 and the development of Source D and Source G. These satellite boreholes were developed in the confined chalk where there were no significant impacts on surface water features.

3.3.2 Habitats Directive Review of Consents

The Habitats Directive Review of Consents was carried out by the Environment Agency in 2005. As a result of the review Portsmouth Water made changes to the following licences:

- Source N
- Source U
- Source O
- Source P
- Source M
- Source L
- Source B
- Source A

3.3.3 Further Habitats Directive Investigations

Following completion of the initial Habitats Directive Investigations, and having complied with the Site Action Plans, Portsmouth Water was required to carry out further studies at a number of sites. This involved further work on harbours and estuaries and was carried out by our Consultants AMEC who produced a Final Report in March 2013. Portsmouth Water were asked to study:

- Hamble Estuary
- Titchfield Haven
- Hill Head Harbour
- Fareham Creek

AMEC concluded that there were no adverse effects from abstraction on the Hamble Estuary. They also concluded that there was no adverse effect on Titchfield Haven or Hill Head Harbour but there might be an 'in-combination' effect. There are a number of spray irrigators which abstract water from the River Meon and the 'Canal' at Titchfield Haven. The Environment Agency chose to initially time limit Portsmouth Water's Source F Licence until December 2017 to allow time for further investigations to take place.

Our understanding is that the spray irrigators were not approached until the end of 2014 and one spray irrigator agreed to a voluntary licence reduction at that time. In January 2015 the

Environment Agency commissioned AMEC to undertake modelling of Titchfield Haven. This was designed to show if there was an 'in combination' effect on the Haven or the Harbour in relation to the internationally protected bird interests.

The modelling tested whether there was an in-combination effect on the protected features at Titchfield Haven. The environmental criteria were:

- Enough flow for habitats in Titchfield Haven
- Some flow into Hill Head Harbour
- Enough flow for upstream fish migration

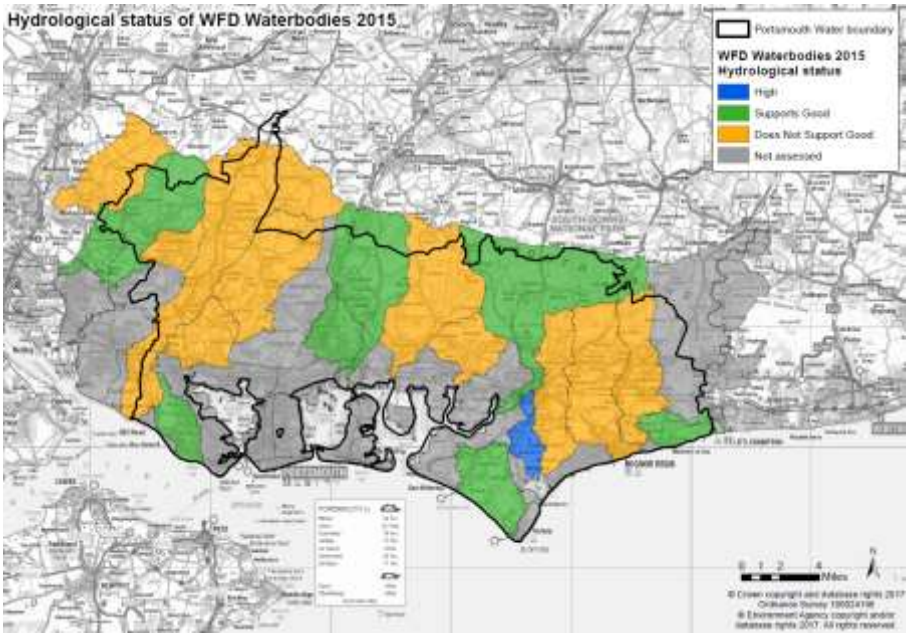
The modelling concluded that reductions in the spray irrigation abstractions could reduce, but not remove, the risk of impact on the special protection area (SPA) at Titchfield Haven. Groundwater modelling shows that Portsmouth Water's abstractions on the Meon have relatively little impact on low flows. The Environment Agency, however, decided to impose a temporary augmentation clause on the Source F licence which was reviewed in December 2015.

The temporary clause was due for re-assessment in December 2017 and Portsmouth Water proposed alternative mitigation works at Titchfield Haven. These were rejected by the Environment Agency and the augmentation clause will become permanent in December 2017. This has resulted in a deployable output reduction of 2.0 Ml/d in the WRMP for Source F.

Fareham Creek is impacted by abstraction at Source I and Source J. At low flows it was agreed that abstraction at Source I should be restricted to 1.5 Ml/d to ensure freshwater discharges to the harbour. The Source I Licence was varied in May 2015 and the Deployable Output Assessment has taken account of this restriction.

3.3.4 Water Framework Directive

The Water Framework Directive (WFD) has become the main driver for sustainability investigations. The Environment Agency published the River Basin Management Plan in the South East in December 2009, with the aim of returning all water bodies to 'Good Ecological Status' (GES) by 2015. Where this is not practical for economic reasons, further deadlines have been set for 2021 and 2027. Below is a map of the Portsmouth Water operating area which shows the water bodies and their hydrological status.



High level information regarding these water bodies can be found in the Drought Plan (Appendix 'U').

In 2010 Portsmouth Water asked AMEC to investigate the impact of abstraction on four water bodies:

- River Hamble
- River Wallington
- River Ems
- River Lavant

An additional water body, Source T Rife, was added to the list in 2011 and the Environment Agency chose to investigate three further water bodies:

- River Meon
- Bosham Stream
- Fishbourne Stream

As part of the investigation Portsmouth Water set up a 'Stakeholder Group' which consisted of the following regulators and NGO's:

- Environment Agency
- English Nature
- CC Water
- Hampshire County Council
- Hants and Isle of Wight Wildlife Trust
- Sussex Wildlife Trust

AMEC concluded that the River Hamble was in relatively good condition but abstraction from Source C will impact on the North Pond in Bishop's Waltham and the water body just

downstream. Options for supporting flows in this section of river were considered in the NEP (Section 3.3.6).

The Upper Wallington has little or no connectivity with groundwater at times of low flow. The impact of abstraction on the ecology of the river is considered to be minor. The Lower Wallington would only be impacted under 'Fully Licensed' conditions and then only in the area of the tidal limit. Low flows are supported by discharges and the licence variation at Source I (May 2015) included a limit on abstraction which will improve flows at the bottom of the catchment.

AMEC concluded that the River Ems was impacted by abstraction but an augmentation scheme went some way to mitigate this at low flows.

It was recommended that the augmentation scheme be reviewed and this was done in association with the Environment Agency. Source U, which is adjacent to the River Ems, became available as a raw water augmentation source. The works washout discharges into the River Ems approximately 0.8km upstream from the original augmentation point. During 2013 and 2014 trials were carried out using the washout location and a raw water flow of double the existing agreement. The majority of this augmented water reached the village of Westbourne and continued down the River Ems to the tidal limit.

The Environment Agency expressed concern about the short circuiting of augmented water back to the Source U. Under the flow conditions experienced in 2013 and 2014 this did not seem to be the case. It is possible that under drier conditions, such as 1973 or 1976, not all the augmented water would reach Westbourne. This was taken into account when the Source N and Source U Licences were re-issued in April 2016. These licences are time limited to 2028 with the augmentation flow falling to the lower original flow and location if not renewed.

The River Lavant is naturally 'ephemeral' with periods of no flow in most years. The overall ephemeral nature and extent is not affected by abstraction. The ecological data shows relatively little sensitivity to the duration of wetting and drying with rapid recovery once flow commences.

The Company believes abstraction within current licenses is sustainable under the Water Framework Directive. A large number of licences have been varied and conditions set to protect the environment. Since the 1980s overall abstraction has fallen significantly due to leakage reductions and the decline of manufacturing in the area. Under drought conditions the need for 'Drought Orders' or 'Drought Permits' has been carefully considered. The environment will only be impacted during rare events when many features would naturally be dry. Under extreme events the Secretary of State will determine what license conditions can be overturned in the interest of public water supplies.

The WFD investigations were completed in March 2013 and the subsequent options appraisals were completed in 2014 and included in the National Environment Programme (NEP).

The outcomes from the WFD Investigations were considered in the WRSE Modelling. Portsmouth Water believes that further sustainability reductions are unlikely and no allowance has been made in the current WRSE modelling.

3.3.5 Water Resources in the South East

Portsmouth Water has been involved in Water Resources in the South East (WRSE) for many years. This is a joint initiative to identify potential 'Regional Solutions' such as bulk supplies between companies. WRSE undertook a modelling exercise, producing a base line solution and a number of scenarios. Although the Baseline model only contains confirmed and likely sustainability reductions other scenarios consider larger sustainability reductions.

3.3.6 National Environment Programme

The National Environment Programme (NEP) was set up by the Environment Agency to ensure compliance with environmental legislation. In August 2012 the Environment Agency published a list of possible environmental schemes based on the evidence available at that time. With the publication of the PIM/WFD Investigations it was possible for the Environment Agency to update the NEP programme. The Environment Agency published the National Environment Programme (NEP) in August 2013.

The NEP spreadsheet contained proposals to review augmentation on the River Ems and to consider river restoration work. The NEP also covered river restoration on the Hamble to support abstraction at Source C. Portsmouth Water included these schemes in the WRMP 2014 and in the Business Plan 2014. The NEP Scheme was covered by an 'Outcome Delivery Incentive' (ODI) in the Business Plan.

Portsmouth Water considered river restoration at two sites on the River Ems at Watersmeet and Deep Springs. The Watersmeet site proved unsuitable for major restoration work due to the presence of a large number of Water Voles. Portsmouth Water did assist with the de-silting of an online pond and funded alterations to two control structures. The control structures allow low flows to be diverted to the 'Main River' for the benefit of migrating fish.

At Deep Springs the river benefits from the revised augmentation flows and the channel was suitable for restoration. Portsmouth Water worked with the local Rivers Trust to produce an acceptable scheme. This included liaison with the land owners and regulators including Natural England and the South Downs National Park. The work was completed in September 2015 and accommodated high flows that winter.

Collaboration with the Rivers Trust ensured that other schemes were developed downstream with other landowners and funding sources. This has provided a real benefit in terms of fish migration on the River Ems.

On the River Hamble the Environment Agency set out a range of measures that it wanted to see. These included:

- Bankside fencing
- Installation of Woody Debris

Unfortunately due to issues with the land owners it was not possible to deliver these measures. In association with the Rivers Trust and the Downs and Harbours Clean Water Partnership alternative measures were developed. These included:

- Silt traps
- Road drainage improvements
- Hard surface cattle crossings

- Weir removal

These measures were approved by the Environmental Agency and implemented in the summer of 2016 and 2017.

At Titchfield Haven Portsmouth Water initially assumed that variations to the spray irrigators licences would ensure a sustainable outcome. In September 2015 the Environment Agency informed Portsmouth Water that they intended to place a temporary augmentation clause on the Source F Licence. This was challenged by the Company because of the loss of deployable output. An offer of mitigation measures at Titchfield Haven was rejected and the augmentation clause will become permanent in December 2017. The augmentation water is provided by Source G and represents 2.0 Ml/d.

The licence variation at Source I was agreed without the need for further investigations or any river restoration measures.

The 'Catchment Partnerships' which oversee implementation of the WFD schemes encourage collaborative work with local stakeholders. Portsmouth Water has worked with the two partnerships in its area of supply to help deliver the NEP schemes. Successful management schemes have involved joint working with NGO's and the regulators.

3.3.7 Water Industry National Environment Programme

The Water Industry National Environment Programme (WINEP) was published in September 2017 by the Environment Agency to ensure compliance with current environmental legislation. Portsmouth Water has already complied with the majority of the sustainability drivers. The key issue for Water Resources seems to be the prevention of deterioration of Water Body status. The Environment Agency has suggested that Portsmouth Water should study the following source works again:

- Source O
- Source L
- Source M
- Source J
- Source N
- Source F
- Source A

Abstraction at all of these sites is considered to be sustainable by Portsmouth Water as we have recently varied licences. Portsmouth Water have existing bulk supplies to Southern Water and the WRMP contains proposals for the enhancement of one bulk supply and the provision of a new one to South East Water. These bulk supplies will require additional abstraction but the issue is whether these additional abstractions are damaging to the environment. In the case of the enhanced bulk supply to Southern Water this is designed to replace an existing unsustainable abstraction upstream on the River Itchen by Southern Water.

Water for the bulk supply will be abstracted at Source A. This is also on the River Itchen but it is downstream and in a more sustainable location. In the future the bulk supply will also be supported by the development of Havant Thicket Reservoir. The reservoir will be filled with

water from Source B Springs. Abstraction at this location is also sustainable with Minimum Residual Flow (MRF) conditions to protect the bird interests in Langstone Harbour.

The Environment Agency has also asked Portsmouth Water to investigate the impact of tighter flow standards on the River Itchen. These flow standards are set out in the 'Common Standards Monitoring Guidance' (CSMG) document but these are not a regulatory requirement yet. They have not been the subject of a Regulatory Impact Assessment and the Environment Agency has not provided any details for the River Itchen.

Using the flow simulation from the DO assessment it is possible to estimate the impact of the tighter standard. Portsmouth Water think that all the impact will be at low flows and that it will fall on Southern Water's SRN Source A abstraction. This abstraction is upstream from Source A and upstream from the Chickenhall WWTW discharge. Even under the lowest flow conditions, Portsmouth Water should be able to abstract 20 Ml/d at Source A. If abstraction is limited to this figure then the bulk supplies to Southern Water would be affected but not the supply to Portsmouth Water.

The WINEP spreadsheet, which sets out the Environment Agency's requirements, also includes a new designation, the Solent and Dorset Coast SPA. Natural England have confirmed verbally that this is a marine protection area designed to ensure feeding areas are available for Terns. The associated harbours have already been investigated by Portsmouth Water and the freshwater flows do not influence feeding Terns. We believe there is no justification for any further investigations (See appendix 'B').

3.3.8 Sensitivity Tests

The planning guidance requires companies to consider scenarios to test its Plan. Portsmouth Water has considered the sensitivity of the Plan to even lower deployable output. This could be due to further sustainability reductions or to greater than expected climate change impacts.

Section 8 considers a scenario where deployable output is reduced by a further 10% of the end of the planning period.

3.4 Climate Change

For the WRMP 2019, Portsmouth Water has completely revised the assessment and the data on which it is based. The WRMP requires companies to use UKCP09 data and the methodology set out in the UKWIR report 'Climate Change and Water Resources Planning' (2012). In addition to this new guidance was issued in relation to forecasting river flows in the 2080's.

3.4.1 Vulnerability Assessment

The first stage of the methodology is to assess the vulnerability of the Company's sources to climate change impacts. Portsmouth Water employed AECOM to do the overall deployable output assessment and they were assisted by HR Wallingford (HRW) for the climate change work. The vulnerability assessment is based on information already available from previous WRMP's and Drought Plans.

HRW produced a vulnerability assessment summary table (see Appendix 'C') and this concluded that the overall sensitivity was 'medium'. This implied that a full climate change assessment was not required but AECOM has carried out one anyway.

3.4.2 Climate Change Impacts on Surface Water

For the WRMP 2019, HRW have used the UKCP09 projections of climate change impacts. The full set of data contains 10,000 projections of weather data but HRW advised the company that a subset of 100 results represents the full range of uncertainty in the climate change projections. HRW have set out how the sampling approach works and what the results look like for the South East of England (Appendix 'C').

To apply the climate change projections to surface water flows the consultants used a CATCHMOD surface water model developed for the River Itchen at Source A. The Environment Agency provided baseline daily rainfall, potential evaporation and temperature data from 1880 to 2005. This data was 'perturbed' using the monthly UKCP09 factors for the 100 selected samples and the model was run 100 times. A set of 100 river flow time series were generated for the flow gauging sites at Allbrook and Highbridge (which are both upstream of our abstraction) and these were then transposed to Riverside Park using a regression relationship. Riverside Park is the gauging point at the tidal limit which is used to control abstraction at Source A.

Figure 14 presents the potential impact of climate change on flows by 2080 for Allbrook and Highbridge under a 'Medium' emissions scenario.

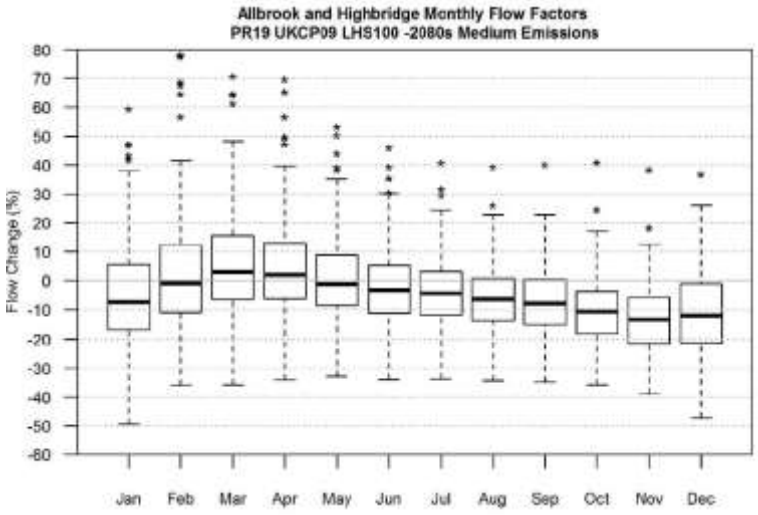


Figure 14: Climate Change Impact on Surface Waters

3.4.3 Climate Change Impacts on Groundwater

For the WRMP 2019, AECOM have produced a 'Groundwater Level' model which allows groundwater impacts to be assessed in more detail. The sub set of 100 climate change projections is used to perturb Well 'X' levels. Portsmouth Water uses this well to measure the level of groundwater. The 100 groundwater levels are inserted into the 'Resource Zone' model, which calculates the abstraction rate at each source works. This relatively simple approach to climate change impacts on groundwater has produced results that are consistent with previous modelling. Climate change causes groundwater levels to fall and therefore groundwater yields to fall also.

3.4.4 Combined Climate Change Impacts

When the surface water impacts at Source A are added to the groundwater impacts the combined impact in 2044 is -0.92 Ml/d at average and -2.70 Ml/d at peak.

Year	2019	2024	2029	2034	2039	2044
ADO	-0.04	-0.21	-0.39	-0.60	-0.75	-0.92
PDO	-0.2	-0.70	-1.20	-1.70	-2.20	-2.70

Table 10: Climate Change Impact of on Deployable Output

The requirement to set out the water balance for drought events, in the WRMP, means that the impact of climate change on rare events needs to be considered. This was not done for the Drought Plan 2018 because it was considered to be an 'operational plan' and specifically excluded climate change. It is likely that climate change will impact on rare events and more work needs to be undertaken.

3.4.5 Headroom Allowance

The statistical approach to climate change produces a central forecast and a range of uncertainty. This can be used to calculate the impact of climate change on deployable output and feeds into the headroom assessment. (See appendix 'F')

For the WRMP 2019, AECOM have used the uncertainty data from HRW to populate the Monte Carlo simulation. The guideline and the table definition require the climate change element of headroom to be separated out. Headroom is described more fully in Section 5.2 and in Appendix F.

3.5 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.

3.5.1 Previous Outage Assessment

The outage assessments are based on the UKWIR methodology 'Outage Allowances for Water Resources Planning' (1995). For the 2014 Plan, data was analysed for the period 2007-2012.

For the WRMP 2019, the assessment is based on data from 2007-2016. This ensures that the outage is relevant for the following five year time step. Over a longer period outage will continue to be influenced by power failure, system failure and pollution incidents.

3.5.2 Current Guidance

The guidance requires companies to pre-consult on the outage methodology if it is different from the UKWIR methodology therefore Portsmouth Water did not need to pre-consult with all the stakeholders but has shared the Draft Report with the Environment Agency.

3.5.3 Methodology

The methodology is set out in the report produced by AECOM and complies with the UKWIR approach (see Appendix 'D'). Historical data has been split into outage categories with magnitudes and durations recorded. A Monte Carlo simulation is used to simulate outage in the future having justified which events are 'legitimate'. AECOM used a model called @ RISK to carry out the simulation and have commented on the seasonal distribution of outage and the repeatability of results. The risk percentiles and the relative contributions are set out in the appendix.

3.5.4 Analysis of Recorded Data

Since 2007 Portsmouth Water's operational staff has 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 the Company have been recording outages of less than one day.

Figure 3-1 Seasonal Distribution of Recorded Outage Events, 2007 – 2016

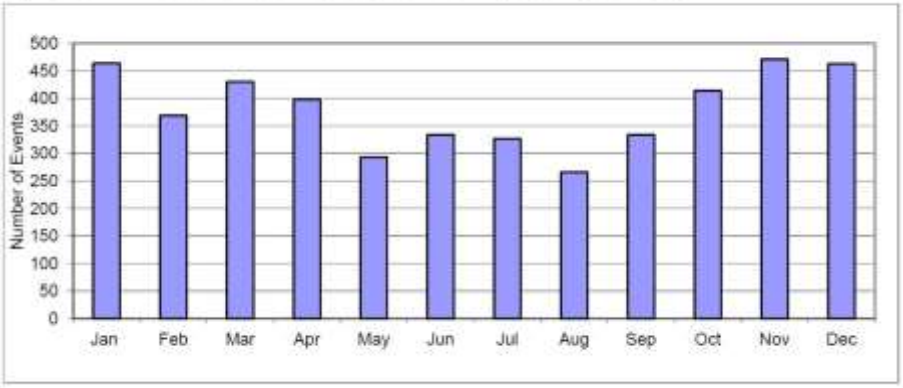


Figure 15: Outage Events by Month

Over the ten year period there were 4,563 outage events of which 19% were planned and 81% were unplanned. Less work is planned in the summer months when peak demands are likely to occur.

3.5.5 Outage Assumptions

The analysis of future outage is based on events that are considered to be 'legitimate'. If an unplanned event lasts for more than 90 days it is capped at 90 days. This is because the works may have shut down because it was not needed to meet demand rather than because of an actual outage event. Additionally, events that have lasted for long periods, such as a shutdown to reduce the risk of cryptosporidium, will have been resolved by capital investment prior to the next plan.

For the current assessment the following events have been capped at 90 days:

- 112 day event at Source O caused by turbidity
- 365 day event at Source F caused by a system failure (Booster pump)
- 345 day event at Source G caused by a system failure (Telemetry)
- 128 day event at Source K caused by a system failure (Membrane)
- 149 day event at Source A caused by a system failure (Booster pump)

Most outage events at Portsmouth Water are considered to be all of the deployable output at each site. This is because works shut down on alarms and are only re-started when supply staff visit site.

Planned events are not included in the analysis of the critical period because maintenance is not carried out in the peak week.

Significant outages related to cryptosporidium have been reduced with the provision of UV treatment plants at Source Q and Source R.

Oil pollution has been included as a generic risk in headroom because it is considered to be randomly related to individual works. Past pollution incidents at Source J, Source C, Source K and Source R do not mean that these sites will be impacted again in the future.

The turbidity events can increase the risk of cryptosporidium risk because turbidity can mask the presence of crypto oocysts. Cryptosporidium risk can be seasonal because it is linked to lambing and surface run off.

The algae category has been dropped from the analysis because the problems at the River Itchen works have been resolved. There is no algae risk at the groundwater sources.

The Monte Carlo simulation now involves 10,000 iterations rather than the 1,000 used previously providing a more robust result.

3.5.6 Results

Outage allowances have been calculated for three scenarios:

- Annual Average
- Critical Period (Peak Week)
- Minimum Deployable Output

A probability of 90% has been used and the results compared with the previous Plan.

Scenario	WRMP 2014	WRMP 2019
Annual Average	9.3	14.7
Critical Period	4.6	12.5
Minimum Deployable Output	10.8	16.2

Table 11: Outage included in WRMP (Ml/d)

Outages is assumed to be higher than the previous plan because events shorter than one day have been included.

Outage has been calculated for each works but the figures are not cumulative as all sites are not assumed to be unavailable at the same time. The combined probability distributions are provided in the detailed report (Appendix 'D').

3.6 Process Losses

Treatment works losses only apply to sources with more complex processes such as rapid gravity filtration and membrane filtration. Portsmouth Water has two works with full conventional treatment and two works with membranes for cryptosporidium removal. At two works there is a compensation water condition in the licence but this raw water loss is not included in process losses.

In general, complex treatment works such as Works A have losses of around 5% of DO. At Works B, membrane filters have now been replaced with a UV treatment plant and losses have fallen to less than 1%.

The following table summarises the process losses assumed for a Dry Year:

Source Works	Treatment	Average (Ml/d)	Peak (Ml/d)
Works A	Complex	1.9	1.9
Works B	Complex	0.2	0.2
Source F	Membrane	0.1	0.1
Source K	Membrane	0.1	0.1
Source P	Membrane	0.1	0.1
Total		2.4	2.4

Table 12: Process Losses

Portsmouth Water does not include treatment works losses in the calculation of deployable output. Treatment works losses and raw water losses are entered as separate lines in the WRMP Tables. The tables then combine these to give the overall process loss.

The River Ems augmentation flow has been removed from the process losses because it has been be provided by raw water since 2015. The augmentation is provided by Source U which has been removed from the overall DO assessment.

3.7 Bulk Supply Imports

The guidance requires companies to consider a wide range of supply options including bulk transfers from other companies and third party suppliers. Portsmouth Water has been fully involved in the WRSE modelling programme which included bi-directional flows in the existing Southern Water bulk supply and potential bulk supplies from South East Water. That said, these options are not required.

3.7.1 Whiteways Lodge (Southern Water)

The existing bulk supply from Portsmouth Water to Southern Water has an average and a peak capacity of 15.0 Ml/d. Water is pumped from Source S Works to Whiteways Lodge and then gravitates to SRN Source D Treatment Works. It would be possible to pump water from SRN Source D to Whiteways Lodge and for the water to gravitate to Source S. From here it could be pumped to Littleheath Reservoir using the existing booster pumps.

3.7.2 Clanfield (South East Water)

An option to transfer water from a South East Water Service Reservoir in Petersfield, to the Portsmouth Water Service Reservoir at Clanfield was included in the WRSE model. This would include high lift pumps at Petersfield and a pipeline across the South Downs to Clanfield. A route was selected that would minimise the pumping head and minimise the environmental impact on the chalk downs and ancient woodland. This option was not selected by the model and South East Water did not offer a bulk supply to Portsmouth Water.

3.7.3 Third Party Supplies

No third party suppliers have contacted Portsmouth Water with a firm offer of supplies. The Contact Plan (Appendix 'T') records the potential suppliers that Portsmouth Water considered. Portsmouth Water already has two housing developments where a third party delivers the water to the end user. In these cases, Portsmouth Water is retained as the bulk supplier and there is no net increase in supply. It would be possible for a developer to install effluent re-use and therefore create a nominal surplus for Portsmouth Water to use elsewhere. This has not happened so far.

3.7.4 Bulk Supply Exports

Portsmouth Water already has a bulk supply export to Southern Water (as explained in Section 4.9).

A second bulk supply to Southern Water is due to be commissioned in 2018. It would be possible to use this bulk supply in reverse but under dry or drought conditions Southern Water do not have a surplus. Under normal conditions this reversal does offer some additional resilience to Portsmouth Water.

4 DEMAND

4.1 Introduction

This section details the Portsmouth Water demand forecast for WRMP19.

Figure 1 shows the company's historic Distribution Input (DI) from 1963/64 to 2016/17. There has been a steady decline in DI since the industry was privatisation in 1989 as a result of leakage management, declining non-household demand and greater household water efficiency. Since 2010 there has been a steady fall in DI from 181 Ml/d to 170 Ml/d in 2016/17, this is attributed to a fall in commercial demand of 7 Ml/d in addition to increased active leakage control, pressure management and household water efficiency.

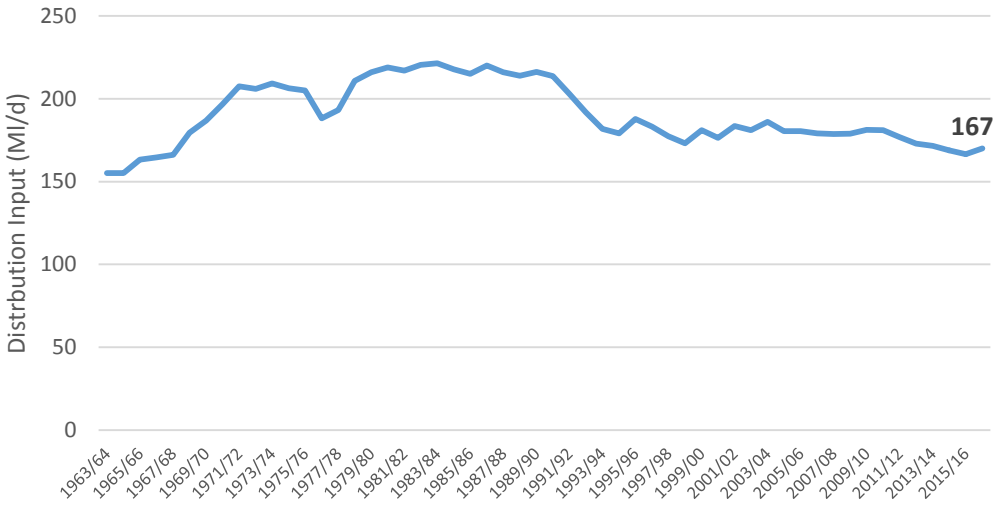


Figure 16: Historic Average Distribution Input (Ml/d)

The base year for the forecast is 2015/16 in which the company saw its lowest recorded DI of 167 Ml/d. The outturn DI figure for 2016/17 shows an increase of 3 Ml/d from the base year as a result of dry conditions causing an increase in water delivered and leakage; this however does not significantly alter the assumptions used for the forecast demand out to 2044/45.

	Units	2015/16	2025/26	2035/36	2044/45
Population	#	715,452	758,716	799,930	832,739
Properties	#	314,005	335,637	359,503	379,156
Meter Penetration	%	27%	49%	61%	67%
Average PCC	l/h/d	139	132	130	130
Distribution Input	Ml/d	168	167	169	172

Table 13: Summary of baseline WRMP Demand Forecast (Normal Year Annual Average, NYAA)

Table 13 shows a summary of the demand forecast for the Normal Year Annual Average (NYAA) scenario. Despite that total population is expected to increase by nearly 16% by 2044/45, overall DI is expected to remain relatively flat, falling over the period before returning to 172 Ml/d by 2044/45.

Demand is supressed over the period as a result of baseline water efficiency, falling non-household demand and the companies continued commitment to 5,000 meter optants per year up to 2027/28. The 5,000 meters per year average target consists of traditional meter promotion activities in addition to a new 'not for revenue meters' approach will start in 2018/19.

4.2 Demand Scenarios

The following demand scenarios are presented in this section.

- **Normal Year Annual Average Demand (NYAA):** The annual average daily value of demand under 'normal' weather conditions.
- **Dry Year Annual Average Demand (DYAA):** The annual average value of demand under dry conditions without any restrictions in place. For Portsmouth Water this is considered to be a 1 in 20 year event and is matched against a 1 in 20 year Deployable Output and the 1 in 20 Minimum Deployable Output (MDO) scenario.
- **Dry Year Critical Period Demand (DYCP):** the peak week in summer that occurs during the Dry Year (1 in 20), this demand scenario is matched with the Peak Deployable Output (PDO) scenario.

4.3 The Base Year

4.3.1 Demand Normalisation

Demand varies year to year as a result of long term changes such as leakage reduction, non-household demand, water efficiency, metering and increasing properties and population. Demand is also affected by weather which has a more immediate effect on consumption and leakage.

Demand normalisation seeks to separate trend from the effects of weather so that an estimate can be made of the demand that would have occurred in the base year had 'Normal' or 'Dry' conditions been experienced.

A weather demand model consistent with that described in the UKWIR 'WRMP19 Methods – Household Consumption Forecasting' (UKWIR, 2016) guidance was developed that allows historical weather data to be run through the base year to determine 'what if the weather in year X occurred again in 2015/16?

The model was developed using the following process:

1. Weekly company record of Distribution Input (DI) back to 1997/98 is combined with rainfall and temperature data.
2. DI is decomposed into a smoothed trend element reflecting changes in the customer base and leakage reduction.

3. A Random Forest regression, an effective non-linear statistical model, is fitted to the trend and weather data.
4. The model is validated against the historical data.
5. The trend element is held as at 2015/16 whilst historical weather is run back through the model.
6. The weekly simulated time series is aggregated to annual averages and annual maximum DI (peak week).
7. Statistical distributions are fit to annual averages and annual maximums.
8. The 50th Percentile is used to represent the Normal Year whilst the 95th Percentile is used to represent the Dry Year (1 in 20).

UKWIR WRMP19 Methods – Household Consumption Forecasting' recommends removing leakage from DI before modelling. A weekly time series of leakage for the period was unavailable therefore could not be separated from DI. It is argued however that the impact of this is relatively small as the variance of leakage will likely only account for up to 5% of total variance in DI in any week. Additionally, long term leakage control will be reflected in the trend element of the models whilst the leaks from bursts as a factor of weather will be captured in the weather variables.

Portsmouth Water have not had any restrictions in the period 1997 to 2015 and so all years are included in the analysis.

Figure 17 shows the model fitted to the historic data, the model appears to fit well.

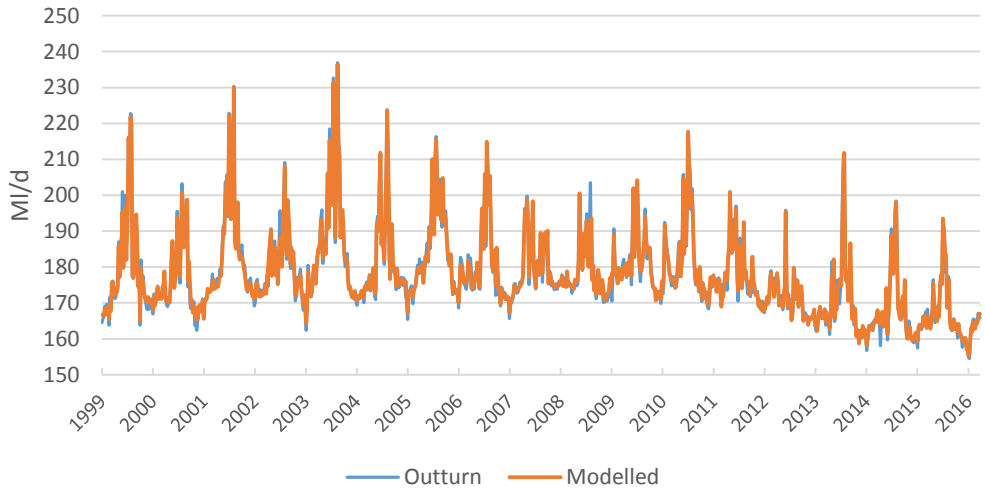


Figure 17: Model fitted to historic Distribution Input

Figure 18 shows the normalised result, the blue line shows the historic line whilst the green line is the estimation of what demand would be if that year's weather happened again with the current customer base and behaviours. The normalised line values produce a sensible result with DI being lower than historic levels and less 'peaky' in nature. The NYAA and DYAA figures were validated using a 'Comparison of summer and winter consumption' approach

from the 'WRMP19 Methods – Household Consumption Forecasting' (UKWIR, 2016) guidance which produced a similar result.

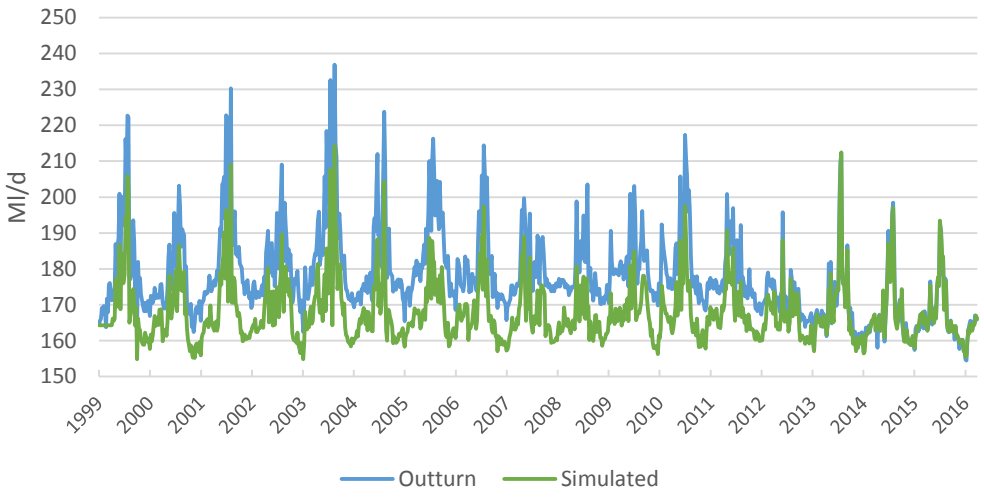


Figure 18: Normalised Distribution Input Time series

Figure 19 shows the fitted statistical distribution for the annual average and annual peak from which the 50th and 95th percentile are extracted, the results of which are presented in Table 14.

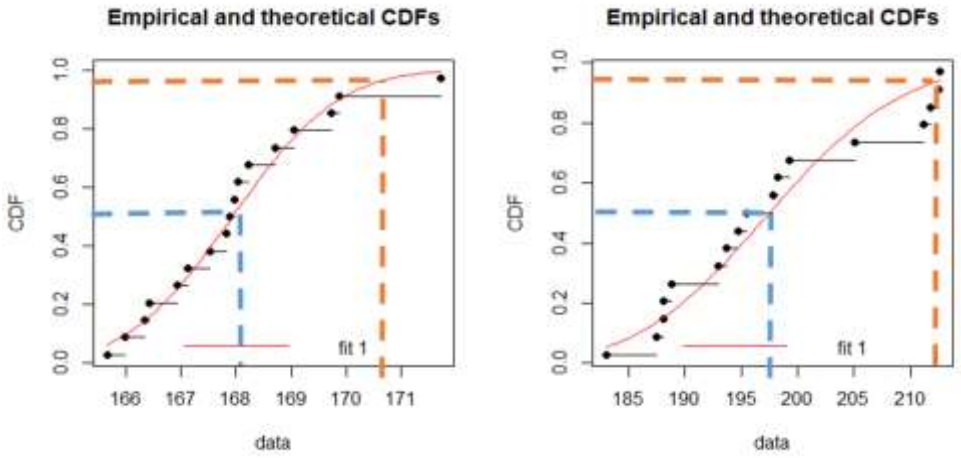


Figure 19 : Fitted Cumulative Distribution Functions; Annual Average (Left) Peak Week (Right)

	Average	Peak
Normal (q50)	168.1	197.5
Dry (q95)	170.6	213.5

Table 14: Normal and Dry Year Estimates of Distribution Input

Normalised DI is input into a water balance for a Normal and Dry Year in order to derive the sub components, Table 15. The bottom-up Non-household and Household elements are derived from regression models described later in this section.

Outturn leakage for 2015/16 has been increased by 5.14 Ml/d over the originally reported figure of 28.18 Ml/d as a result of the industry wide leakage convergence project, the impact of which is described later in this section.

A mild winter in 2014/15 lead to particularly low leakage levels, 6% below that of the company target. For WRMP19 the company target has been used in place of the outturn 2015/16 figure. The company leakage target for the period 2015/16 – 2019/20 is 30 Ml/d, this figure is rebased to 35.14 Ml/d as a result of the convergence reporting.

Table 15 presents the water balances for the 2015/16 outturn, 'Normal Year' and the 'Dry Year'. The outturn uses the 2015/16 DI with the adjusted leakage figure with the other elements also recast. The 'Normal' and 'Dry' balances use the DI output from the weather/demand model with leakage set to the rebased target of 35.1 Ml/d in both instances.

	2015/16 Outturn		**Normal Year**		**Dry Year**	
Component	**Ml/d**	**%**	**Ml/d**	**%**	**Ml/d**	**%**
Unmeasured Households	86.5	51.6%	83.7	49.8%	85.0	49.8%
Measured Households	20.2	12.0%	21.5	12.8%	21.7	12.7%
Unmeasured Non-Households	0.2	0.1%	0.2	0.1%	0.2	0.1%
Measured Non-Households	33.8	20.2%	33.3	19.8%	34.2	20.1%
Distribution Losses	24.2	14.4%	26.6	15.8%	26.6	15.6%
Total Leakage	*33.3*	*19.5%*	*35.1*	*20.9%*	*35.1*	*20.6%*
Distribution System Operating Losses	0.4	0.3%	0.4	0.3%	0.4	0.2%
Water Taken Legally Unbilled	1.6	0.9%	1.7	1.0%	1.7	1.0%
Water Taken Illegally Unbilled	0.7	0.4%	0.7	0.4%	0.7	0.4%
Total	**167.5**	**100%**	**168.1**	**100%**	**170.6**	**100%**

Table 15: Outturn, Normal and Dry Year Water Balance

4.3.2 Customer Segmentation

4.3.2.1 Household Segmentation

Household demand is modelled at a Per Household Consumption (PHC) level for Measured and Unmeasured customers. The model reflects new properties and movements of population from unmeasured to measured status as a result of metering. Portsmouth Water has an optant policy whereby customers are encouraged to switch to a meter, this is achieved through meter promotion and in the future will include the installation of 'not for revenue meters'. It is assumed that some customers are more likely to switch to a meter than others and most likely, those with a lower occupancy. Data was collated from occupancy surveys, ONS demographic data sets and the company billing system to define 62 unique customer types used to produce measured/unmeasured occupancy and to create a profile of customers moving from the unmeasured customer base on to a meter.

- ONS Demographic Super Groups (8 Groups)
- Flat/Non-flat status (2 Groups)
- Meter Optant/Non Meter Optant status (2 Groups)
- New Property (Post 2004)/Existing Property (2 Groups)

Table 4 to Table 7 present the measured/unmeasured splits between each of the 4 factors.

	Unmeasured	Measured
Constrained City Dwellers	14%	8%
Cosmopolitans	6%	4%
Ethnicity Central	2%	1%
Hard-Pressed Living	21%	12%
Multicultural Metropolitans	3%	1%
Rural Residents	7%	11%
Suburbanites	20%	33%
Urbanites	27%	30%
Total	100%	100%

Table 16: ONS Demographic Super Groups

	Unmeasured	Measured
Non-Flat	85%	82%
Flat	15%	18%

Table 17: Flat/Non-flat status

	Unmeasured	Measured
Non Optant	100%	32%
Meter Optant	0%	68%

Table 18: Meter Optant/Non Meter Optant status

	Unmeasured	Measured
Existing Property	100%	68%
New Property (Post 2004)	0%	32%

Table 19: **New Property/Existing Property Status**

4.3.2.2 Non-Household Segmentation

A 'top down' and 'bottom up' approach are both modelled to forecast non-household demand whereby the 'top down' uses economic and weather factors to model total non-household volumes whilst the 'bottom' up approach uses segmentations of the Non-household customer base aggregated up to total NHH demand.

For the bottom up approach, 20 classification groups are used, 19 of which refer to Standard Industry Codes (SIC) whilst 1 category represents the defence presence in the area. Figure 20 shows the split of measured non-household demand aggregated into 12 ONS categories based upon 2015/16 volumes.

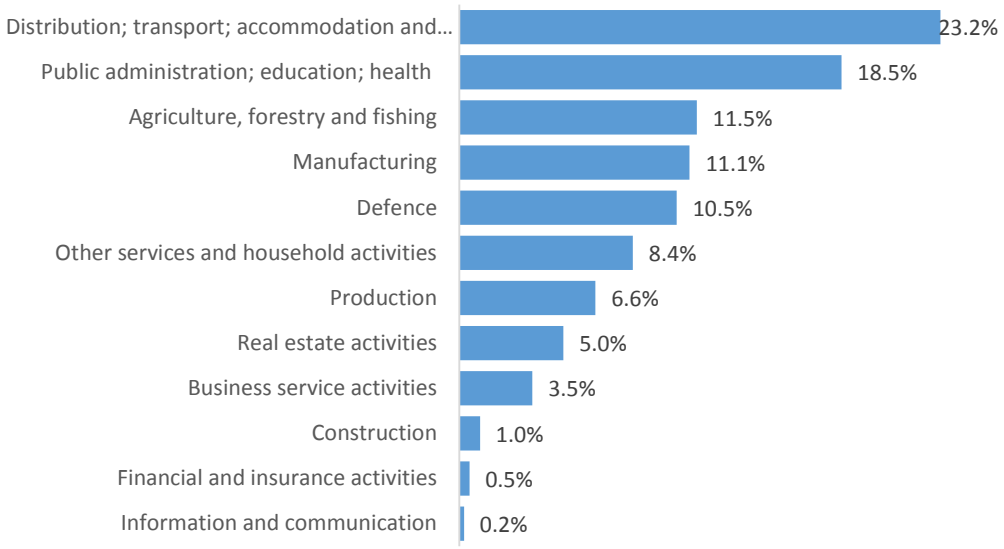


Figure 20: **% Volume Split of Non-household Demand**

4.3.3 Base Year Population, Property and Occupancy Estimates

4.3.3.1 Base Year Household Population

Population and Properties data for WRMP19 was provided by Experian as part of a Demand Forecasting in the South East (DFSE) club project with four other water companies ensuring consistency with bordering companies South East Water and Southern Water in particular.

Table 20 shows that since WRMP14 there has been a relatively small reduction of less than 1% in the estimation of the company household population as a result of the WRMP19 population reassessment.

	WRMP14	WRMP19	Difference
2015/16 Household Population	702,777	701,651	-1,126

Table 20: **WRMP14/WRMP19 Household Population Estimation**

4.3.3.2 Base Year Household Properties

1.1. The number of household properties in the base year is held consistent with the company billing system in 2015/16.

	Measured	Unmeasured	Total
2015/16 Household Properties (Exc.voids)	210,156	78,509	288,665

Table 21: Base Year Household Properties

4.3.3.3 Base Year Household Occupancy

Household occupancy is calculated using the Experian 2015/16 population estimate divided by the number of properties in the company billing system. In order to derive a split of the company occupancy between unmeasured and measured properties, Portsmouth Water commissioned an online survey of over 2,600 customers.

A regression on occupancy was undertaken using known features of the customer base which create the 62 unique groups which are aggregated up to Measured and Unmeasured status. The residual difference between survey occupancy and the company occupancy provide by Experian is allocated proportionally to the Measured and Unmeasured customer base, the final results are shown in

Table 26.

Supergroup Name	Unmeasured	Measured
Constrained City Dwellers	2.31	2.08
Cosmopolitans	2.22	2.03
Ethnicity Central	2.32	2.13
Hard-Pressed Living	2.55	2.35
Multicultural Metropolitans	2.17	1.89
Rural Residents	2.52	2.28
Suburbanites	2.53	2.27
Urbanites	2.33	2.09

Table 22: Occupancy Split by ONS Supergroup

	Unmeasured	Measured
Non-Flat	2.51	2.29
Flat	1.86	1.78

Table 23: Occupancy Split by Flat Status

	Unmeasured	Measured
Non-Optant	2.41	2.19
Optant	NA	2.21

Table 24: Occupancy Split by Optant Status

	Unmeasured	Measured
Existing Prop	2.41	2.21
New Prop	NA	2.19

Table 25: Occupancy Split by New Property Status

Unmeasured	Measured	Company Average
2.49	2.27	2.43

Table 26: Aggregated 2015/16 Occupancy by Measured/Unmeasured Status

4.3.3.4 Base Year Non-Household Population

Non-household/communal population refers to residential accommodation such as sheltered accommodation units, student halls of residence, large hostels, hospitals and prisons.

Table 27 shows the comparison of WRMP14 Non-household population with the revised Experian WRMP19 estimate to which there is a marginal difference. Non-household population is not used as a factor in the Non-household demand forecast.

	WRMP14	WRMP19	Difference
2015/16 Measured Non-Household Population	12,940	12,574	-366 (-2.8%)
2015/16 Unmeasured Non-Household Population	1,262	1,376	114 (9.0%)

Table 27: Non-Household Population

4.3.3.5 *Base Year Non-Household Properties*

In 2015 and 2016 a data cleansing exercise was undertaken to align the company billing system with the Ofwat guidance on eligibility for the opening of the non-household retail market which saw some relatively small movements between household and non-household classifications. It is these values which are reflected in WRMP19.

Figure 21 shows the trend in measured and unmeasured non-household properties since 2010. There has been a steady decline in the number of non-household properties in both groups with the effect of the data cleansing activity is largely unapparent as the movement between household and non-households is broadly equal. Furthermore, there is no significant impact of the cleaning exercise on total non-household volumes with standard variability observed between years, this may be unsurprising as those contestable properties are typically low users; home businesses, cattle troughs, bin stores etc.

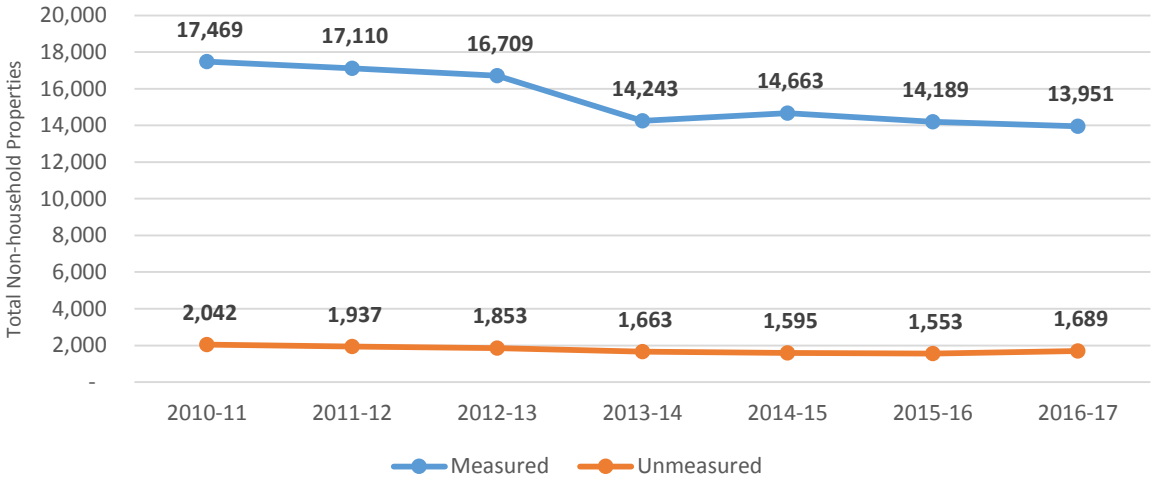


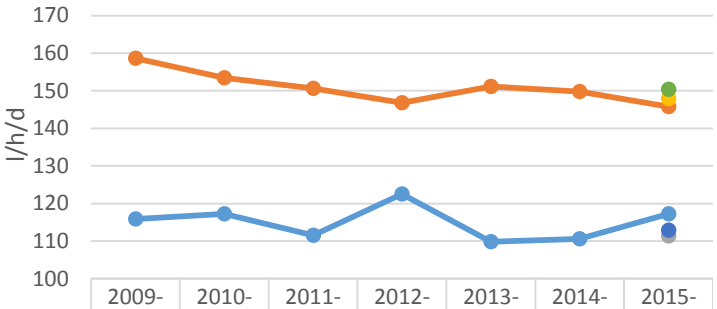
Figure 21: **Historic Outturn Non-Household Properties**

The drop in measured properties in 2013/14 is a result of a change in the company billing system when significant data cleansing occurred.

4.3.4 Base Year Per Capita Consumption (PCC)

Unmeasured PCC has shown a steady decrease from 160 l/h/d in 2009/2010 to 146 l/h/d in 2015/16 whist measured PCC has remained almost flat since 2009/2010 with a slight increasing trend from 2013/14. A step change can be observed in 2012/13 in both unmeasured and measured PCC as a result of revised population figures. Figure 16 displays the trend in PCC, note that these are not the historically reported PCCs but revised PCC that account for the change in the water balance as a result of the leakage convergence project.

The base year PCCs under Normal and Dry Year conditions are calculated via a base year water balance whereby the DI output by the weather-demand model is balanced with the bottom up regression model of the sub components of DI. A good balance is provided with an error of just 1%.



	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Outturn Measured	116	117	112	122	110	111	117
Outturn Unmeasured	159	153	151	147	151	150	146
Normal Year Measured							111
Normal Year Unmeasured							148
Dry Year Measured							113
Dry Year Unmeasured							150

Figure 22: Per Capita Consumption (PCC)

For WRMP19 regression models where developed for Measured and Unmeasured PHC which reflect factors including changes in the customer base and weather variations. Reductions in PHC as a result of water efficiency and water using device replacement are treated outside of the model using assumptions largely based upon modified DEFRA Market Transformation Programme forecasts. Percentage reductions are assumed using the splits of measured and unmeasured PCC shown. The Splits of PCC are based upon the WRc Compendium of Micro Components (WRc, 2012).

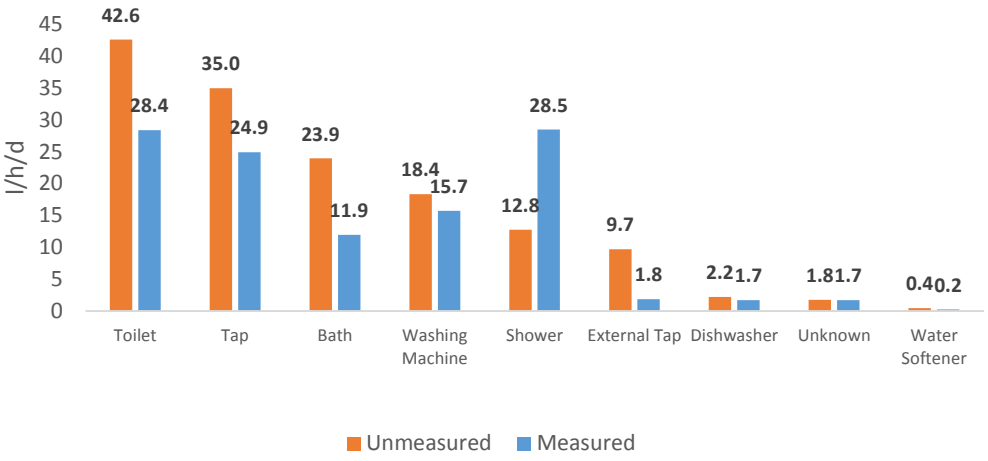


Figure 23: Breakdown of Base Year per Capita Consumption (PCC)

4.3.5 Base Year Leakage impact on PCC

For WRMP19 Portsmouth Water are using the rebased leakage figure as a result of the Ofwat Leakage Convergence Project which has seen an increase of 5.14 Ml/d on the pre-MLE leakage figure. The result of the project brings the base year leakage figure up from 30 Ml/d to 35.14 Ml/d. This does not significantly alter the baseline demand forecast as the new leakage figure feeds into the NYAA and DYAA water balance. As a result of the increase in leakage, Normal Year 2015/16 PCC falls from 145 l/h/d to 139 l/h/d (-4.3%).

4.4 The Demand Forecast

4.4.1 Household Property & Population Forecast

The forecast of Properties and Population was undertaken by Experian and commissioned by the Demand Forecasting in the South East (DFSE) group consisting of five water companies. Neighbouring companies South East Water and Southern Water are included within the DFSE group providing consistency at the company boundary. A full copy of the Experian report is available in appendix G.

For WRMP19 Experian produced a Trend based, Plan based, Econometric and a Most-likely/Hybrid forecast.

- **Trend:** Represents growth if recent trends (5 to 6 years) in terms of demographic change (births, deaths and migration) and long-term household formation patterns continue into the future
- **Plan Based**: show the expected growth if local authorities are able to deliver the dwelling targets set out in their plans
- **Econometric**: forecast is designed to determine what growth would be expected once economic factors are taken into account

In WRMP14 a similar approach was taken. The WRMP14 results of the projected population and household estimates against the outturn for the period 2011-2015 are in

Table 28. The outturn population projection was closest to the trend and most-likely estimations which had an error of 0.1%. Outturn household forecast was closest to the plan and most-likely/hybrid estimation, both with an error of 0.1%.

Forecast	% population growth, 2011-2015	% household growth, 2011-2015
WRMP14 Trend	3.0	3.6
WRMP14 Plan	2.3	2.8
Outturn	2.9	2.7

Table 28: WRMP14 Projections comparison with Outturn

In WRMP19 there is a requirement that water companies must take account of planned growth. For WRMP Portsmouth Water intend to meet this requirement however will not be directly using a Plan based forecast, instead a Trend based method is used.

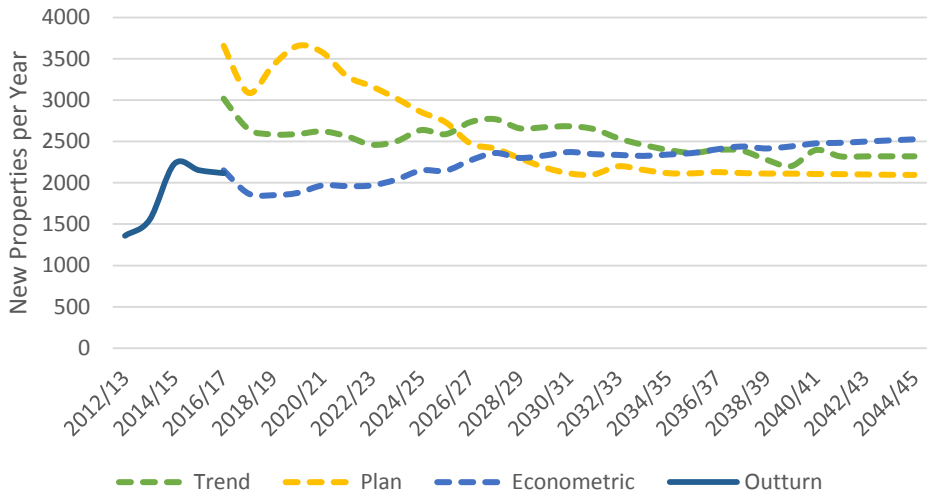


Figure 24: New Household Connections per Year

The Trend based approach is used over a Plan based approach as it provides a smoother, more reasonable connection profile compared to the recent outturn in new property connections whilst delivering a very similar amount of properties over the forecasted period.

	Total new properties 2016/17 to 2044/45	Average New properties per year 2016/17 to 2044/45
Trend	73,082	2,520
Plan	73,610	2,538
Econometric	65,521	2,259
Hybrid	60,360	2,081

Table 29: New Household Properties

Figure 25 and Figure 26 show the forecasted property and population figures for WRMP19 using the Trend based approach. An average of 2,520 new properties are expected per year leading to 73,082 new properties by 2044/45, growth of 35% on 2015/16 household property counts (exc voids).

Population is expected to increase by 111,627 over the period, a growth of 16% on the 2015/16 population.

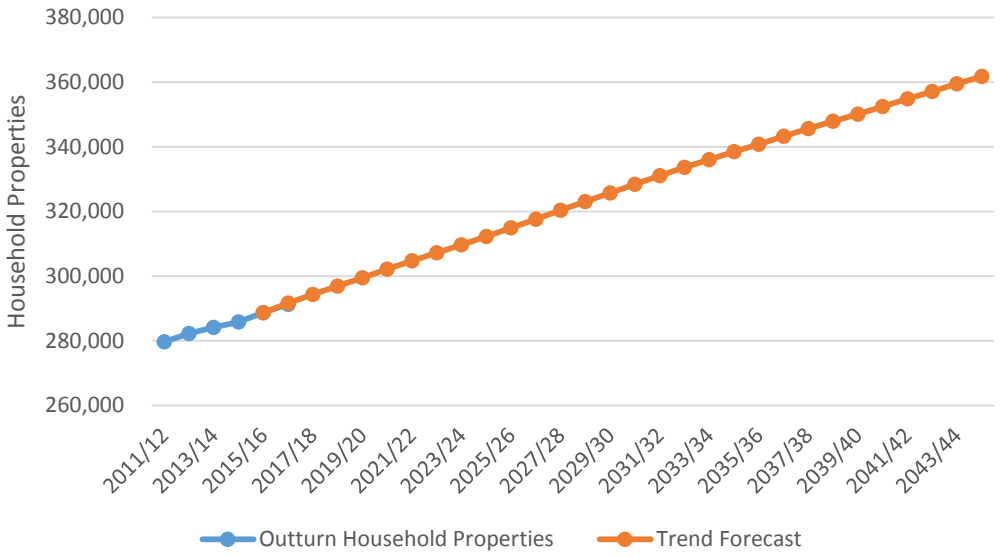


Figure 25: Household Property Forecast

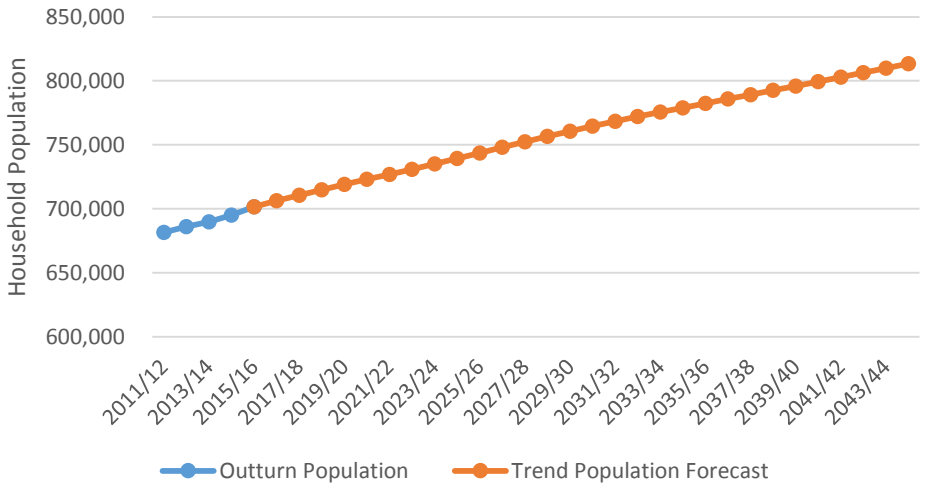


Figure 26: Household Population Forecast

New housing is expected to outstrip new population growth in the region resulting in occupancy falling from 2.43 in 2015/16 to 2.25 by 2044/45.

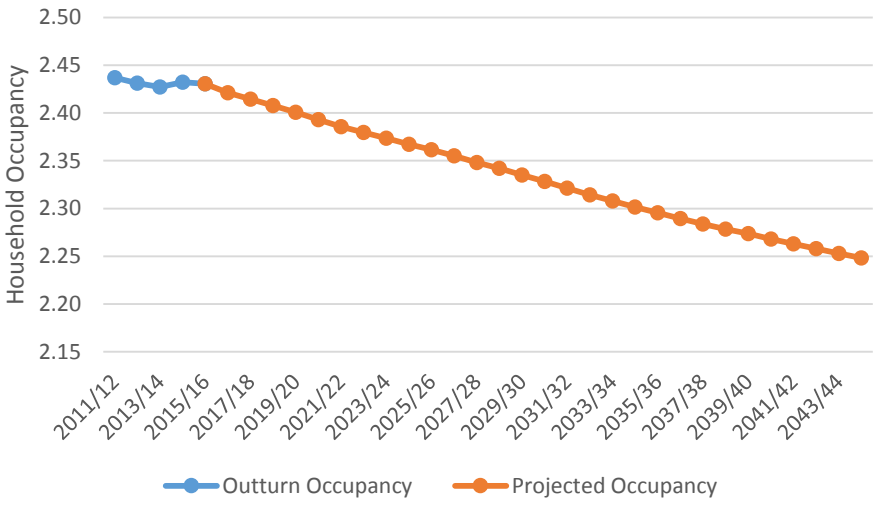


Figure 27: Household Occupancy Forecast

4.4.2 Baseline Metering Policy

Table References: 45.2BL, 45.6BL

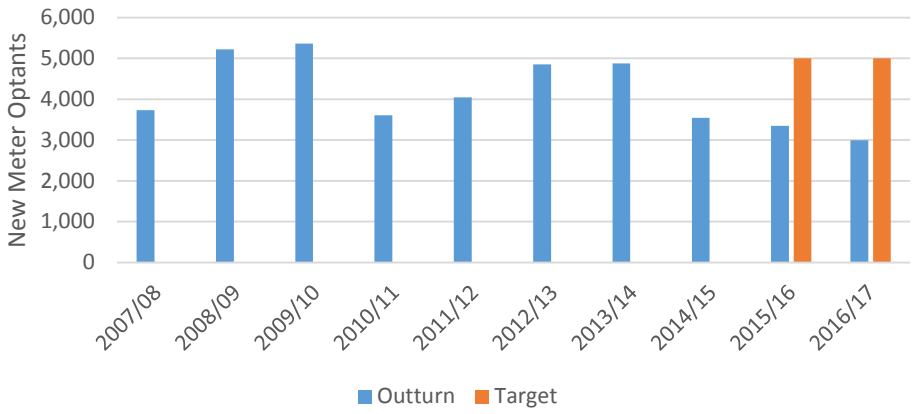


Figure 28: Meter Optants 2007/08 to 2016/17

In 2012 the Environment Agency produced a revised assessment of 'Water Stress'. This assessment is referred to in the legislation for compulsory metering and the 2017 Directive requires Water Companies to consider this option if their area of supply is 'Seriously Water Stressed'. Portsmouth Water's area of supply is only 'Moderately Water Stressed' and Defra have confirmed verbally, in April 2017, that the Company cannot legally compulsory meter its domestic customers.

Portsmouth Water currently has an optional metering programme where unmeasured customers are encouraged to switch to a meter using promotional activities. In WRMP14 Portsmouth Water committed to 5,000 meter optants per year. In the first two years of the plan, despite additional promotional efforts by the Company to increase the uptake of metering, the outturn number of optants has fallen below the target (Figure 28).

Since 1990 Portsmouth Water has been installing meter boxes when conducting mains renewal activity. There are an estimated 68,000 unmeasured properties whom have an existing meter box and therefore can cost effectively have a meter installed without the requirement for excavation. From 2018/19 Portsmouth Water will seek to attract more customers onto a meter by using a dual-billing style approach referred to as 'Metering not for revenue' whereby unmeasured customers whom have an existing meter box will be fitted with a meter and will be encouraged to switch by offering comparative bills and water efficiency advice.

For WRMP19 the number of meter optants achieved through promotional activities is expected to fall away whilst the deficit of the 5,000 meters will be met using a dual billing approach, Figure 29. A meter uptake rate of 1/3 of dual billed customers is expected until the initial 68,000 customer base is exhausted in 2027/28. From 2025-26 metering falls back to promotional activities in addition to those dual billing customers achieved through mains renewal activity.

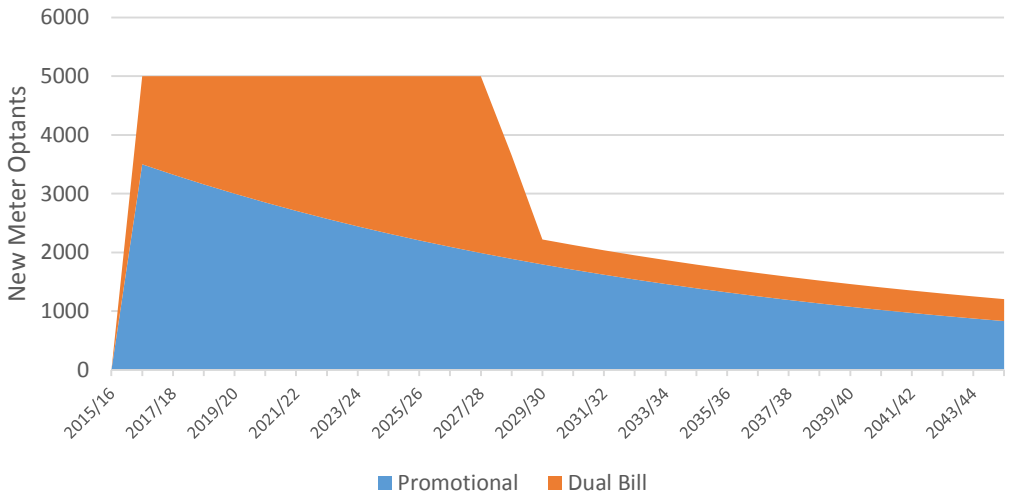


Figure 29: **Meter Optant Baseline Policy**

4.4.3 Per Household Consumption (PHC) /Per Capita Consumption (PCC) Forecast

Table References: 29BL, 30BL, 31BL

For WRMP19 a mix of methods suggested in the 'Household Consumption Forecasting (UKWIR 2016)' has been used. Whilst a Regression Model is used to reflect changes in the customer base, percentage reductions in micro-components are used to adjust the forecast.

The Regression models are modelled on Measured and Unmeasured PHC. PHC was selected over PCC as it is not sensitive to changes in population estimates. A range of variables were trialled which included changes in the customer base: new properties, meter optants, meter penetration, occupancy rates. The inclusion of weather variables also allow for Dry Year estimates for PHC to be calculated and fed into the NYAA and DYAA water balance.

Table 30 below shows the variables that were included in the final models in addition to the Mean Absolute Percentage Error (MAPE), a measure of the predictive accuracy of the regression models on the outturn data.

Group	Predictor Variables	Mean Absolute % Error
Unmeasured PHC	Unmeasured Occupancy Total Rainfall (Annual) Total Dry Days (Annual) Average Summer Max Temperature	0.80%
Measured PHC	Meter Penetration Occupancy change (Dummy variable to capture post 2015 occupancy reassessment)	1.71%

Table 30: Summary of Regression Models

Whilst changes in the customer base are included within the regression models, reductions in consumption as a result of water device replacement are handled outside of the model using litre reductions in PHC/PCC in each year, Figure 30 and Figure 31. Volume reductions are based upon Defra Market Transformation Program (MTP) baseline reductions although some adjustments have been made, for example reductions associated with toilet flushing have been reduced by 8pp as newer dual flush toilet systems have been shown to leak leading to a reduced benefit. By 2044/45 Unmeasured PCC is expected to fall by 11.1 l/h/d as a result of device replacement, largely due to reduced volumes in bathing and replacement of single flush toilets. Measured PCC is expected to remain mostly unchanged with a total reduction of 0.2 l/h/d by 2044/45.

The impact of climate change on PHC/PCC is also treated outside of the PCC model. PCC is expected to increase by 0.7 l/h/d and 0.9 l/h/d by 2044/45 for Measured and Unmeasured customers respectively. These assumptions align with the 'Impact of Climate Change on Water Demand' guidance (UKWIR, 2012) assumptions for a water company operating in the South East of England.

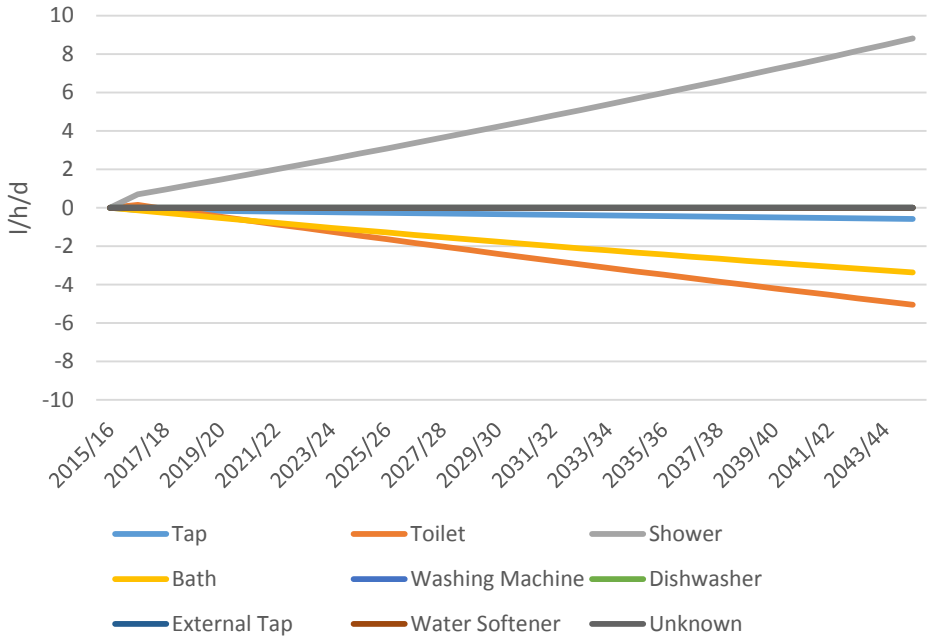


Figure 30: Cumulative change in consumption (Measured PCC)

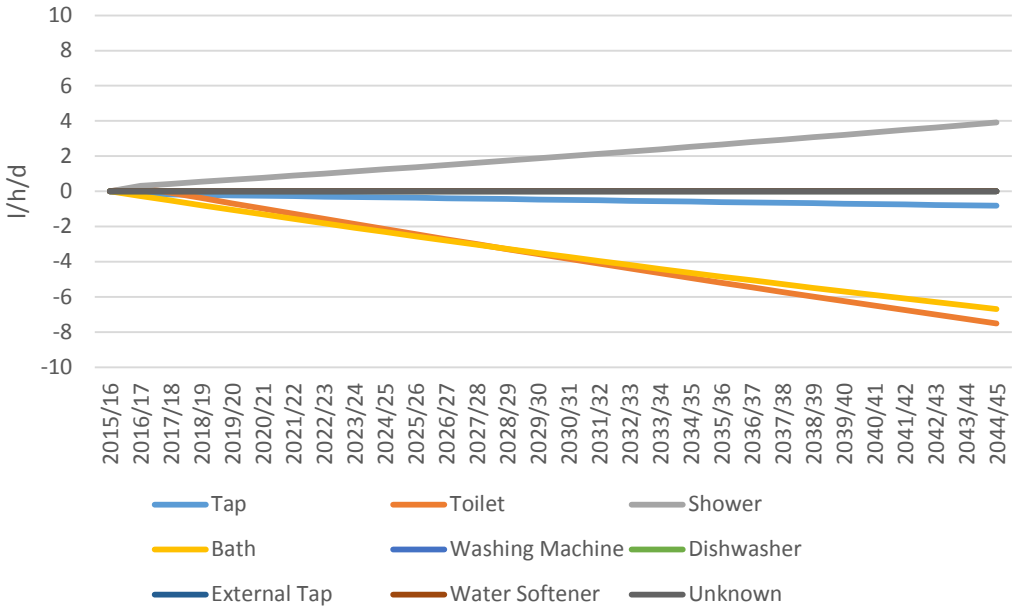


Figure 31: Cumulative change in consumption (Unmeasured PCC)

The difference in PCC as a result of changes the customer base, device replacement and climate change adjustments are presented in Figure 32.

Unmeasured PCC is expected to fall from 147.9 l/h/d in 2015/16 to 139 l/h/d by 2044/45, largely as a result of device replacement. Measured PCC is expected to show a steady increase from 111.4 l/h/d to 125.7 l/h/d in 2044/45 as metered properties become occupied by less efficient households than the existing new property/meter optant customer base with increased meter penetration. Average PCC falls over time and becomes increasingly weighted to the Measured PCC. By 2029-2030 the rate of unmeasured customers moving to the measured customer base slows as all customers that are likely to have opted through the dual billing exercise would have been metered and the number of meter optants falls back to those achieved through promotional activities.

In 2035/36 the company average PCC falls to 130 l/h/d, the Defra aspiration for per capita consumption.

A small reduction of 5% in unmeasured PCC is expected as a result of those customers who are dual billed and change their behaviour without switching to a meter.

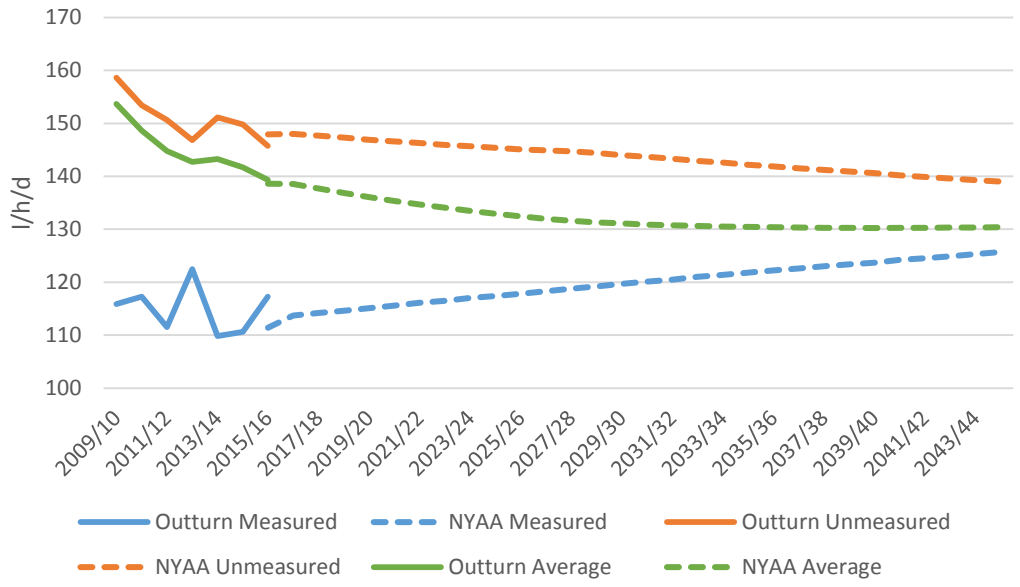


Figure 32: Forecasted NYAA PCC

4.4.4 Leakage

Leakage, water abstracted and treated but not delivered to customer's taps is of significant concern to the Company and its customers. The amount of water lost through leaks in customer's pipes ideally would be zero. However the reality is that the majority of water lost is as a result of leaks that occur on underground pipes without the water rising to the surface. The leaks that do result in water being visible on the surface are easy to identify and consequently are repaired quickly and are not a significant proportion of the leakage reported by companies.

Leakage reduction activities involve companies' identifying and reporting the 'non-visible' leaks through various techniques. These include reducing the pressure in the system which reduces the flow of water from leaks, which stops new leaks developing active leak detection activities and replacing old pipes which have recurrent failures. The Company seeks to balance the cost of leakage reduction activities against the cost of the water lost through the leaks. In assessing both of these costs, the Company considers externalities such as the carbon cost of pumping and treating water, and the benefit to the environment of not abstracting the water. The point at which the costs of the water lost through leakage is equal to the cost of reducing leakage further is known as the sustainable economic level of leakage (SELL). The Company's leakage should not rise above this point, however the Company should consider if their leakage forecast should be below the SELL, for example if customers place a value on this and would be willing to pay for a lower level of leakage.

4.4.4.1 New Leakage Methodology

The Government's 'Guiding Principles' for Water Resource planning states that leakage should not rise at any point in the planning period. At the same time a new methodology has been produced to ensure that there is consistent reporting between companies. For Portsmouth Water the new methodology produces higher outturn leakage figures and also a higher Sustainable Economic Level of Leakage (SELL). This does not represent a deterioration in terms of leakage control, only a rebasing of the figure. The WRMP is based on the new methodology and Ofwat reporting will follow in 2020. Historic leakage performance has been re-based to be consistent with the new approach. Distribution Input does not change, therefore historic per capita consumption figures are lower to compensate.

4.4.4.2 Leakage Assessment for the Last Plan

The current leakage assessment was undertaken at the same time as a review of leakage management by Portsmouth Water. The Company engaged Tooms Moore Consulting to undertake a full SELL appraisal which included a review of the marginal cost of water. Tooms Moore are also the consultants undertaking the independent leakage review and this allowed them to understand the uncertainty in the leakage calculation and deal with it appropriately in the plan.

4.4.4.3 Current Leakage Assessment

The current leakage assessment was also undertaken by Tooms Moore Consulting and was based on the new methodology. A full SELL appraisal was based on the latest marginal cost of water. This reflects variable costs, such as power and chemicals, and the most expensive source. If water is saved through leakage control it is assumed that abstraction at the most expensive source is reduced (appendix 'K').

The SELL Report indicates that leakage could be reduced by the introduction of District Metering Areas (DMA's). At the moment, Portsmouth Water operates larger Strategic Metering Areas (SMA's).

4.4.4.4 Scope of Current Leakage Assessment

The scope of the project was to deliver an SELL based on industry best practice.

Overall the methodology was developed to meet the requirements set out in the main guidance and best practice documents. The key documents are:

Document	Summary of relevant content for SELL
Economics of Balancing Supply and Demand, EA, 2003	Sets out how options for maintaining the supply-demand balance (including leakage reduction options) should be appraised
Water Resources Planning Guideline, Ofwat/EA/Defra, 2012	Describes the water resource planning requirements and sets out how leakage options should be assessed and reported for the Water Resource Plan
Review of SELL, EA/Ofwat/Defra, 2012	Makes a number of pragmatic recommendations for how SELL should be assessed
Best Practice Derivation of Leakage Cost Curves, UKWIR, 2011	Provides guidance on the assessment of leakage cost curves, but concentrating on active leakage control. It also describes an alternative method, which is a development of a Method B approach
Managing Leakage 2011-Report 3: Setting Economic Leakage targets, UKWIR, 2011	Set out principles of SELL
Tripartite study: Best Practice Principles for Economic Level of Leakage Calculation, EA/Ofwat/Defra, 2002	Now partially superseded. This report provides guidance on principles of SELL, including the idea of Method A and Method B approaches
Best Practice Guidance on the Inclusion of Externalities in the ELL Calculation, Ofwat, 2007	Covers the calculation of externalities. Partially superseded by the Review of SELL (2012)
Consistency of Reporting Performance Measures UKWIR 2017	Revised leakage calculation methodology.

The project delivered:

- A baseline leakage level that minimises costs (including external costs). This includes transition costs from the current leakage level.
- A cost vs leakage reduction relationship, which can be used as part of the input to the WRMP.

The activities that were assessed as part of the SELL were:

- Changing Active Leakage Control (find and fix) (ALC). - This could include changed detection technology, improvements in management systems, changes in the number of detection staff and reconfiguration of SMAs and DMAs to improve efficiency.
- Changing pressures by the use of control valves or pumps. - This will include pump control, changed PRV control, new PRVs and zone reconfiguration.
- Infrastructure renewal. - This includes mains, communication pipes, supply pipes and possibly service reservoirs. Activities are likely to be targeted on particular assets with known poor performance.
- Management of repairs. - This is mainly about shortening repair time for reported and detected leaks by changed systems and increased repair resources.

The Company also undertook a further assessment of the approach to assessing policy minimum, the details of which are included in Appendix 'K'. This assessment identified the uncertainty associated with policy minimum assessment which is presented in the report.

4.4.4.5 Marginal Cost of Water

The marginal of cost of water was assessed as part of the project and took into account:

- Operating cost savings seen by the Company; typically power and chemicals costs.
- Capital deferral seen by the Company if supply-demand investment is required within the planning horizon. This component is excluded if the Company undertakes a least cost planning exercise to avoid double counting the benefit of deferral.
- Environmental benefit of reduced abstraction.
- Carbon cost saving, typically driven by the electricity saving due to less pumping.

4.4.4.6 Short Run SELL

The SELL assessment concludes that the SELL is in the range of 32.0 to 39.9 Ml/d with the central point being 34.1 Ml/d. The range in the SELL reflects the uncertainty in the underlying data.

The Company has decided to set an initial leakage target of 35 Ml/d based on this SELL assessment reducing to 30 Ml/d in 2025.

4.4.4.7 Baseline Leakage Forecast

Over the planning period the level of leakage will change as a result of increased customer metering which can be expected to reduce supply pipe leakage. The Company is also expecting a growth in the number of properties over the planning period which is likely to result in an increase in the length of mains and the number of connections which will result in a rise in leakage. Furthermore, it is reasonable to expect that there will be improvements in efficiency and advances in leakage detection technology over the planning period and this is likely to result in a reduction in the costs of leakage management and a corresponding fall in the SELL.

Ofwat have stated that SELL does not necessarily drive sufficient efficiency improvements or innovation. They have suggested that all companies could make the same percentage reduction in total leakage. This reduction should be achieved during the first five years of the next Plan.

To ensure that the water balance stays in surplus in the early years of the Plan, it may be necessary to reduce leakage as soon as possible. This could be done as a baseline activity or as a demand management option.

The Company has to take account of these factors when forecasting the baseline level of leakage. The Company believes that it is reasonable to expect the increase in leakage from growth in the distribution network to be offset by expected gains in efficiency and technology. It is reasonable to expect that the savings resulting in supply pipe leakage from the metering of customers to be reflected in the leakage forecast. The Company has allowed for this benefit in their baseline leakage forecast which results in a falling leakage forecast over the planning period. This is illustrated in the graph below.

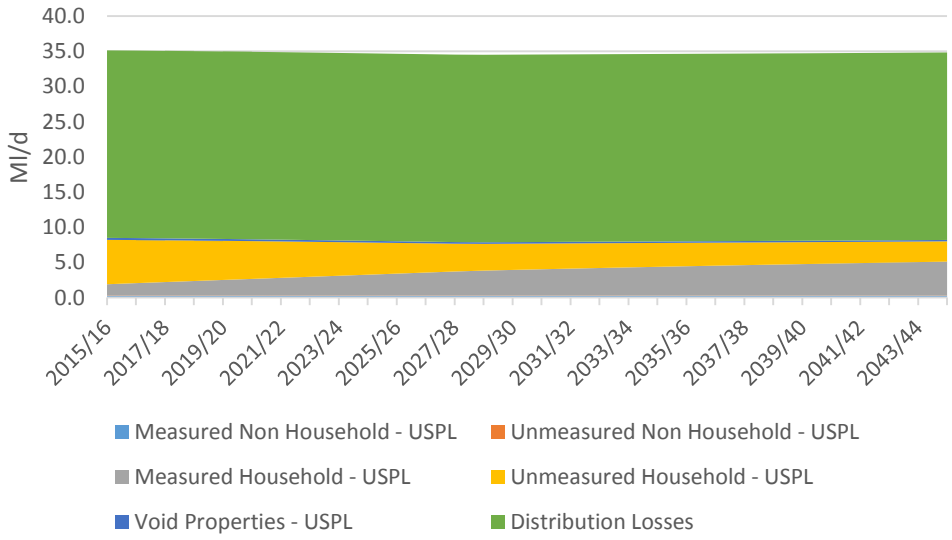


Figure 33: Total Leakage Forecast

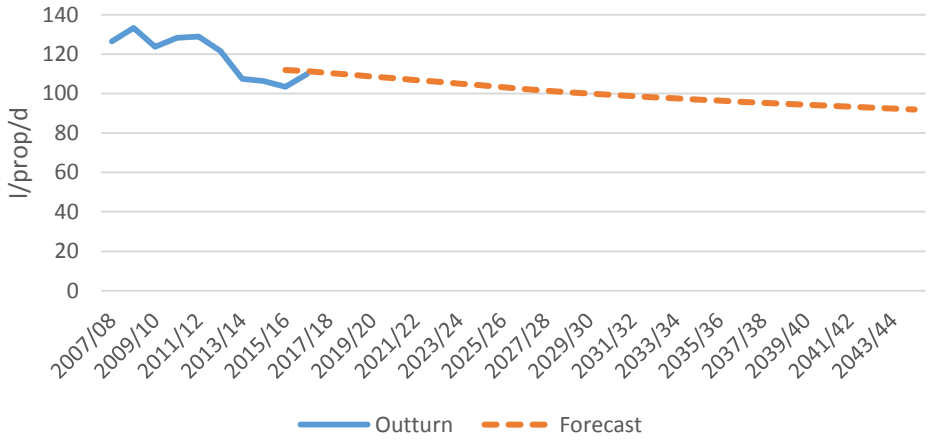


Figure 34: Leakage per property per day

4.4.4.8 Customer Supply Pipe Leaks

The leakage figure reported by Portsmouth Water includes water that is lost through customers supply pipes. Portsmouth Water undertakes leakage detection activity to identify these leaks or customers sometimes become aware of the leaks themselves. The Company

continues to offer up to 2 free supply pipe repairs or a subsidised replacement of the supply pipe.

Supply pipe leakage tends to be lower on measured properties than on unmeasured properties. If a leak occurs on a measured property customers will notice the step change in the volume consumed. Also when a customer opts for a meter a check is undertaken on the customer's supply pipe. Consequently the leakage forecast falls over the period to take account of the reduction in supply pipe leakage as a result of the number of customers opting for a meter.

4.5 Non-Household Demand Forecast

For the Non-household demand forecast two approaches were applied; a Top-Down and a Bottom-Up linear regression forecast.

Both methods utilise the same data sources; local weather factors (temperature and rainfall) in addition to regional Gross Value Added data by SIC code which reflect the changes in local economic conditions. The Top-Down model consists of a single model regressed on the total Measured Non-Household volumes for the period 2005 to 2015. The Bottom-Up model consists of 21 sub models for different SIC groups which utilise a subset of economic factors.

The resulting estimates of future Non-household demands are presented in Figure 35. The two forecasts provided differing projections on Non-household demands. The Top-Down forecast shows demand falling rapidly from 35 Ml/d to 24Ml/d in 2044/45. The Bottom-Up forecast shows Measured Non-household demand to remain flat with a small increase of 0.8Ml/d by the end of the period. Since both models performed well against the historic data and produce reasonable forecasts, a hybrid approach is adopted for WRMP19 which is simply an average of the two models.

Portsmouth Water has engaged with Castle Water, the largest Non-household retailer in the company area. Whilst water efficiency activities are planned by Castle Water, the scale of the savings are largely unknown. Reductions as a result of retailer water efficiency activities are not specifically included in the model however water efficiency will be somewhat captured within the regression models although not included as a specific factor.

Portsmouth Water has also engaged with the West Sussex Growers Association regarding the growth of horticultural activities in the area of supply. Whilst growth between 5% to 10% is expected per year, this will be met with greater water efficiency activities in addition to some reliance on the growers own resources. No additional growth on top of that implicit within the regression models is assumed over the planning period.

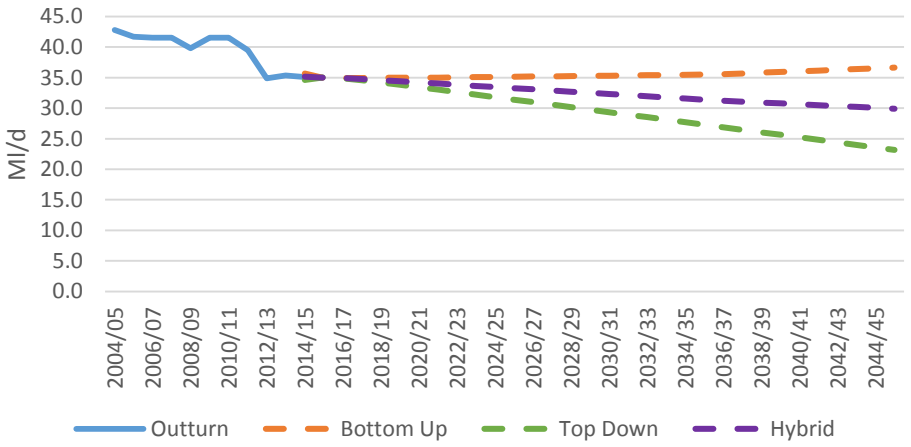


Figure 35: Measured Non-Household Demand Forecast

Unmeasured non-household demand makes up less than 1% of demand and is assumed to stay at the same rate over the planning period at 0.17 Ml/d.

The UKWIR Impact of Climate Change on Water Demand (UKWIR, 2012) guidance suggests that there is little evidence to suggest that climate change will have an influence on Non-household water demand therefore no increase is applied.

4.6 Other Components of Demand

Table References: 32BL, 33BL

Other components of demand include

- **Distribution System Operating Usage (DSOU)** – Water run to waste such as that used for the purpose of mains flushing.
- **Water Taken Unbilled** – Includes water legally and illegally unbilled. Legally unbilled water includes water used for firefighting purposes whilst water illegally unbilled includes void properties which are actually occupied.

Water Taken Unbilled and Distribution System Operational Usage is assumed to stay at the same rate over the period at 2.42 Ml/d and 0.43 Ml/d respectively.

4.7 The NYAA and DYAA Scenario

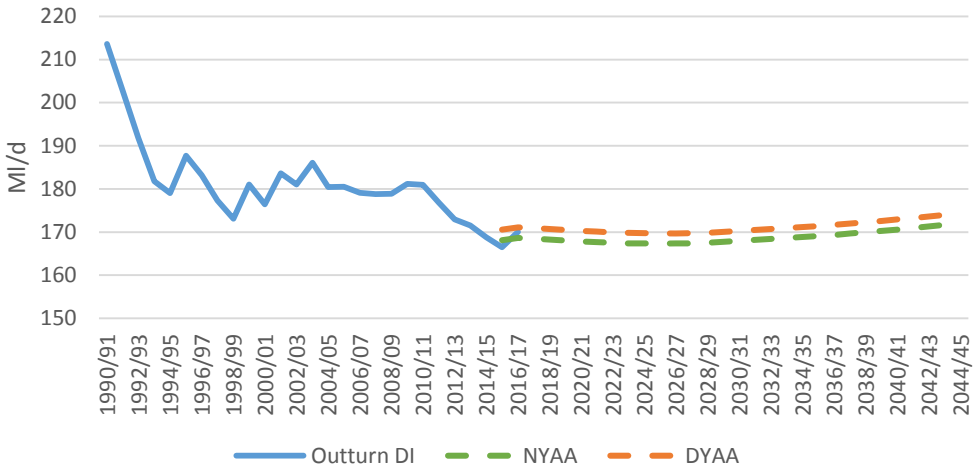


Figure 36: Baseline NYAA & DYAA Forecast

Demand is expected to remain broadly flat up to the end of the planning period. Demand continuously falls until 2025-26 when demand reaches 167.3 Ml/d under NYAA conditions, this is a combined result of falling measured non-household demand and the movement of 5,000 unmeasured properties onto a meter in each year as a result of the meter promotion and 'not for revenue metering' exercises.

From 2025-26 demand slowly rises back up to just above 2015/16 levels at 172.1 Ml/d under the NYAA scenario. Demand increases post 2025-26 as all those unmeasured customers that are likely to have switched to the measured tariff as a result of the dual billing exercise will have been metered. From 2025-26 metering levels fall back to those achieved through promotional exercises and new dual-bill properties become available through mains renewal.

4.8 The DYCP Scenario

In WRMP14 the DYCP was the critical scenario. A review of the Deployable Output assessment has shown the peak scenario to be less important in terms of operational supply, however it is still included as a scenario in WRMP19.

The approach for WRMP19 is consistent with the 'Peak Water Demand Forecasting Methodology' guidance (UKWIR, 2006). A regression was undertaken on weekly peak demands since 1997 with the variance explained using a mixture of variable which reflect weather variations and changes in the customer base, Table 31.

Factors	Mean Absolute % Error
• Total Dry Days (Week) • Total Rainfall (Week) • Max Average Temperature (Week) • Month: Aug • Month: Jul • Household Demand (Year) • Measured Non-Household Consumption (Year)	1.67%

Table 31: **Peak Demand Model Summary**

The weather variables are held at notional Dry Year values as at 2013, which was shown to be drier than normal, and balanced against the peak demand as derived from the demand normalisation process. Forecasted 'Household Demand' and 'Measured Non-Household Consumption' values output from the DYAA forecast are then fed through the model providing future estimations of peak demand.

As with the NYAA and DYAA forecasts Climate Change is accounted for outside of the model using the UKWIR Impact of Climate Change on Water Demand' (UKWIR,2012) guidance. Climate Change assumed to only impact on household volumes. The increase as a result of Climate Change by the end of the planning period is 1.1 Ml/d or 0.6% of total demand.

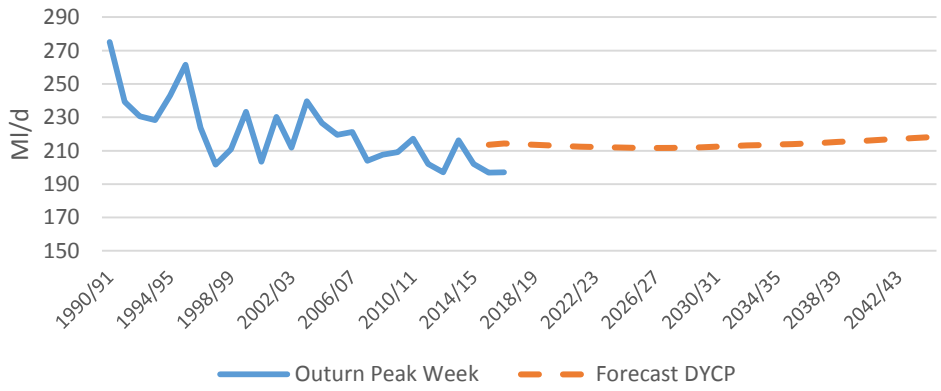


Figure 37: **Dry Year Peak Demand Forecast**

Peak Demand falls to its minimum in 2027-28 at 212 Ml/d before rising back up to 218 Ml/d by the end of the planning period as a result of increasing population.

4.9 Bulk Supply Exports

Bulk supplies to other companies are included in Table 2 Baseline Supply and contribute to the overall reduction in deployable output. They are not actually supply reductions and are therefore detailed under the demand section of this WRMP.

4.9.1 Southern Water Sussex North

Portsmouth Water has one existing bulk supply agreement which is with Southern Water and supplies their Sussex North zone. The bulk supply was constructed in 2004 and the agreement was renewed in 2016.

The maximum transfer rate is 15.0 Ml/d and this was originally intended to be available only at Minimum Deployable Output during the autumn. Southern Water took the bulk supply for a much longer period in 2004 and into the winter of 2005. Portsmouth Water obtained a licence variation for the QRST Group to help secure the bulk supply. The bulk supply agreement was renewed on the basis that 15.0 Ml/d can be delivered at an average and peak demand.

The existing bulk supply is available under all the scenarios considered in this WRMP. Under some drought conditions the supply would be delivered on a 'best endeavours' basis with the assumption that Southern Water had applied temporary demand restrictions and drought permits.

The current bulk supply is not bi-directional and this is reflected in Section 3.7.

4.9.2 Southern Water Sussex Worthing

There is a cross connection between the bulk supply to Sussex North and an existing Southern Water main to their Sussex Worthing zone (Littlehampton). This connection provides operational flexibility but does not increase the total transfer capacity. When Southern Water is operating their SRN Source C the main is not available as a bulk supply.

4.9.3 Sussex North Duplication

Portsmouth Water has considered an option for duplicating the existing bulk supply to Sussex North. This would follow the same route to Whiteways Lodge and would require Southern Water to duplicate their main as well. Additional pumps would be required at Source S but no allowance has been made for increasing the capacity of the break pressure tank.

If developed, this bulk supply would deliver an additional 15 Ml/d. In the WRSE Modelling, it is assumed that the duplicate bulk supply would deliver 15 Ml/d at average, peak and MDO conditions. The new bulk supply will be reliable if additional resources are developed by Portsmouth Water.

4.9.4 Southern Water Hampshire South

As part of the WRMP14 a second bulk supply was offered to Southern Water from the River Itchen Works. Initially this was expected to go to Moor Hill Service Reservoir but as the project progressed, it was clear that the bulk supply would go directly to Southampton (Hampshire South Zone). Southern Water have now completed the main and Portsmouth Water have provided a new connection and new pumps within an existing building.

A new bulk supply agreement has been drafted and this is based on the assumption that Portsmouth Water can supply 15.0 Ml/d at all times. This includes average and peak demand

and scenarios from the 'Normal Year' to the 'Severe Drought'. The new pipeline offers some increased resilience for Portsmouth Water under normal conditions. It would be possible to discharge water from Southern Water into the contact tank at Source A and for this to be pumped to Hoads Hill Reservoir in an emergency.

Southern Water have experienced problems in their Hampshire South Zone in relation to meeting the sustainability reductions. Two sources of water, Testwood and the Candover Augmentation Scheme, may have less water available than expected. This means that their new Plan has to consider alternative supply options to meet demand. At the time of producing this Draft WRMP19 Southern Water expect that additional bulk supplies from Portsmouth Water will be required. Their modelling has selected an enhancement to the current bulk supply and a new bulk supply. The enhancement involves fitting bigger pumps in Portsmouth Water's pumping station but using the same pipeline to Southampton. The pumps are assumed to provide an additional 9 Ml/d bringing the total pumped to 24 Ml/d.

The new bulk supply would require a new connection to Southern Water's distribution system. This may not be in Southampton but in another area where there is housing growth. The new connection would be sized at 21 Ml/d but would not be available until 2029. This bulk supply would increase the total amount of water provided to Hampshire South to 45 Ml/d. This is the full works capacity at Source A but this water would only be available if Portsmouth Water develop alternative supplies for their customers, at Havant Thicket for example.

The need for alternative supplies is covered in Section 6 Options Appraisal. Under drought conditions only 30 Ml/d of water is available from the River Itchen at Source A. To make up the additional 15 Ml/d Portsmouth Water would have to backfeed water from Hoads Hill Service Reservoir to Source A. The Company needs to ensure that its distribution system can cope with the revised flow patterns. Portsmouth Water customers will then be supplied with different water but it all originates from the same chalk aquifer.

4.9.5 South East Water - Petersfield

South East Water has formally requested a bulk supply from Clanfield Service Reservoir to Tilmoor Reservoir in Petersfield. Construction of the bulk supply will be split between Portsmouth Water and South East Water. The route crosses the South Downs National Park but it is not expected that there will be significant lasting environmental impacts. The pipeline will be sized to supply 10.0 Ml/d and South East Water has requested to use this bulk transfer under all scenarios from 2058. This is outside Portsmouth Water's planning period but water supply options could be brought forward to meet this demand. This bulk supply will be reviewed in the next WRMP.

5 BASELINE SUPPLY/DEMAND BALANCE

5.1 Introduction

In order to assess security of supply, Portsmouth Water has to compare the baseline deployable output with the baseline demand forecast. It has been assumed that these will both have the same probability of occurrence or return period. This is related to the 'Level of Service' (LOS) referred to in Section 3.2.5. In a 'Dry Year', temporary demand restrictions are just avoided and the current LOS is 1 in 20 or a 5% risk of failure.

In a 'Historic Drought' there will be domestic temporary use bans but further restrictions will be avoided; the return period for this scenario is 1 in 40. An 'Extended Drought' will just avoid Ordinary Drought Orders such as Non-essential Use Bans and most Drought Permits. This scenario has a return period of 1 in 80.

In a 'Serious Drought' Non-essential Use Bans and Drought Permits will be required. The scenario has a return period of 1 in 125.

In a 'Severe Drought' stand pipes in the street are just avoided. This scenario has a return period of 1 in 200.

For the WRMP 2019, Portsmouth Water has decided to submit tables for Annual Average and Peak Week demand to show that the correct 'Critical Period' is identified. There are tables for the 'Dry Year' and the 'Severe Drought' to cover the range of weather conditions possible. Minimum Deployable Output is no longer considered to be critical for Portsmouth Water.

5.2 Headroom Assessment

Target headroom is a buffer between supply and demand and allows for uncertainty and risk. Demand is based on a 'Trend' forecast for the population numbers and a central forecast of per capita demand. Headroom takes account of the fact that these could be under estimated and that deployable output could be lower. Security of supply is maintained even if all of the headroom is used.

5.2.1 Methodology

Portsmouth Water employed AECOM to carry out the headroom assessment and asked them to use the 'Improved Methodology'. 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 @ RISK software with 10,000 iterations. The higher numbers of iterations were used to improve repeatability of results.

5.2.2 Headroom Uncertainty Factors

The standard methodology includes thirteen uncertainty factors:

Uncertainty Factors

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
D3	Impact of Climate Change on Demand
D4	Demand Management Measures

Table 32: 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 software 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 and a family of headroom graphs produced. The Water Resources Planning Guideline states that companies should accept a higher level of risk in the future. This is because the Regulators feel that the uncertainties that the industry will face in the future can be managed.

It is helpful to consider each of the uncertainty factors and their influence on the final headroom figure. More detail is contained in the AECOM Headroom Allowance Assessment Report (see Appendix 'F').

5.2.2.1 S1 Vulnerable Surface Water Licences

Portsmouth Water only has one surface water abstraction which is from the River Itchen at Source A. The abstraction licence has been varied to comply with the Habitats Regulation Review of Consents. There are no additional abstraction issues for Portsmouth Water from the Water Framework Directive. No allowance has been included for this factor in the calculations.

5.2.2.2 S2 Vulnerable Groundwater Licences

The WRPG, published by Ofwat, the Environment Agency and Defra, say that it is not necessary to include this factor in headroom. Portsmouth Water remains concerned that further sustainability reductions, as a result of the Water Framework Directive, are a key area of uncertainty for the future.

5.2.2.3 S3 Time Limited Licences

Time limited licences are a potential area of uncertainty for Portsmouth Water. The existing bulk supply to Southern Water in Sussex North relies on a licence variation that is time limited to 2028. The licence that relates to the new bulk supply into Hampshire is not time limited.

The guidance says that the impact of time limited licences should not be included in headroom. This is because the Environment Agency will give notice of any proposed licence reductions and there will be enough time to 'restore' the supply/demand balance. In the past, Portsmouth Water believed that this was a key area of uncertainty but did not include it in headroom to comply with the guidance.

No allowance for confirmation of time limited licences in the future has been included in the WRMP 2019.

5.2.2.4 S4 Bulk Imports

Portsmouth Water does not currently have any bulk imports of water and there are no such arrangements currently planned. This factor has been excluded from the headroom assessment.

5.2.2.5 S5 Gradual Pollution

There are five sources of gradual pollution in the Portsmouth Water area of supply:

- Nitrates
- Pesticides
- Turbidity
- Oil Spillages
- Cryptosporidium

In the past, high nitrate levels have been managed by the introduction of blending schemes. In addition to blending, Portsmouth Water is now involved in 'Downs & Harbours Clean Water Partnership' with the Environment Agency, Natural England and the South Downs National Park. With these measures in place it was decided not to include gradual nitrate pollution in headroom. Further nitrate blending schemes may be included in the Business Plan to address specific problems. If shut downs occur due to nitrate levels in the shorter term, these will be covered by the outage allowance.

One sample failure for pesticides was detected in Source B Spring water in 2016. If these developed to a critical level it is likely that granular activated carbon would be added to the filters at Farlington WTW. No allowance for gradual pesticide pollution has been included in headroom.

In the recent past Portsmouth Water has experienced outages due to oil spillages. These have occurred at:

- Source C 2005
- Source K 2011
- Source J 2011
- Source R 2014
- Source H 2016

These events represent a medium term loss of deployable output and a risk of further losses at other works in the future exists. In order to comply with the guidance, events that last longer than 3 months are excluded from the outage calculations. These incidents represent a loss of deployable output and are reported in the Annual Review. If the causes are not removed by capital works the loss of DO becomes permanent. Portsmouth Water has decided to include oil pollution as a generic risk at all works. The risk is calculated to be 0.83% for any source for any future year. We have a proactive catchment management programme to mitigate this risk.

5.2.2.6 S6 Accuracy of Supply Side Data

A small allowance has been included from the uncertainty in the accuracy of abstraction meters and the source yield assessment. This factor does not significantly influence the overall headroom figure.

5.2.2.7 S7 Single Source Dominance

This factor is no longer included in the headroom assessment because Portsmouth Water only has one water resources zone.

5.2.2.8 S8 Impact of Climate Change on Deployable Output

For the WRMP2019, a new assessment has been carried out by AECOM and HR Wallingford using the latest UKCP09 climate change scenarios. The assessment is based on a sub set of 100 scenarios selected from the full set of 10,000 scenarios in UKCP09. For each of the 100 scenarios, models have been produced for groundwater level, spring flow and river flow. These were used to develop a 'Resource Zone Model' to give 100 possible outcomes for each scenario.

The model results give a statistical mean, minimum and maximum for average and peak demand periods. The variability of the results is used in the headroom calculation and the mean figures are included as a reduction in deployable output in Table 2, Baseline Supply. In 2040's, these figures are -0.9 Ml/d at average and -2.7 Ml/d at peak.

5.2.2.9 D1 Accuracy of Sub-Component Demand Data

A small allowance has been included for the uncertainty in the accuracy of distribution input meters. These meters are located at Service Reservoirs and are not the same as the meters located at source works. This factor does not significantly influence the overall headroom figure.

5.2.2.10 D2 Demand Forecast Variation

The demand forecasts for the WRMP2019 submission are based upon population and property estimates provided by Experian. In addition to the central estimate presented in the WRMP19 text, Experian also provided forecasts at 10% and 90% confidence. These bands were used as scenarios in the Portsmouth Water demand spreadsheet model to derive a 'low' and 'high' forecast which in turn are used in the headroom assessment.

By 2044/45 the under 'low' growth the demand drops to 161 Ml/d whilst under extreme growth demand could reach 187 Ml/d.

5.2.2.11 D3 Impact of Climate Change on Demand

In the WRMP 2014, this factor was included as a separate line in Table WRP2 for the impact on the baseline forecast.

Portsmouth Water produced three climate change scenarios for measured and unmeasured household demand:

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

The variation in demand as a result of climate change is relatively low causing less that 1Ml/d difference by 2044/45 under the 'Most Likely' scenario.

5.2.2.12 D4 Demand Management Measures

The baseline supply/demand balance does not include additional demand management measures other than the existing meter optants achieved through promotion and 'metering not for revenue'.

There are assumptions about the existing optional metering policy and its ability to influence demand. Portsmouth Water calculated an upper and lower band representing variations in meter uptake. These were used to calculate the contribution of demand management uncertainty to headroom.

5.2.2.13 Target Headroom Allowance

The results of the Monte Carlo simulation are presented in Appendix 'F' and the profiles for the selected profiles are shown on the following graph for Dry Year Annual Average.

Headroom increases with time and the impact of selecting different risk assumptions. Within a 90% probability (10% risk of failure), headroom would be 11.4 Ml/d in 2017/18.

The WRPG states that companies should be prepared to take more risks at the end of the planning period. This is represented as a stepped reduction in probability starting at 90% in 2020/21. Portsmouth Water has assumed that probability would fall by 1% for each 5 year time step.

The risk profile adopted was:

Period	Risk	Probability
2020/21-2024/25	10%	90%
2025/26-2029/30	11%	89%
2030/31-2034/35	12%	88%
2035/36-2039/40	13%	87%
2040/41-2044/45	14%	86%

Table 33: Headroom Risk Profile

The results in the following headroom profile which has been used for the WRMP.

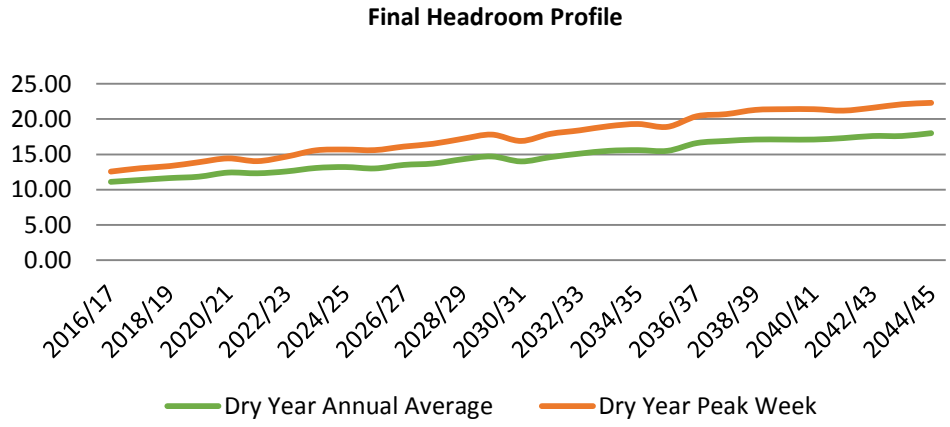


Figure 38: Final Headroom Profile

The final headroom allowance can be compared with the previous plans for 2019/20:

Scenario	WRMP 2009	WRMP 2014	WRMP 2019
Annual Average	10.7 Ml/d	10.3 Ml/d	11.8 Ml/d
Critical Period	12.4 Ml/d	13.8 Ml/d	13.9 Ml/d

Table 34: Headroom Assumed 2019/20

Target headroom is higher than previous plans but this is due to increased risks associated with oil spills and a greater range of uncertainty around future demands. Climate change uncertainty is also higher at the start of the planning period due to a change of methodology.

Final Headroom Allowance

Year	Dry Year Annual Average Ml/d	Dry Year Critical Period Ml/d (Peak Week)
2017/18	11.4	13.0
2019/20	11.8	13.9
2024/25	13.2	15.7
2029/30	14.7	17.8
2034/35	15.6	19.3
2039/40	17.1	21.4
2044/45	18.0	22.3

Table 35: Headroom Allowance 2019/20

5.3 Baseline Supply/Demand Balance

The 'Baseline' supply/demand balance is a comparison of Deployable Output (DO) and Distribution Input (DI). It is based on unconstrained demand and can be presented for a range of scenarios from 'Normal Year' to 'Severe Drought'.

The baseline balance can be carried out for Annual Average and critical period conditions with reductions in DO for 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 resulting from recipient company requests, WAFU is compared with DI. This figure is called 'Available Headroom' and it can be compared to the 'Target Headroom' calculated in Section 5.2.

If Available Headroom is greater than Target Headroom, at any given time step, then there is a surplus. If there is a surplus until the end of the planning period, then the plan balances and there is no need for any further actions. If there is a deficit then a further stage of options appraisal needs to take place.

5.3.1 Average Supply/Demand Balance

The baseline supply/demand balance is shown in Water Resource Planning Table WRP4 with deployable output information drawn from WRP Table 2 and demand data from Table 3. These tables form a separate appendix to this report. The balance can be represented as five year time steps.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	170.8	170.0	170.3	171.4	172.8	174.6
Deployable Output	226.5	226.5	226.5	226.5	226.5	226.5
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.0	0.2	0.4	0.6	0.7	0.9
Outage	14.7	14.7	14.7	14.7	14.7	14.7
WAFU	209.4	209.2	209	208.8	208.7	208.5
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	179.4	170.2	149	148.8	148.7	148.5
Target Headroom	11.8	13.2	14.7	15.6	17.1	18.0
Available Headroom	8.6	0.2	-21.3	-22.6	-24.1	-26.10
Supply Demand Balance	**-3.2**	**-13.0**	**-36.0**	**-38.2**	**-41.2**	**-44.1**

Table 36: Baseline Supply Demand Balance - Dry Year Annual Average

This table shows data for the 'Dry Year' scenario as required by the Planning Guideline. Data has also been produced for all the other scenarios from the 'Normal Year' to the 'Severe Drought' which is the Reference Level of Service. For the baseline supply demand balance distribution input is 'unconstrained' with no demand restrictions. Deployable output remains constant except for the influence of climate change which causes a gradual reduction.

Water Available for Use (WAFU) is calculated by subtracting climate change, process losses and outage from deployable output. Total WAFU is WAFU minus any bulk supplies to other

companies. For Portsmouth Water the bulk supply to Southern Water is expected to increase by 9 Ml/d in 2022/23 and a further 21 Ml/d in 2028/29. These bulk supplies have been agreed in principle but will require further detailed negotiations before they are confirmed.

Under the baseline scenario, with the additional bulk supplies to Southern, the supply demand balance is in deficit and schemes will have to be brought forward to correct this. Portsmouth Water is unable to implement Compulsory Metering for legislative reasons and so the baseline demand forecast assumes an impact from optional metering and a new initiative, 'Metering not for revenue'. This is covered in more detail in Section 6 Options Appraisal.

Under the 'Reference Level of Service' scenario of a 'Severe Drought' (1 in 200) there would be a significant reduction in deployable output. Groundwater levels and river flows would be lower and there would be some restrictions in abstraction to protect the environment. For the baseline balance the distribution input would be the same because it is 'unconstrained' however the reduction as a result of demand restrictions is considered in the final planning tables. The bulk supply is assumed to be the same but in reality there may be a degree of pain sharing under severe drought conditions.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	170.8	170.0	170.3	171.4	172.8	174.6
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	0.0	0.2	0.4	0.6	0.7	0.9
Outage	14.7	14.7	14.7	14.7	14.7	14.7
WAFU	173.6	173.4	173.2	173.0	172.9	172.7
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	143.6	134.4	113.2	113.0	112.9	112.7
Target Headroom	11.8	13.2	14.7	15.6	17.1	18.0
Available Headroom	-27.2	-35.6	-57.1	-58.4	-59.9	-61.9
Supply Demand Balance	**-39.0**	**-48.8**	**-71.8**	**-74.0**	**-77.0**	**-79.9**

Table 37: Baseline Supply Demand Balance – Severe Drought Annual Average

5.3.2 Average Balance Graphical Representation

The WRMP Tables are included as an appendix to this report and have a graphical representation of the supply demand balance. This is shown below for the average Dry Year scenario.

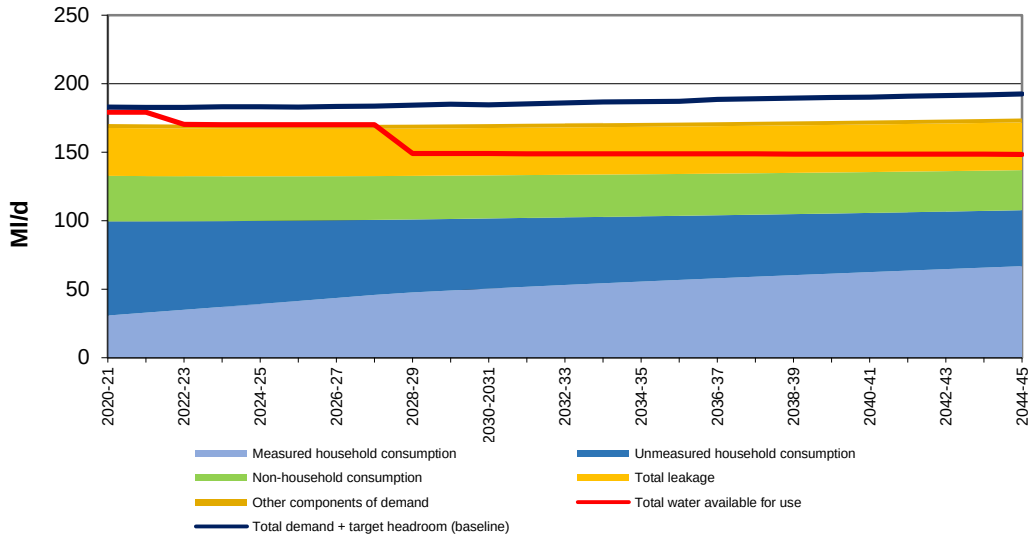


Figure 39: Baseline Annual Average Dry Year

The baseline graph for average conditions shows the impact of optional metering on overall demand. Non-household demand falls gradually over the planning period and leakage falls as a result of reductions in supply pipe losses. The blue line represents demand plus target headroom and it is these numbers that are compared with supply in the baseline balance. The red line represents total water available for use. Total WAFU is calculated from deployable output minus climate change, outage, process losses and bulk supplies.

The graph shows that the red line is below the blue line so there is a deficit at average demand. This increases with time as the impact of climate change is felt and the bulk supplies increase. Supply and demand management schemes will be required to regain the balance.

For comparison the graph of the Severe Drought Scenario shows a much lower Total Water Available for Use (Total WAFU). The red line is well below the blue line and the deficits are greater than the Dry Year Scenario. The baseline supply demand balance is based on unconstrained demand and there are no demand restrictions such as Temporary Bans. These are considered in the Final Planning Tables (Section 7.5)

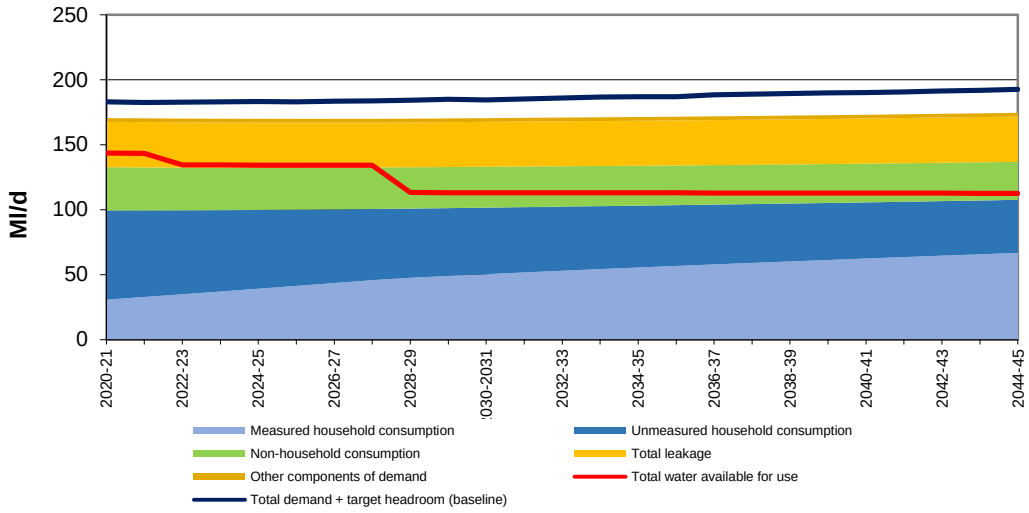


Figure 40: Baseline Annual Average Severe Drought

The severe drought has a return period of around 1 in 200 years (0.5% probability) and matches the Reference Level of Service. This reference level just avoids the use of standpipes in the street and rota cuts.

5.3.3 Peak Week Supply/Demand Balance

Portsmouth Water has 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 which was assumed to occur in June or July. Some recent years have seen peaks occur in August and this plan is based on revised demand profiles. For the critical period of 'Peak Week' the data has been set out for the five yearly time steps of the Business Plan.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	213.5	212.0	212.3	213.9	215.8	218.3
Deployable Output	280.3	280.3	280.3	280.3	280.3	280.3
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	12.5	12.5	12.5	12.5	12.5	12.5
WAFU	265.2	264.7	264.2	263.7	263.2	262.7
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	235.2	225.7	204.2	203.7	203.2	192.7
Target Headroom	13.9	15.7	17.8	19.3	21.4	22.3
Available Headroom	21.7	13.7	-8.1	-10.2	-12.6	-25.6
Supply Demand Balance	**7.8**	**-2.0**	**-25.9**	**-29.5**	**-34.0**	**-37.9**

Table 38: Dry Year Peak Week

The distribution input figures in this table are unconstrained and the bulk supplies increase with time. Compared to WRMP 2014 deployable output is lower and outage and headroom

are higher. The deficits are similar for the peak week and annual average demand so this is no longer the critical time period.

5.3.4 Peak Week Balance Graphical Representation

The WRMP tables are included as an appendix to this report and a graphical representation of the data is shown below for the peak week Dry Year scenario.

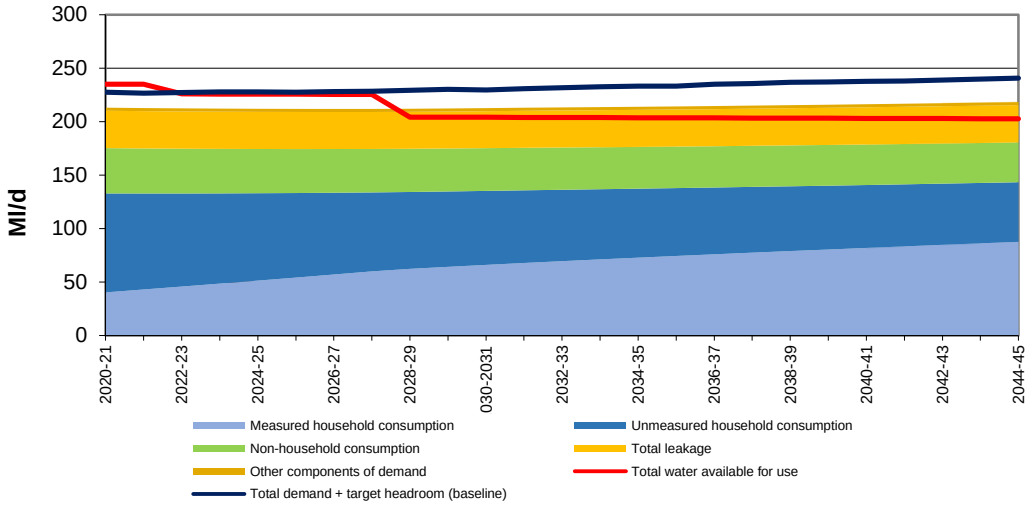


Figure 41: Baseline Peak Week Dry Year

The baseline graph for peak week Dry Year conditions shows the impact of optional metering with unmeasured demand reducing. Non-household demand falls gradually over the planning period and leakage falls as a result of reductions in supply pipe losses. The blue line represents demand plus target headroom and the red line represents the total water available for use.

The graph shows the red line above the blue line at the start of the planning period but drops below as the bulk supplies are increased.

For comparison the data for the peak week severe drought has lower deployable outputs and greater deficits.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	213.5	212.0	212.3	213.9	215.8	218.3
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	12.5	12.5	12.5	12.5	12.5	12.5
WAFU	220.5	220.0	219.5	219.0	218.5	218.0
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	190.5	181.0	159.5	159.0	158.5	158.0
Target Headroom	13.9	15.7	17.8	19.3	21.4	22.3
Available Headroom	-23.0	-31.0	-52.8	-54.9	-57.3	-60.3
Supply Demand Balance	**-36.9**	**-46.7**	**-70.6**	**-74.2**	**-78.7**	**-82.6**

Table 39: Severe Drought Peak Week

The graphical representation is shown below:

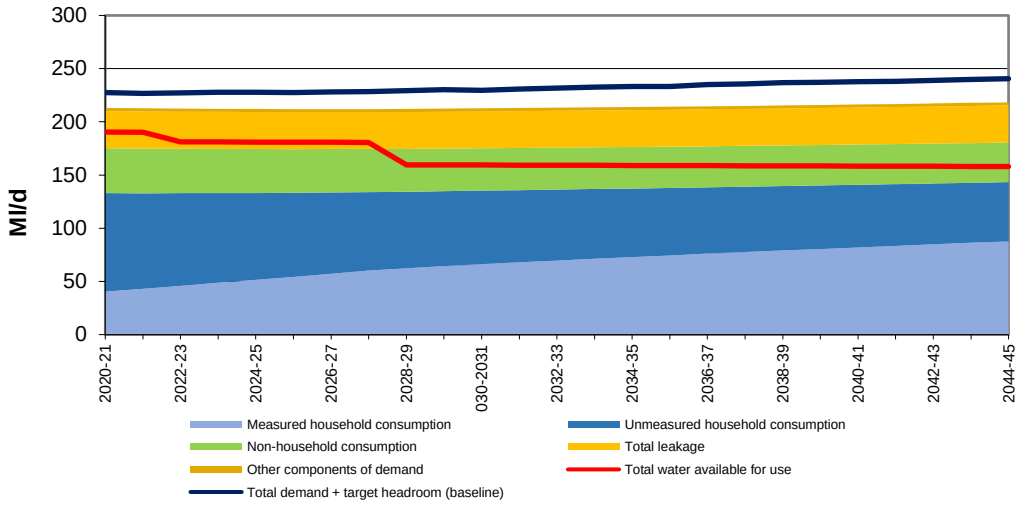


Figure 42: Baseline Peak Week Severe Drought

The peak week in a severe drought has marginally higher deficits than the annual average condition. It does not follow that this is the critical scenario because the supply options will provide greater benefits at peak week compared to annual average.

5.3.5 Minimum Deployable Output Supply/Demand Balance

In Section 3.2.6, the concept of 'Minimum Deployable Output' (MDO) is raised in relation to planning scenarios. For a groundwater based company, with no raw water storage, it is possible that the critical period occurs in the autumn.

AECOM have calculated a deployable output for the MDO scenario but the figures are higher than ADO. This means that MDO is not a critical period and the tables and graphs are not included in the WRMP.

6 OPTIONS APPRAISAL

6.1 Introduction

Having developed a baseline supply demand forecast, an assessment can be made as to which one of the following situations the Company is in:

- There is enough supply to meet demand over 25 years
- There is enough supply to meet demand, however the Company wishes to implement a series of measures to become more efficient, better for the environment and meet Government aspirations
- There is not enough supply to meet demand, options need to be investigated.

When a water company has a deficit in its baseline supply demand balance, supply side options can help to increase supplies, whilst demand side options can help to reduce demand. Implementing both options simultaneously is called a 'twin-track' approach and may be the best way to remove the deficit.

Conversely, where a water company has surplus supplies, surplus water can be used to help other water companies in a deficit, by providing a bulk supply.

The Options Appraisal process outlines the potential options on the supply and demand side to resolve a supply/demand deficit should this exist. This process has many stages before a final planning solution can be sought. These stages include but are not restricted to:

- Unconstrained Options
- Feasible Options
- Economic Appraisal
- Programme Appraisal
- Preferred Programme of Options

Unconstrained options are generated based on technical feasibility but tend not to be constrained by regulatory restrictions. These options are generated from past and present information available to the Company and take into account the core business functions and government aspirations.

Feasible options are those short listed from the original list of unconstrained options (Section 6.2). These are options considered to be technically feasible but are constrained by restrictions. The original list of unconstrained options is screened against marking criteria and a feasible options list is generated.

This feasible options list is then economically appraised by taking into account financial costs, social and environmental costs, carbon costs, yield and delivery uncertainties (Section 6.3).

An integral part of the process involves the assessment of the options potential negative and positive impacts on the environment and protected habitats (Section 6.4.7). To ensure that this process is as robust as possible, all feasible options identified are screened in line with national guidance. The completed assessments include;

- Strategic Environment Assessment (SEA)

- Habitats Regulations Assessment (HRA)

After these stages are complete, a final planning solution can be sought taking into account the results from all screening processes and whether options are needed to remove the deficit, or support bulk supplies.

Engagement with the regulators and stakeholders has taken place throughout this whole process to ensure statutory compliance and incorporation of industry expertise.

6.1.1 Contact with Third Party Suppliers

The WRPG requires companies to engage with third party suppliers to see if they have feasible options. As set out in Section 2.9, Portsmouth Water contacted a number of water companies and potential suppliers as part of the pre-consultation process. The following organisations were considered to be potential suppliers:

- Southern Water
- South East Water
- Albion Water
- SSE Water

6.1.2 Options Assessment Process

In order for Portsmouth Water to develop its assessment of options for this Water Resources Management Plan, the Company enlisted AMEC to assist in carrying out the Options Appraisal process. AMEC worked with the Company to review the process through which supply and demand side options are identified, appraised and selected for inclusion in the Plan.

6.2 Unconstrained Options

A generic list of options was taken from the Economics of Balancing Supply and Demand (EBSD) report was used to develop a list of unconstrained options. These options are technically feasible but are not constrained by restrictions such as environmental permits and planning issues.

Portsmouth Water considered options which take into account customer management, distribution management, production management and resource management. These include but are not restricted to, water efficiency, leakage, resource sharing and options proposed by third parties.

An initial list of 179 unconstrained options was created based on:

- Portsmouth Waters 2014 Water Resources Management Plan
- 'Generic' options from the EBSD Guidelines
- Consideration of other water companies supply demand balance by including bulk supply options
- Leakage management options as recommended in the Sustainable Economic Level of Leakage (SELL) report
- Bids by third parties (including other water companies)

The unconstrained list included options such as:

- Havant Thicket Winter Storage Reservoir
- Portsmouth Harbour Desalination Plant
- Budds Farm Effluent reuse scheme
- Leakage Control
- Compulsory Metering
- Water Efficiency
- Drought Measures

A full list of the unconstrained options can be found in Appendix 'R'.

6.3 Feasible List of Options

The Unconstrained Options List was then reduced down to create a feasible options list using a six step screening process. Feasible options are considered to be technically feasible and capable of implementation within the current regulatory and legal framework.

6.3.1 Unconstrained Options Screening

From the unconstrained options, a list of feasible options was selected using the screening process

- Step 1 – Remove baseline and duplicate activities
- Step 2 – Remove options that compete with Southern Water for resources
- Step 3 – Identify mutually exclusive options and apply a risk based approach to options selection
- Step 4 – Technical credibility
- Step 5 – Assess how well the option can be promoted and if it is acceptable to stakeholders and customers
- Step 6 – Other issues which may suggest that an option is not feasible

Since WRMP14 there have been a number of policy changes that have affected options:

- Retail competition affecting the ability of a wholesaler (Portsmouth Water) to interact directly with commercial customers

6.3.2 Options included in Baseline

Due to slower than expected progress with optional metering it was decided to put option C005 'Metering not for revenue' in baseline. This option provides a meter where water mains have been refurbished and then uses a dual bill marketing approach to inform customers of their usage patterns and encourage them to switch to the measured tariff.

6.3.3 Foundations for a Feasible Options List

This screening process used EBSD and included the following criteria:

- Does the option address the problem?
- Does the option breach unalterable planning constraints?

- Is it promotable?
- Does it have a high risk of failure?
- Yield Uncertainty?
- Flexibility to adjust yield to meet requirement?
- Conservation Impact?
- Landscape and Heritage Impact?
- Social Impact?
- Sustainability?
- Technical Difficulty?

Each option was screened against the eight criteria and a score was assigned for each of the criteria on a 1-5 scale (1=good and 5=poor). The scores were summed up to give a total with the maximum score being 32 for the best performing options and a minimum score of zero for the worst performing options. Initially options with a score of 17 or more were excluded, whilst options with a score of 16 or less were included for further consideration.

Sense checking identified options which scored poorly but were considered appropriate to be included. The next step in the screening process involved identifying options which can be combined and are mutually exclusive. With stakeholder agreement, many options including water efficiency, leakage, Havant Thicket Winter Storage Reservoir and metering were reduced in number and combined with similar options. This rationalisation resulted in a reduction in the total number of feasible options.

The next stage identified options with an unacceptably high risk against any of the criteria.

Factors that cannot be fully reflected in the screening criteria are identified at this stage. For example, options were awarded a score of above four but were seen to have an unacceptably high risk of delivery.

Finally, options where there was significant uncertainty to the viability of the option were removed. These options get 'parked' and may be added at a future date if they are proven viable. The removal of these options resulted in a total of 20 options retained in the feasible options list. The comments and justification for not including particular options within the feasible options list can be found in Appendix 'R'.

6.4 Appraisal of Feasible Options for the Draft Plan

Each of the feasible options has been appraised fully in line with the WRPG which refer to the key principles set out in the ESBD.

The Company is aware that climate change has the potential to impact upon the feasibility of the options identified to maintain the supply demand balance. This could range from changes in the patterns of water used by customers, the yield available from sources as rainfall patterns change, and increased risk of outage due to extreme weather events.

The Company is fully committed to cutting greenhouse gas emissions to reduce the effects of climate change as a result of the Climate Change Act (HM Government, 2008). The Company have taken this into account determining feasible options.

The next stage in the process was to derive estimates of costs and yield for each scheme. These costs (or benefits) are split up into:

- Cost of building the scheme (The Capital cost or CAPEX)
- Cost of operating the scheme (The Operating cost or OPEX)
- Social and Environmental costs of the scheme
- Carbon costs of the scheme

The Company assessed the feasible options on an 80 year planning horizon for each of the following parameters.

6.4.1 Financial Costs

Capital costs were assessed for all items associated in the creation of the asset which includes design, feasibility, planning, construction costs and initial operational requirements once implemented.

Operational costs such as labour, electricity, chemicals and abstraction charges were assessed. The change in operational costs can also be negative i.e. a cost saving. For example, demand reduction schemes can lead to the savings in electricity and chemicals through the reduced volume of water used. All financial cost information is included in an Appendix but this document is commercially confidential and is not included in the public version of this plan.

6.4.2 Social and Environmental Costs

A monetised assessment of the impacts upon the environment and the relevant population affected using the approach recommended by the WRPG. This assessment was also informed by the Environmental and Social Costs Supporting Document.

6.4.3 Carbon Costs

A whole life carbon cost for each feasible option is determined, this included embodied carbon resulting from the commissioning of the asset and the operational carbon associated with operating the asset. Carbon emissions have been monetised using the updated central short term traded carbon value.

6.4.4 Risk of Delivery and Yield

For each of the feasible options, an assessment of the risk of delivery and any practical difficulties that may prevent a solution being implemented. These can include engineering difficulties in delivering the solution or obtaining the necessary permissions such as planning permission or abstraction licences.

Each of the options were assessed for the risk associated with the yield; the risk differs from the risk of delivery in that a groundwater source could be commissioned, however, there is uncertainty relating to the output that may be achieved from the groundwater source. Similarly, a metering programme may be delivered but there will be uncertainty around the amount by which it reduces consumption.

A qualitative assessment of these risks is undertaken for each scheme and this assessment is carried out to inform the choice of the final planning solution.

Yield information for all the feasible options is included in the text and has been based on full implementation.

6.4.5 Average Incremental Costs and Average Incremental Social Costs

The Average Incremental Costs (AIC) approach gives each scheme a cost in terms of pence per cubic metre of water delivered or saved. This enables each scheme to be compared with any other scheme on a sound financial basis. Schemes can then be ranked by cost to identify the options needed to maintain the balance between supplies and demand at lowest cost (AIC's do not take into account social and environmental costs). The Average Incremental Social Costs (AISC) includes social and environmental costs.

The AISC's for each of the options are included in the following sections.

6.4.6 Assessment of Individual Options

For each of the feasible options, a description is given, with an explanation of how each of the parameters described previously has been assessed.

The Company has undertaken a complete reappraisal of options for inclusion in this Plan since the Water Resources Management Plan in 2014.

For the purpose of representation, AMEC have given each option a specific code containing a letter and three numbers. In doing so, AMEC have categorised the options into segments. These segments such as Distribution options (e.g. D004) and Resource options (e.g. R013) have been used to describe the option and a table has been produced including the AISC's and yield for each option.

6.4.7 Strategic Environmental Assessment and Habitats Regulation Assessment

The Strategic Environmental Assessment Directive (SEA EU, 2001) requires a formal environmental assessment of certain categories of plans and programmes which are likely to have significant effects on the environment. The directive has been transposed into The Environmental Assessment of Plans and Programmes Regulations HM Government, 2004. The Company accept that the WRMP falls within the remit of the SEA Directive and has carried out the appropriate assessments. The Environmental Report produced as a result of the SEA process is available in Appendix 'P'.

The SEA considers the potential impacts of the options that could be included in the WRMP against 10 objectives including; biodiversity, soil/land use, water quality/quantity, flood risk, effects on climate change, economic/social needs, protection/enhancement of human health, wise use of water and other resources, protecting/enhancing historic assets and landscape character. The assessment considered the nature of the effect, its timing and geographic scale, the sensitivity of the people or environmental receptor that could be affected, and how long any effect might last (short, medium or long-term). The objectives and approach to the assessment was set out in a Scoping Report which was issued for consultation on 22 July 2016. The approach taken was refined to address the feedback from the three regulators who responded (English Heritage, Environment Agency and Natural England).

The Company also determined that because of the proximity and potential for an impact on European Protected sites of some of the feasible options the plan needed to be assessed under the Conservation of Habitats and Species Regulations HM Government, 2010. Regulation 102 requires that competent authorities assess the potential impact of land use plans on the Natural 2000 network of European protected sites. The HRA determines whether there will be any 'likely significant effects' on any European site as a result of the Plan's

implementation (either on its own or 'in combination' with other plans or projects), and if so, whether these effects will result in any adverse effects on the site's integrity.

In accordance with accepted best practice, the HRA and SEA have been run as an iterative process alongside the plan development. All feasible options have been screened in accordance with national SEA and UKWIR guidance where appropriate, in order to identify whether potentially significant effects are likely to occur which would then require further assessment, or if serious enough the rejection of an option. The completion of the HRA had the added benefit of identifying options that might be high risk in terms of plan delivery if they were selected, as they were unlikely to meet the requirements of the Habitat Regulations, or where further detailed assessment and studies would be needed before the option could be fully assessed.

Portsmouth Water has ensured that the Strategic Environmental Assessment (SEA) and Habitats Regulations Assessment (HRA) have been an intrinsic part of the options appraisal process. Information on the outcome from the HRA and SEA process is summarised below the description of each of the options. The HRA and SEA have been completed by environmental consultants at AMEC who specialise in this work. The full HRA and SEA can be found in Appendix 'O' and 'P', along with tables summarising the outcome of each assessment for all of the feasible options.

6.5 Production Side Options

The Company reduced operational losses at its biggest treatment works, Works B, in 2016/17. Other washwater recovery schemes were considered at Source F and Source P for this plan but these are modern membrane plants and the savings were not considered significant enough for them to be included.

6.6 Resource Side Options

Resource options relate to making better use of water resources to ensure they are available in the future. These options incorporate regulatory aspirations to include schemes which consider;

- The promotion of winter storage reservoirs to store excess water from the winter when it is plentiful for use in the summer when it is less so
- Further resource sharing between water companies in surplus or deficit in the form of bulk supply imports or exports
- New technology such as desalination of seawater to produce potable water, or the re-use of sewage effluent
- Maximising the deployable output of existing sources

6.6.1 Havant Thicket Winter Storage Reservoir

Following a commitment to further work in previous Plans, the Company considered a number of winter storage options. These included alternative sizes for Havant Thicket and the following alternative locations:

- Southleigh Farm
- Colden Common
- Testwood Lakes

- Woodend
- Boarhunt

Havant Thicket Winter Storage Reservoir (HTWSR) was assessed and agreed with stakeholders as the most feasible reservoir option to take forward. This option relates to the construction of a pumped storage reservoir at Havant Thicket. Water would be sourced from the Source B Springs during the winter period and stored in the reservoir for use in the summer when necessary. Water would be abstracted using a draw off structure and transferred through a dedicated main to Bedhampton, where it would link to existing infrastructure for transfer to Works B. Depending on the quality of the reservoir water, some additional treatment may be required at Bedhampton.

The SEA process has identified the impacts of HTWSR as being largely neutral, minor or positive during the different stages of the project. During the construction phase, there would be significant negative effects against the climate change and landscape objectives of the assessment, due to embodied carbon in construction materials, and because this would be a large construction project visible to some extent from the South Downs National Park, Staunton Country Park and some residential properties. A significant positive effect is recorded against the economy objective due to the employment that will arise from this large construction project. The majority of the material used in the construction of the embankments would be sourced from the site resulting in only a minor negative effect assessment against the 'use of resources' objective.

During operation, the SEA records significant positive effects against the economy as the large yield from the HTWSR will support economic growth in the region and ensure the continuity of a safe and secure supply of drinking water. The associated green infrastructure will be of benefit to the existing community and help to support new housing growth, as this is a strategic project in the Partnership for Urban South Hampshire (PUSH) Green Infrastructure Strategy. The new paths, cycle ways, spaced play and water sports training facilities will provide a significant positive benefit in relation to the human health objective. Positive effects are also recorded in the longer term in relation to biodiversity and flood risk.

Once constructed, the reservoir provides a conjunctive use scheme which anticipates the future effects of climate change to store excess water from the Source B Springs in wetter winters, to be supplied to customers in drier summers. A new visitor centre will provide opportunities to explain and promote 'water wise' messages and alternative energy solutions.

The HRA concluded for the HTWSR site that construction works associated with this option will have no likely significant effects on the European sites (SPA/SAC/Ramsar) downstream of the reservoir, assuming normal best practice measures are adopted during construction. The analysis of operational impacts has concluded that there will be no significant effect on European sites (SPA/SAC/Ramsar) from; the additional abstraction within the existing licensed volume at the springs, potential changes in water quality, or emergency drawdown.

Option Number	Option Name	AISC at Average Deployable Output (p/m3)	Yield (Ml/d)
R013	Havant Thicket Winter Storage Reservoir	20.6	23

Table 40: Havant Thicket Winter Storage Reservoir

6.6.2 Resource sharing

These options relate to the sharing of surplus resources with other companies in the area. Options were considered to use the existing bulk supply pipework to Southern Water in reverse. Unfortunately Southern Water does not have a planned surplus in either Sussex North or Hampshire. These pipelines do, however, provide some additional resilience under 'Normal Year' emergency scenarios.

Conjunctive use of options considered whether additional resource benefit could be gained by operating Portsmouth Waters existing resources in a different way to current. For example, whether operating certain sources during the winter period would result in greater resources remaining in the Chalk aquifer during dry or summer periods. However the hydrological characteristics of the area do not allow for any long-term storage of groundwater. Any water not abstracted from the aquifer will flow into the harbours and not be available in the future to abstract.

Regional water resources options were considered. This would involve the import of water from regional sources developed through the Water Resources in the South East Group (WRSE). It is assumed that rather than dedicated mains being developed into Portsmouth Waters area, the construction of new resources elsewhere would enable benefits to be 'cascaded' through the South and East. This would enable existing bulk supply exports from Portsmouth Water to cease, and the resources could be used to benefit Portsmouth Water customers.

Phase 3 of the WRSE regional modelling identifies regional solutions such as Havant Thicket Winter Storage Reservoir but it does not select any reversals of flow or cancellations of existing bulk supplies.

Portsmouth Water have not received any offers of bulk supplies or considered the termination of the existing bulk supplies to Southern Water.

6.6.3 Maximise Deployable Output

The options appraisal process considered several schemes to recover deployable output. These options were initially identified through the Deployable Output Assessment (Appendix 'A') Consideration of water quality issues and Deepest Advisable Pumping Water Level indicated that DO could be recovered at:

- Source O
- Source J
- Source H
- Source C

At Source O the existing boreholes are connected with horizontal adits which are at a relatively high level. As the water level is drawn down in dry conditions the adit is exposed and sediment causes water quality problems. Various options were considered to resolve this problem but the AISC calculation is based on extending the existing casing at the top of borehole No 2 to block off the adits. The borehole will then be deepened by 24m so that it matches borehole No1. The borehole pump will be re-installed at a lower level to give greater drought resilience. The ADO will rise from 3.7 Ml/d to the recent actual abstraction of 5.5 Ml/d giving a potential DO recovery of 1.8 Ml/d. The deepened boreholes would require a licence variation but there would be no deterioration under the WFD. The Source O option has been included in the SEA and should be available early in the planning period.

The Source J has a deployable output of 9.2 Ml/d under dry conditions. With a current average licence of 22.7 Ml/d it could be possible to abstract an additional 12.5 Ml/d from the site. Source J is currently being investigated for water quality reasons and it is possible that satellite boreholes are part of the solution. The WFD investigations concluded that abstraction at Source J did not significantly impact on low flows in the River Wallington. Source I licence has already been reduced to protect flows in the lower reaches of this river.

Option R022a which seeks to maximise the deployable output from the Source J within the existing abstraction licence requirements was found to have significant positive effect against any of the SEA objectives. This is a groundwater scheme, increasing the yield from an existing source in the confined aquifer. Minor negative effects were determined against three of the SEA objectives during the construction (soils, climate change and human health). During operation a minor negative effect was determined against climate change, with significant positive effects anticipated in relation to the economy and human health.

Source H has deployable output of 7.1 Ml/d under dry conditions and this is constrained by water quality issues. With a current average licence of 9.1 Ml/d it should be possible to recover an additional 2.0 Ml/d from this site. This is a water quality scheme but the AISC has been based on the cost of air lifting the existing boreholes, to clean them, and a maximum rate pumping test to confirm the DO. Source H impacts on the River Meon which has not previously been studied as part of the Habitats Review of Consents or the WFD. The Environment Agency has raised concerns about 'Deterioration' of the River Meon under the WFD.

Source C has a deployable output of 16.5Ml/d in dry conditions and this is due to a water quality constraint. If the pumps are run at the full licenced capacity of 20.5 Ml/d turbidity causes the works to cut out. The licence capacity is only needed in dry or drought conditions which occur relatively infrequently. It has been proposed that cartridge filters are provided to allow the pumps to run at the full licensed quantity. This would recover 4.0Ml/d of DO at average demand but would involve regular replacement of the filters. In terms of 'Deterioration' under the WFD the River Hamble has already been the subject of an investigation. The Source C Licence was confirmed in April 2016 and a time limit was set at 2028. As part of the National Environment Programme (NEP) the river restoration scheme was completed on the River Hamble in 2017. This should make the river more resilient to low flows and allow fish to migrate up and down stream.

Option Number	Option Name	AISC at Average Deployable Output (p/m3)	(Ml/d)
RO21a	Source O DO Recovery	6.3	1.8
RO22a	Source J DO Recovery	6.2	12.5
RO23a	Source F DO Recovery	6.6	2.0
RO24a	Source C DO Recovery	14.4	4.0

Table 41: Existing Resource Options

6.6.4 New Technology

As a commitment for further work, the Company have considered new resource options such as effluent re-use.

For Portsmouth Water, this could involve the construction of Budds Farm Effluent Re-use scheme. This scheme could involve the direct reuse of treated wastewater effluent from Budds Farm Wastewater Treatment Works but this is unlikely to be acceptable to customers.

The second option would be indirect use after the water was polished using a membrane treatment process. The water would be pumped to Havant Thicket Reservoir for blending before being put into supply. Budds Farm Indirect Effluent Re-Use has not been fully costed and is not considered in this WRMP.

6.7 Distribution of Water Options

Along with supply side options, distribution side options are an important part of the 'Twin Track' approach. A water company can manage demand for water by enhancing leakage control, manage pressure effectively and replace mains when appropriate to reduce the amount lost through leakage and excess consumption.

6.7.1 Leakage Management

In the last WRMP there was some uncertainty about the methodology used to assess leakage levels and therefore justify further reductions. A new methodology has been developed by the Water Industry and this has been adopted for the WRMP19. (Consistency of Reporting Performance Measures UKWIR 2017). The new methodology suggests that leakage was higher than previously reported and that per capita consumption was lower. Leakage is now an integral part of the overall demand forecast and the change of methodology does not affect the forecast of the total amount of water required.

The new methodology allows more consistent comparisons between companies and with the performance of other countries. This is a Government requirement set out in the Guiding Principles (Appendix 'N'). The new methodology uses the 'Lowest Achieved' level of leakage in a control zone. This new approach requires the calculation of a revised 'Sustainable Economic Level of Leakage' (SELL). Under the current leakage control policy this SELL figure is higher than previously.

Calculation of the SELL is set out in Appendix K and the revised figure is 34.1 Ml/d.

The revised SELL report sets out options to reduce leakage. The first option refers to the installation of additional district meters throughout the distribution network. The district meters would enable more detailed monitoring of flows within the distribution network and allow leakage to be targeted more readily. This would result in an increase in the number of leaks identified and repaired, reducing the amount of water lost through leakage. Leakage would be expected to fall by about 5.0 Ml/d to 30.0 Ml/d as a result of the installation of District Meters.

The second option refers to main replacement and would result in targeted replacement of the parts of the network with greatest leakage. Existing distribution mains would be excavated and replace with new mains, reducing leakage.

The third option involves the deployment of permanent noise loggers throughout the distribution network. The noise loggers would be linked through telemetry and would automatically identify when suspected new leaks occur within the distribution network. This would result in an increase in the amount of leaks identified and repaired, reducing the amount of water lost through leakage (D004).

In the SEA the leakage options are assessed as having neutral or minor positive and minor negative effects against eight of the ten objectives. The exceptions to this are objectives 5 (climate change) and 6 (economy) in relation to mains replacement.

Option Number	Option Name	AISC at Average Deployable Output (p/m3)	Yield (Ml/d)
D004	Deployment of permanent noise loggers	42.3	4.9
D005	Installation of district meters	13.3	5.1
D007	Mains Replacement	N/A	N/A

Table 42: Leakage Management Options

Option D007 (mains replacement) has been assessed as having a significant negative effect during construction against the climate change objective. Although the mass of materials and embodied carbon in these materials is not known at present, the option is likely to require the replacement of several tens of kilometres of mains, which would have significant embodied carbon.

Three additional leakage options were considered in the options appraisal report:

- Additional pressure management (D006)
- Increased find and fix activity on trunk mains and distribution mains (D002)
- Increased find and fix activity on communication pipes (D003)

These options are now considered to be baseline activity with little further benefit from pressure reduction.

6.8 Customer Side Options

Customer side options relate to the conservation of water through education of customers and promotion of water efficiency to allow other options such as metering to work more effectively.

6.8.1 Metering Options

The first metering option refers to upgrading meters installed as 'Not for Revenue' optants to a 'Smart' system. Portsmouth Water intend to install meters in all existing meter pits and in all new meter pits added as part of a main refurbishment scheme. This will be part of the baseline provision but will use the existing dumb meters.

The second metering option involves replacing dumb meters with smart meters in new properties. Customers would be provided with additional advice and encouraged to use meter readings to change their behaviour. The initial roll out period would be five years with a review at that stage.

The third metering option refers to upgrading all the remaining meter optants to a smart system on request. Customers would be provided with additional advice and encouraged to change their behaviour or to fit more water efficient fixtures and fittings. Water efficiency audits would also be offered.

Portsmouth Water has considered metering customer with high discretionary use (such as swimming pool owners) during the options appraisal process. This option was considered as having a high risk of not delivering any yield as it was considered that customers are likely to require the same amount of water whether they are metered or not.

In the SEA the metering and tariff options were assessed by AMEC as having neutral or minor negative effects against seven of the ten objectives. The exceptions to this were;

- Climate change – significant negative effect during construction, positive during operation.
- Economy – significant positive effect during construction, neutral during operation.
- Human health – combination of positive and negative effects for tariff options. The use of tariffs to manage demand may impact on vulnerable customers, such as those on low incomes, or those with medical conditions that are dependent on using more water for treatment and personal hygiene.

The large-scale metering options have been assessed as having significant negative effects against the climate change objective during construction. This is due to the large number of meters being installed and the embodied carbon within the meters, and the emissions associated with their installation (vehicle movements). Following implementation, the same options are assessed as having a significant positive effect against the same objective due to the reduction in emissions from pumping, treating and distributing water and reduction in energy use from heating water in the home. These options are also assessed as having a significant positive effect against the economy objective during construction due to the large number of meters that would require installation, and employment opportunities that result. Options C005, C069 and C075 and the tariff options were also assessed as having a significant positive effect against objective 8 (wise use of resources) as a result of the reduction in energy use (treatment, pumping, distribution and heating water in the home) during operation.

Demand side measures such as metering and water efficiency options were screened out and not considered further in the HRA. This was because collectively they are likely to have a positive effect on European sites by reducing water demand. The only potential mechanism for a negative effect would be through direct encroachment at the local level. For example, if a meter was installed in or near a Special Area of Conservation (SAC). Further information on why it was appropriate to screen out demand side measures is included in Section 3 of the HRA.

Optant Number	Option Name	AISC at Average Deployable Output (p/m3)	Yield (Ml/d)
C005	Not for Revenue Optional Metering (Smart)	281	0.1
C069	Smart Metering New Properties	46.6	0.2
C075	Smart Metering Existing Properties	191	1.4

Table 43: Metering Options

6.8.2 Water Efficiency Options

The core objectives of all these options are to 'free up' resources to make them available to meet supply demand deficits.

The first water efficiency option refers to offering subsidies to customers who have purchased water efficient appliances. This option involves the introduction of a Portsmouth Water funded subsidy (i.e. vouchers) on water efficient washing machines and dishwashers. The rationale behind this option is to encourage wider uptake of water efficient appliances amongst customers (C026a).

The second option would be to retrofit existing toilets. Retrofitting using dual flush mechanisms in toilets in household and non-household properties would replace existing higher flush volume mechanisms. The rationale behind this option would be to reduce demand for water used for toilet flushing.

The third option would be to retrofit spray fittings to existing taps in household and non-household properties. This would be applied to bathroom taps as kitchen use is often more volume driven whereas wash basin taps is often 'action' driven. Spray inserts are only suitable for taps with round flow diameters. The rationale behind this option is that spray fitting reduces the volume of water that passes through the tap each time it is used (compared to a tap that does not have a spray fitting).

The fourth option is to fit Water Butts and trigger guns to properties with gardens.

The fifth option would be to run a Water Efficiency Programme in association with partners such as Housing Associations and possible Southern Water.

Water efficiency is included in the demand forecast in the form of falling average per capita consumption. This is a result of the impact of optional metering and changes in customer behaviour. Metering and water efficiency will be promoted via the company's website and through joint work with other organisations such as the National Park Authority and Wildlife Trusts.

The water efficiency options were assessed by AMEC as having neutral effects against most of the SEA objectives during construction and operation. Minor positive and minor negative effects were recorded against three of the objectives (water, climate change and use of resources) reflecting benefits of water savings, and minor increases or decreases in energy use and carbon emissions during construction and operation.

Option Number	Option Name	AISC at Average Deployable Output (p/m3)	Yield (Ml/d)
C026	Subsidiary to customers that purchase water efficient appliances – washing machines and dishwashers	-14.7	0.1
C034	Water savings devices – retrofitting existing toilets	11.2	0.1
C040	Water saving devices – retrofitting spray fittings to taps	426	0.1
C043	Fit Water Butts and Trigger Guns	274	0.1
C046	Water Efficiency Programme	-21.7	1.2

Table 44: Water Efficiency Options

6.9 Drought Options

The Government's Guiding Principles and the Water Resources Planning Guideline both require companies to consider drought or resilience options. These can take the form of supply options, such as Drought Permits, or customer side measures such as demand restrictions. AMEC were asked to consider these options as part of the appraisal process and the SEA/HRA assessment.

The first drought option is voluntary calls for restraint and additional leakage control as the drought starts. The triggers for this action are set out in the Drought Plan but it is likely to happen in the 1 in 40 Historic Drought Scenario. It has been assumed that demand will fall by approximately 2.5% and this represents 4.3 Ml/d under all scenarios.

The second drought option is the introduction of Temporary Bans. These would be triggered by the Drought Plan under the 1 in 80 Extended Drought Scenario. It has been assumed that demand will fall by an additional 5% and this represents 8.3 Ml/d. The Drought Plan now contains additional concessions and these reduce the potential savings from Temporary Bans.

The third drought option is the introduction of Drought Directions by the Secretary of State. These require a 'Serious Shortage of Rainfall' and include restrictions on commercial demand previously known as Non-essential Use Bans. These restrictions would be in place under the Serious Drought Scenario and a further 5% reduction in demand would be expected. This represents a 7.9 Ml/d benefit to the supply/demand balance.

The final drought option is the introduction of the Source S Drought Permit. This would allow more water to be abstracted from the QRST Group of licences. This option would be introduced as and when required under the Drought Directions. It would be implemented in association with Southern Water who have two other abstractions in the area. Details of the Source S Drought Permit are given in the Draft Drought Plan 2018 due to be published at the same time as the Draft WRMP2019.

Option Number	Option Name	AISC at Average Deployable Output (p/m3)	Yield (Ml/d)
C078	Voluntary Restraint	102	4.3
C079	Temporary Bans	163	8.3
C080	Non Essential Use Bans	136	7.9
R068	Source S Drought Permit	5.3	8.5

Table 45: Drought Options

6.10 Current Operations

In undertaking the options appraisal Portsmouth Water has considered if any of the options identified should be implemented even if a surplus exists over the planning period.

The Company reviewed the AISC for each option; if a scheme was assessed to have a negative AISC then the conclusion would be the benefits of the scheme outweigh the costs. Schemes were identified with negative AISC for water efficiency and these will be included in the water efficiency program.

7 FINAL PLANNING

7.1 Introduction

In developing the final planning solution, the Company has given due consideration to the issues raised by stakeholders throughout the pre-consultation process.

In selecting the final planning solution, the Company has sought to balance the expectations of customers, the needs of the environment and Government policy priorities.

The baseline supply/demand balance shows a deficit at average and peak week (Section 5.3). This means that the existing supply network can't cope with future demands and all of the assumed uncertainties and risks.

The results of WRSE identify further bulk supplies from Portsmouth Water to neighbouring companies. Portsmouth Water has included bulk supplies that other companies have agreed to in principal. These bulk supplies drive the supply/demand balance and the need for resource options.

7.2 Selection of the Final Planning Solution

The Water Resources Planning Guideline sets out the steps that the options appraisal should follow. These include data collection, problem characterisation and modelling to find a solution. The Final Planning Solution represents Portsmouth Water's preferred, or best valve solution, rather than the least cost solution. It takes account of resilience, environmental protection and customer preferences. Sensitivity analysis checks that the Final Planning Solution is robust to possible changes in forecasts or availability of resources.

7.2.1 Planning Information

The WRMP is based on the best available information for properties and population and for the commercial demand forecast. Outage and headroom has been re-calculated and deployable output has been re-assessed. Additional bulk supplies have been provisionally agreed and the drought options have been incorporated into the WRMP.

7.2.2 Unconstrained Options

A full list of unconstrained options was considered including third party options, drought options and demand management options. A list of feasible options was then developed with the assistance of the Regulators and other stakeholders.

7.2.3 Problem Characterisation

The initial problem characterisation was produced in July 2016 prior to agreement about the new bulk supplies and the re-assessment of deployable output. It assessed Portsmouth Water as having no problem to solve and with a low complexity score. The size of the bulk supplies, and the resource schemes that are required to meet them, mean that the Characteristic has now changed. It is now likely that the problem has a medium score and the complexity has also risen to medium.

7.2.4 Modelling Method

Despite the problem characterisation rising from low to medium, Portsmouth Water feel that the conventional Economics of Balancing Supply and Demand (EBSD) approach is still acceptable. Modelling carried out for Water Resources in the South East (WRSE) uses more sophisticated techniques. In general these have produced the same range of options and the

same implementation timetable. In this document options are compared using Average Incremental and Social Costs (AISC). The full cost profiles are commercially confidential and are not in the public domain.

7.2.5 Options Selected

The timing of the new bulk supplies, and the earliest completion dates of the options, means that all of the feasible options are selected as soon as possible in the planning period. Some schemes are mutually dependant on others, such as Budds Farm Effluent Re-Use, and must follow in sequence.

Option	Description	Yield (Ml/d)
D005	District Metering	5.0
C026-46	Water Efficiency	1.6
C078-80	Drought Measures	20.7
R013	Havant Thicket Reservoir	23
R021a	Source O DO Recovery	1.8
R022a	Source J Boreholes	12.5
R023a	Source H DO Recovery	2.0
R024	Source C DO Recovery	4.0
R068	Source S Drought Permit	8.5

Table 46: Selected Options

In addition to these options Portsmouth Water will enhance its optional metering programme within the baseline provision. 'Not for revenue' metering will ensure that the original target of 5,000 meters per year is reached. This is reflected in the baseline demand forecast and results in the overall fall in per capita consumption and the flat demand profile over the planning period.

7.3 Final Planning Solution Constraints

The final planning solution is influenced by external factors such as Government Policy and the involvement of third party water suppliers. They key considerations are as follows:

- The Company is **not** in an 'Area of Serious Water Stress' and is unable legally to compulsory meter its domestic customers
- No third party suppliers of water made a firm proposal to Portsmouth Water
- The surrounding Water Companies have current or future deficits and are unable to supply water to Portsmouth Water
- Government Policy expects per capita consumption and/or overall demand to fall with time

- Government Policy requires leakage to fall with time and for a new methodology to be implemented
- Havant Thicket Reservoir cannot be completed and commissioned before 2029

7.4 Implementation Programme

The following table shows the proposal basket of measures and their earliest construction start and earliest commissioning dates.

Option	Description	Earliest Construction Date	Earliest Commissioning Date
D005	District Metering	2020	2025
C026-46	Water Efficiency	2018	2019
R013	Havant Thicket Reservoir	2018	2029
R021a-24	DO Recovery Schemes	2018	2019
R068	Source S Drought Permit	2018	2018
R022a	Source J Boreholes	2020	2023

Table 47: Implementation of Options

The drought options are available in any year and will be triggered by the Drought Plan. Optional Metering is included in the baseline forecast. Implementation of Havant Thicket Reservoir is related to the bulk supplies to Southern Water.

7.5 Final Planning Tables

The Water Resource Planning (WRP) tables have been produced for all the drought scenarios at average and peak demand. For this document the tables are only summarised for the 'Dry Year' 1 in 20 and the 'Severe Drought' 1 in 200. These tables are included as an Appendix to the Main Report.

7.5.1 Dry Year Average Tables

Under the 'Dry Year' scenario the following final planning numbers are produced at average demand:

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	170.8	170.0	170.3	171.4	172.8	174.6
Demand Management	1.2	6.6	6.6	6.6	6.6	6.6
Deployable Output	226.5	226.5	226.5	226.5	226.5	226.5
Resource Schemes	7.8	20.3	43.3	43.3	43.3	43.3
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	14.7	14.7	14.7	14.7	14.7	14.7
WAFU	217.2	229.5	252.3	252.1	251.9	251.7
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	187.2	190.5	192.3	192.1	191.9	191.7
Target Headroom	11.8	13.2	14.7	15.6	17.1	18.0
Available Headroom	17.6	27.1	28.6	27.3	25.7	23.7
Supply Demand Balance	**5.8**	**13.9**	**13.9**	**11.7**	**8.6**	**5.7**

Table 48: Final Planning Table 'Annual Average' Dry Year

7.5.2 Dry Year Annual Average Graph

The data in the tables can be expressed graphically as this is done in WRZ Summary tab of the WRP tables.

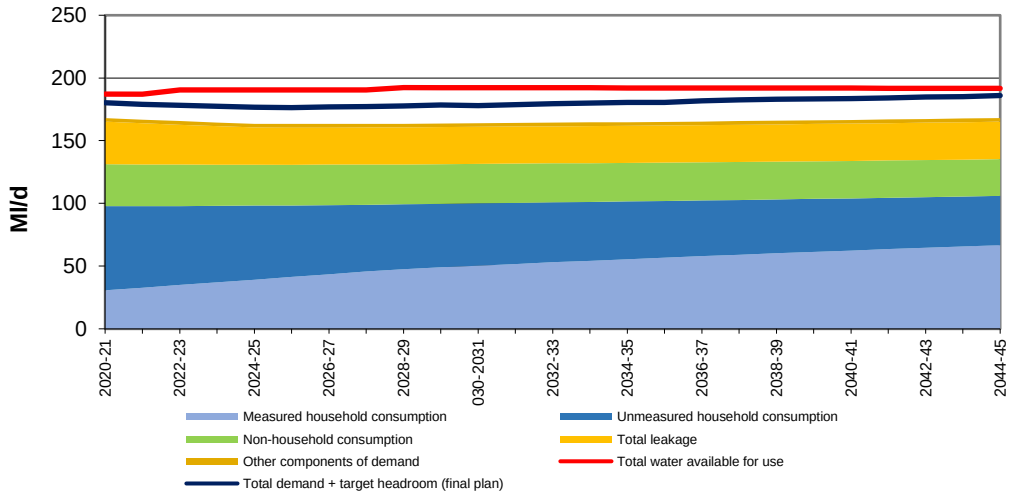


Figure 43: Final Planning 'Annual Average' Dry Year

Compared to the baseline graph the red line (Total WAFU) is now above the blue line that represents total demand. Total WAFU includes reductions to represent the bulk supplies and increases to represent the resources options. Demand Management reduces the total demand line but this is more obvious in the drought scenarios (see below).

7.5.3 Severe Drought Average Table

Under the 'Severe Drought' scenario the final planning numbers at average demand are as follows:

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	170.8	170.0	170.3	171.4	172.8	174.6
Demand Management	21.7	27.1	27.1	27.1	27.1	27.1
Deployable Output	190.7	190.7	190.7	190.7	190.7	190.7
Resource Schemes	16.3	28.8	51.8	51.8	51.8	51.8
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	14.7	14.7	14.7	14.7	14.7	14.7
WAFU	189.9	202.2	225.0	224.8	224.6	224.4
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	159.9	163.2	165.0	164.8	164.6	164.4
Target Headroom	11.8	13.2	14.7	15.6	17.1	18.0
Available Headroom	10.8	20.3	21.8	20.5	18.9	16.9
Supply Demand Balance	**-1.0**	**7.1**	**7.1**	**4.9**	**1.8**	**-1.1**

Table 49: Final Planning Table 'Annual Average' Severe Drought

The reduction in demand in Table is a result of the implementation of Temporary Bans and Non-essential Use Bans. There is a small deficit in the early years due to the commissioning of the second bulk supply to Southern Water. Available headroom is still 10.8 Ml/d.

7.5.4 Severe Drought Annual Average Graph

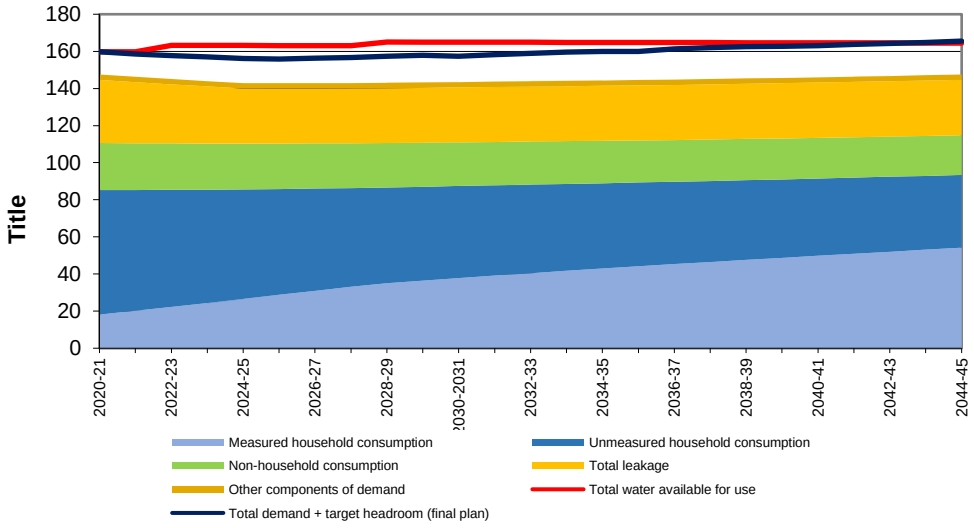


Figure 44: Final Planning Annual Average Severe Drought

Under Severe Drought conditions although deployable output is much lower so is demand. This means that target headroom is met in all but the early years when the bulk supply to Southern is increased.

7.5.5 Dry Year Peak Week Tables

Under the 'Dry Year' scenario the following final planning numbers are produced at peak week demand.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	213.5	212.0	212.3	213.9	215.8	218.3
Demand Management	1.2	6.6	6.6	6.6	6.6	6.6
Deployable Output	280.3	280.3	280.3	280.3	280.3	280.3
Resource Schemes	11.8	26.8	76.8	76.8	76.8	76.8
Process Losses	2.4	2.4	2.4	2.4	2.4	2.4
Climate Change	0.2	0.7	1.2	1.7	2.2	2.7
Outage	12.5	12.5	12.5	12.5	12.5	12.5
WAFU	277.0	291.5	341.0	340.5	340.0	339.5
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	247.0	252.5	281.0	280.5	280.0	279.5
Target Headroom	13.9	15.7	17.8	19.3	21.4	22.3
Available Headroom	34.7	47.1	75.3	73.2	70.8	67.8
Supply Demand Balance	**20.8**	**31.4**	**57.5**	**53.9**	**49.4**	**45.5**

Table 50: Final Planning Table 'Peak Week' Dry Year

When these numbers are compared with the annual average table it is clear that 'Peak Week' is not the critical time period. This is because peak week deployable output is much higher as more licenced abstraction is available during this period.

7.5.6 Dry Year Peak Week Graph

The Dry Year peak week graph shows a surplus for the whole of the planning period.

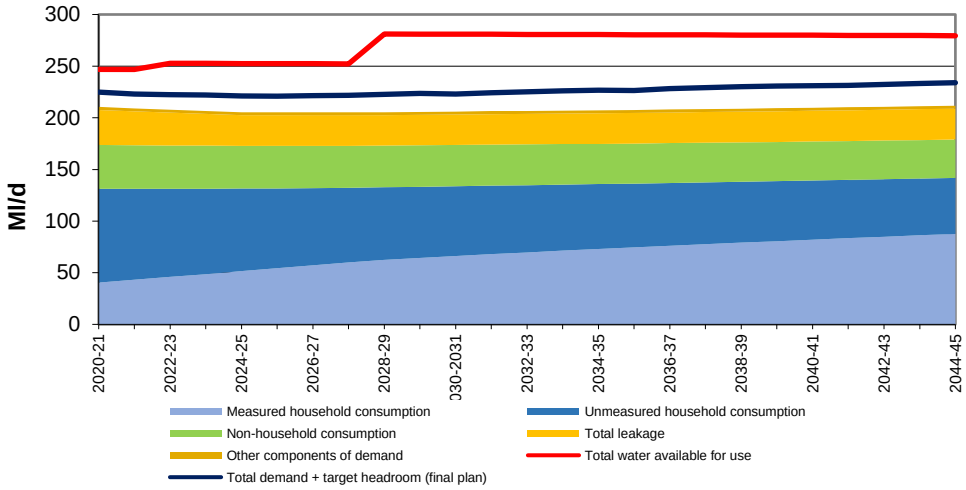


Figure 45: Final Planning Peak Week Dry Year

7.5.7 Severe Drought Peak Week Table

Under the 'Severe Drought' scenario the following numbers are produced at peak week demand.

	2019/20	2024/25	2029/30	2034/35	2039/40	2044/45
Distribution Input	213.5	212.0	212.3	213.9	215.8	218.3
Demand Management	50.0	55.4	55.4	55.4	55.4	55.4
Deployable Output	235.6	235.6	235.6	235.6	235.6	235.6
Resource Schemes	20.3	35.3	85.3	85.3	85.3	85.3
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	12.5	12.5	12.5	12.5	12.5	12.5
WAFU	240.8	255.3	304.8	304.3	303.8	303.3
Bulk Supplies	30.0	39.0	60.0	60.0	60.0	60.0
Total WAFU	210.8	216.3	244.8	244.3	243.8	243.3
Target Headroom	13.9	15.7	17.8	19.3	21.4	22.3
Available Headroom	47.3	59.7	87.9	85.8	83.4	80.4
Supply Demand Balance	**33.4**	**44.0**	**70.1**	**66.5**	**62.0**	**58.1**

Table 51: Final Planning Peak Week Severe Drought

Compared to the 'Dry Year' the 'Severe Drought' peak week surplus are slightly higher due to the impact of demand restrictions.

7.5.8 Severe Drought Peak Week Graph

The severe drought graph shows a surplus for the whole of the planning period.

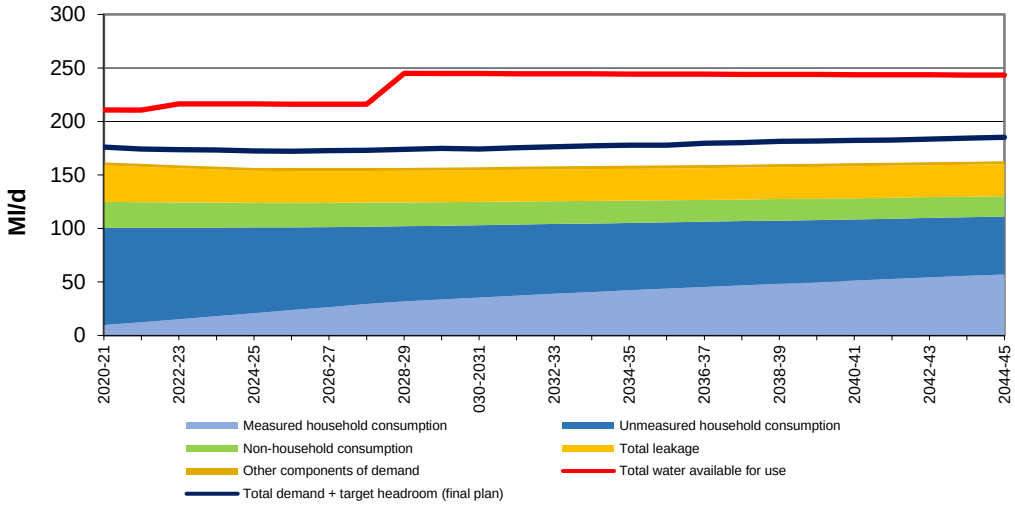


Figure 46: Final Planning Peak Week Severe Drought

7.6 Final Planning Per Capita Consumption

The Government set an aspiration for average per capita consumption to fall to 130 l/h/d by 2030.

The Final Planning for the 'Normal Year' are not included in the WRMP but they show that the average per capita consumption falls to 130 l/h/d by 2034. This is a result of water efficiency, optional metering and changes in customer behaviour. Housing growth will see a greater percentage of water efficient fixtures and fittings in the community. Metering and potential future tariffs could cause further falls in PCC.

7.7 Compliance with the Directions

As part of the water resources planning process Defra and the Environment Agency set out the 'Guiding Principles' (Ofwat, Environment Agency and Defra, 2016). Appendix 'L' to this document sets out the 'Directions' which the water companies must comply with. Portsmouth Water has added an assessment of what has been included in the WRMP2019 and where it is included. This detailed summary is included in Appendix 'L' but some of the key issues are set out below:

- 25 year planning period
- How frequently demand restrictions will be imposed
- Options appraisal methodology including SEA
- Climate change impacts
- Population and housing forecasts
- Compulsory metering options
- Optional metering options
- Implementation programme
- Reasons for not using compulsory metering

- Statutory consultation process
- Statutory publication process

Portsmouth Water considers that they have complied with all the relevant directions in preparing the WRMP.

7.8 Government Policies Influencing this Plan

Portsmouth Water believes that the WRMP meets the policy priorities set out by Government.

The plan considers the long term supply challenges from population growth and climate change.

The final planning solution has a forecast of falling average per capita consumption over the planning period as a result of the 'Metering not for revenue' and 'promotional optional metering programme'.

The final planning solution also includes a reduction in leakage over the planning period as a result of the installation of district metering.

The Company is an active member of the WRSE Group; and this has resulted in the inclusion of additional bulk supplies in the WRMP.

7.9 Strategic Environmental Assessment and Habitats Regulation Assessment

The Strategic Environmental Assessment (SEA) of the draft Plan has assessed the impact on the water environment as neutral. The proposed bulk supply exports to Southern Water and South East Water would be sourced from existing sustainable licences and are considered unlikely to prevent Water Framework Directive objectives being achieved. The construction of the new bulk supply pipelines have been assessed as having significant negative effects during construction against the climate change objective due to carbon emissions during construction and embodied in materials. During operation, no significant negative effects have been identified. The cumulative effect of the options has been assessed as having a significant positive effect on the economy of the region as the additional yield generated by these options will help to meet the needs of economic growth in the region.

The Habitats Regulation Assessment of the Base Plan concluded that;

- The schemes will operate within existing abstraction license volumes and there will be no likely significant effects on any European sites as a result of the operation of these schemes, alone or in combination with other plans or projects
- No likely significant effects on any European sites have been identified, as a result of construction of the schemes, either alone or in combination with other plans or projects, assuming that normal best practice measures are taken.
- The WRMP will have no likely significant effects on any European sites as a result of its implementation, alone or in combination with other plans or projects

The complete SEA and HRA reports can be found in Appendix 'O' and 'P'.

7.10 Commitment to Further Work

The Company's previous WRMP set out a commitment to undertake further work on deployable output and resilience. The Company believes it has met this commitment and this is clearly presented in the relevant sections of the plan.

7.11 Water Framework Directive

The WRPG recommends that companies should assess if the net changes in its operations as a result of the plan has the potential to cause a water body to deteriorate. The Company notes that the WRMP includes two bulk supplies which may cause a net change in operations. For each bulk supply the Company sets out how it has considered this impact.

7.11.1 Bulk Supply from the River Itchen to Southampton

This bulk supply will result in increased abstraction from the River Itchen by Portsmouth Water compared to current levels. However the abstraction will be further downstream than Southern Water's abstraction which will reduce. The current licence was revised in 2013 to comply with the Habitats Directive and is considered sustainable therefore it is unlikely to result in a deterioration of water body status.

7.11.2 Renewal of Bulk Supply to Sussex North

The current bulk supply from Portsmouth Water to Southern Water was renewed in 2016 and has been included in the plan.

7.12 In combination effects

The Company has included the Southern Water bulk supplies in the WRMP and the SEA has been modified to include the impact of the bulk supply pipelines in both the South East and Southern Water's area of supply. Additional work on the 'In combination' effects of the bulk supplies was carried out as part of the WRSE work. Although other bulk supplies cross the South Downs National Park they are not in the same area and do not have the same timings.

8 TESTING THE PLAN

8.1 Introduction

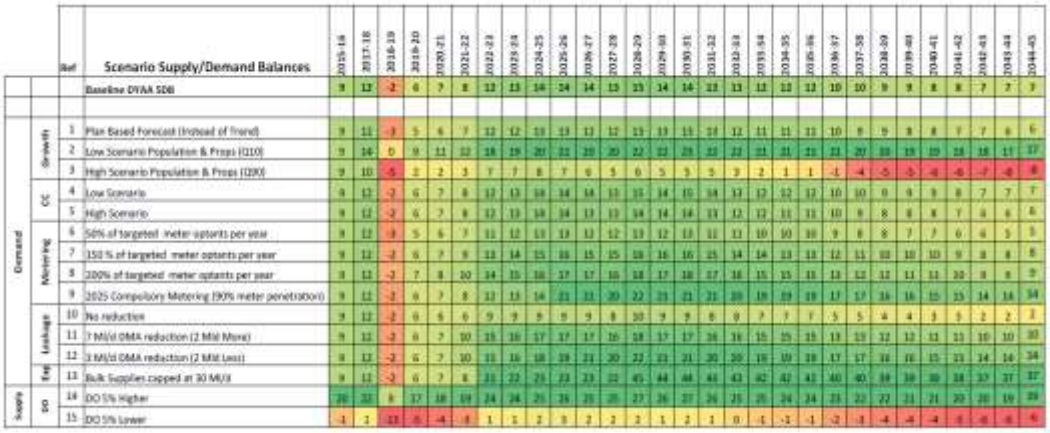
In order to demonstrate the robustness of its plan, Portsmouth Water has undertaken a series of sensitivity tests around key assumptions in the base plan. The sensitivity analysis considers the uncertainty of inputs across the plan such as demand and deployable output.

To test the draft WRMP19 plan 15 scenarios are tested against the Final Planning Supply-Demand Balance (SDB):

1. **Planned Growth:** For WRMP19 Portsmouth Water is using a 'Trend' based forecast provided by Experian. Water companies have been asked to account for 'Planned' growth derived from Local Authority plans; which Experian also produced for the Company. The 'Trend' forecasts delivers a very similar amount of new properties over the planning period however places most new growth in the first half of the plan. This scenario therefore is testing the impact on the SDB with more housing in the first half of the period
2. **Low Growth:** The effect on the SDB as a result of the 'Low' population and property growth scenario (with a 10% chance of growth being below this level).
3. **High Growth:** The effect on the SDB as a result of the 'High' population and property growth scenario (with a 90% chance of growth being below this level).
4. **Low Climate Change (on demand):** The effect on the SDB as a result of the 'Low' climate change scenario (q10).
5. **High Climate Change (on demand):** The effect on the SDB as a result of the 'High' climate change scenario (q90).
6. **Low Metering:** The impact of achieving 50% of the targeted meter optants in each year.
7. **High Metering:** The impact of achieving 150% of the targeted meter optants in each year.
8. **High+ Metering:** The impact of only achieving 200% of the targeted meter optants in each year.
9. **Compulsory Metering:** The impact of compulsory metering in the year 2025/26 with meter penetration up to 90% (15% saving assumed).
10. **Leakage:** No reduction: No reduction in leakage assumed during the planning period.
11. **Leakage: 7 Ml/d DMA reduction (2 Ml/d More than baseline):** Leakage reduced by a further 2Ml/d on top of 5Ml/d assumed in Final Plan
12. **Leakage: 3 Ml/d DMA reduction (2 Ml/d Less than baseline**): Leakage reduced 3Ml/d, 2Ml/d less than that assumed to occur as a result of the installation of the additional DMAs.
13. **Bulk Supply (Capped at 30 Ml/d):** The impact of no further bulk supply exports beyond the currently confirmed 30 Ml/d to Southern Water on the East and West of the company area.
14. **Deployable Output (5%):** The impact of an increase in DO by 5%.
15. **Deployable Output (-5%):** The impact a decrease in DO by 5%

8.2 Sensitivity of the Plan

Figure 47 presents the Supply/Demand Balances for the given scenarios tested against the Final Planning tables.



	Ref	Scenario Supply/Demand Balances	2015-16	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43	2043-44	2044-45
		Baseline DYAA SDB	9	12	-2	6	7	8	12	13	14	14	14	13	13	14	14	13	13	12	12	12	10	10	9	9	8	8	7	7	7
Demand	Growth	1 Plan Based Forecast (Instead of Trend)	9	11	-3	5	6	7	12	12	13	13	12	12	13	13	13	14	12	11	11	11	10	9	9	8	8	7	7	6	6
		2 Low Scenario Population & Props (Q10)	9	14	0	9	11	12	18	19	20	21	20	20	22	22	23	22	22	21	21	21	21	20	20	19	19	18	18	17	17
		3 High Scenario Population & Props (Q90)	9	10	-5	2	2	3	7	7	8	7	6	5	6	5	5	5	3	2	1	1	-1	-4	-5	-5	-6	-6	-7	-8	-8
	CC	4 Low Scenario	9	12	-2	6	7	8	12	13	14	14	14	13	13	14	14	13	13	12	12	12	10	10	10	9	9	8	7	7	7
		5 High Scenario	9	12	-2	6	7	8	12	13	14	14	13	13	14	14	14	13	12	12	11	11	10	9	8	8	8	7	6	6	6
	Metering	6 50% of targeted meter optants per year	9	12	-3	5	6	7	11	12	13	13	12	12	13	12	13	11	11	10	10	10	9	8	8	7	7	6	6	5	5
		7 150 % of targeted meter optants per year	9	12	-2	6	7	9	13	14	15	16	15	15	16	16	16	15	14	14	13	13	12	11	10	10	10	9	8	8	8
		8 200% of targeted meter optants per year	9	12	-2	7	8	10	14	15	16	17	17	16	18	17	18	17	16	15	15	15	13	12	12	12	11	11	10	9	9
		9 2025 Compulsory Metering (90% meter penetration)	9	12	-2	6	7	8	12	13	14	15	15	15	20	22	23	21	21	20	19	19	18	17	17	16	16	15	15	14	14	14
	Leakage	10 No reduction	9	12	-2	6	6	6	9	9	9	9	9	8	10	9	9	8	8	7	7	7	5	5	4	4	3	3	2	2	1
		11 7 Ml/d DMA reduction (2 Mld More)	9	12	-2	6	7	10	15	16	17	17	17	16	18	17	17	16	16	15	15	15	13	13	12	12	12	11	10	10	10
		12 3 Ml/d DMA reduction (2 Mld Less)	9	12	-2	6	7	10	13	14	15	16	15	15	16	16	16	15	14	14	13	13	12	11	10	10	10	9	8	8	8
	Bulk	13 Bulk Supplies capped at 30 Ml/d	9	12	-2	6	7	8	22	22	23	23	23	22	45	44	44	43	43	42	42	42	40	40	39	39	39	38	37	37	37
Supply	DO	14 DO 5% Higher	20	23	6	17	18	19	24	24	25	26	25	25	27	26	27	26	25	25	24	24	23	22	22	21	21	20	20	19	19
		15 DO 5% Lower	-1	1	-13	-5	-4	-3	1	1	2	3	2	2	2	1	2	1	0	-1	-1	-1	-2	-3	-4	-5	-4	-5	-6	-6	-6

Figure 47: Scenario Supply/Demand Balances (Ml/d)

The plan is resilient to most of the 15 scenarios with the exception of scenario 2 and scenario 15.

With scenario 2, 'High' population and property growth, the SDB becomes negative in 2036/37. The probability of this level of growth occurring is just 10% therefore relatively low. Furthermore, since the deficit does not occur for almost 20 years, it is logical that a planning decision relating to this potential deficit is considered when the uncertainty of future growth resolves itself in future planning cycles. Moreover, it should be noted that the options selected in the first half of the planning period for supporting bulk supplies and meeting leakage aspirations also provides some resilience to potentially high future growth.

A deficit is also generated over the planning period under scenario 15, 'DO 5% 'lower'. The 5% provides a notional test to the Final Planning Tables. The Company is confident that the uncertainty as a result of the inaccuracies of modelling DO are sufficiently captured within headroom. It does however highlight the importance that the Company maintains it's DO through operational maintenance. It also suggests that the impact of any future sustainability reductions has upon the SDB and could result in further options being brought forward in order to maintain the Company's resilience and to secure bulk supplies to Southern Water.

9 NEXT STEPS

9.1 Publication Process

The formal process requires Portsmouth Water to publish this Draft Plan following approval from the Secretary of State. This will be done on Portsmouth Water's website www.portsmouthwater.co.uk.

Letters will be sent to each of the stakeholders and a hard copy of the main report will be available at the Havant Office.

A Strategic Environmental Assessment has been carried out in parallel with the production of the WRMP2019. The formal process requires Portsmouth Water to publish the 'Post Adoption Statement' and will be published on the Company website. In addition letters will be sent to the statutory consultees and a hard copy will be available for interested parties at the Havant Offices.

9.2 Water Resources Management Plan 2024

Work has already started on the next Water Resources Management Plan. Portsmouth Water is committed to working with the Environment Agency and other stakeholders on a review of key assumptions. This will include further work by the WRSE group on Robust Decision Making and the use of more sophisticated models.

10 TABLE COMMENTARIES

The WRPG states that 'water resources planning guideline supply-demand tables' must accompany the plan. These tables have to be filled in for the Dry Year scenario and the Reference Scenario. If a Company is in deficit, a critical period table must also be completed. More detail on what is included within the tables is in the technical instructions (Ofwat, Environment Agency and Defra, 2016), whilst the completed WRP tables are in Appendix 'AA'.

Each workbook contains baseline tables based on current policies and final planning tables which represent the solution to any supply demand deficits.

The tables are based on the latest demand forecasts and the options that emerged from the appraisal process. Portsmouth Water only has one water resources zone and the level of service for a Dry Year is 1 in 20 and for the Reference Scenario it's 1 in 200. There is a summary for each set of tables with graphs of baseline and final planning data.

The baseline and final planning graphs are reproduced in the main text with data from the 2020, up to the planning horizon of 2045.

10.1 Dry Year – Annual Average

Hard copies of the WRP Tables are provided for the Dry Year Annual Average. The tables will have also been provided electronically on the company website.

10.1.1 WRP Table 1

Table 1 sets out the abstraction licences available with the total licenced quantity and the deployable output available for each source and for the company area. The group licences are shown separately and there is one 'Unused' licence which provides raw water for river augmentation. The total deployable output is different for each scenario but at its maximum for the 'Dry Year' scenario.

10.1.2 WRP Table 2

Table 2 sets out the Baseline Supply position with lines for bulk supplies, total DO, climate change impacts on DO, sustainability reductions, treatment works losses and outage.

10.1.3 WRP Table 3

Table 3 sets out the Baseline Demand position including household and non-household demand, per capita consumption and total leakage and metering policy. Portsmouth Water have included 'Metering not for revenue' and 'Promotional' optional metering in the baseline forecast. Household population and property projections are based on Experian's 'Trend' forecast adjusted for Portsmouth Water's base year billing records.

10.1.4 WRP Table 4

Table 4 sets out the initial supply/demand balance with an allowance for target headroom.

10.1.5 WRP Table 5

Table 5 sets out the feasible options and the AISC calculation. The detailed cost profiles are commercially confidential and are not included in the public WRMP documents.

10.1.6 WRP Table 6

Table 6 sets out ta preferred list of resource management and demand management options.

10.1.7 WRP Table 7

Table 7 sets out the Final Planning supply numbers with deployable output including the preferred supply options. It also shows treatment works losses and the outage allowance.

10.1.8 WRP Table 8

Table 8 shows the Final Planning demand numbers with household and non-household demand, per capita consumption, metering programme, property numbers and population numbers.

10.1.9 WRP Table 9

Table 9 shows the Final Planning supply/demand balance with distribution input reflecting the demand management schemes, including drought measures, and Water Available for Use reflecting supply schemes. Target headroom allows the final supply surplus/deficit to be calculated.

10.1.10 WRP Table 10

Table 10 is a summary of DO and DI for each of the scenarios and is the same for each set of tables. Portsmouth Water currently has no surface water storage and demand restrictions only impact the demand side of the balance. There is only one drought supply measure, Source S Drought Permit', but DO is different for each scenario. There and no DO impacts of Demand Restrictions.

The Summary Report relates to the individual scenarios such as 'Dry Year' or 'Severe Drought'.

The Baseline and Final Planning graphs are in the WRZ summary tab of the tables. The graphs are reproduced in the main body of the report and clearly illustrate the impact of things like the bulk supplies and the supply schemes over the planning period. Demand management interruptions are more difficult to see because they apply to every year in the sequence if they are selected. They show as lower total demands in the Final Planning graphs.

10.2 Dry Year – Peak Week

WRP tables are provided for the Dry Year 'Critical Period'. The critical period is the peak week which can now occur in August. Comparisons of the Baseline Planning deficits shows that the peak week is no longer the critical time period in the WRMP. The deficits are higher under the average demand condition when group licences have been used up and deployable output is lower.

10.3 Severe Drought – Annual Average

The Severe Drought scenario has a return period of 1 in 200 years and represents the reference level of service. This level of service refers to the avoidance of standpipes in the street and rota cuts. Under this scenario all of the other drought management options are implemented. This includes Source S Drought Permit and Non Essential Use Bans.

10.4 Severe Drought Peak Week

In a Severe Drought the Final Planning demand is significantly reduced by demand management measures such as Temporary Bans and Non-essential Use Bans. In the peak week the peaking factor is much lower and this time period is not critical.